The PNHS organized in 2010 and 2011 a survey to gather information on the conservation value and ecotourism potential of the Teraja area. The survey area, partly protected and partly proposed as a protected area, has still a lot of undisturbed primary forest, but is under threat by developments. We appraised the area in terms of hiking trails, photographic highlights, flora, fauna, folklore and history. The survey shows that the area has particular value because it has high biodiversity, a unique flora and fauna, and great eco-tourism potential.
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Areal view of the Teraja forest area (Teraja longhouse in the right side of the photo) at end of Labi road in 2007, H. Dols
**Introduction**

The “Teraja survey” was executed over various weekends in 2010 and 2011 by PNHS members and some invited scientific experts (e.g. UBD students/staff). It was the idea of Jacqueline Henrot, subsequently worked out by a number of PNHS members. The survey appraises the area in terms of hiking trails, photographic highlights, flora, fauna, and folklore. The purpose is to gather information on the conservation value and ecotourism potential of the area in order to help the authorities concerned in taking the most judicious decision concerning the development, management, and long-term conservation of the Teraja area. The ‘Teraja survey area’ encompasses the Bukit Teraja Protection Forest and the Proposed Bukit Teraja Protection Forest Extension (a narrow strip from Teraja waterfalls via Bukit Teraja ridge up to Rampayoh).

Most of the survey (and most of the recorded trails) is in the proposed Protected Area extension of Bukit Teraja. This is a relatively small piece of land (ca. 2500 ha) that is of particular value because it has high biodiversity value and great eco-tourism potential. It is a piece of fairly undisturbed forest that is accessible by road and has many hiking opportunities. The area holds various habitats: swamps, ridges, waterfalls, rivers - therefore a diverse flora and fauna. The area is used by local people who still hold the traditional knowledge & legends. It is under threat by developments.

This map shows the explored trekking system. The Bkt Teraja Protection forest reserve and proposed extension area are in between the Labi road and **LoggingRoadEast**. There are many waterfalls and hiking treks (Brown = unmarked path, Orange = more difficult hike or animal trail, Red = hard trek, Blue = river scramble). Nearly all ridges have a kind of trail (orange) that is or has been used by seismic survey staff, military, poachers, or animals.

**Map. Location of trails walked in the survey area (Teraja Protection forest and proposed extension). Note that most trails and waterfalls are within the proposed extension.**

**Participants & Topics**

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Background

Brunei Darussalam is unique in the region because nearly half of the country is still primary forest. However, the primary forest cover is reducing and only 17% of the country’s area is protected. The currently existing Protected Areas are mainly located in three regions; Temburong, the Ingai-Bedawan reserves, and the Labi area (Teraja-Mendaram). The Labi area has two separate Protected Areas; the Bukit Teraja Protection forest and the Ulu Mendaram Conservation Forest. Each has an extension area proposed in framework of the Brunei HoB project. The ‘Teraja survey area’ is composed of the Bukit Teraja Protection Forest and the Proposed Bukit Teraja Protection Forest Extension (a narrow strip from Teraja waterfalls via Bukit Teraja ridge up to Rampayoh).

Scope and execution of Teraja survey

The proposed Protected Area extension of Bukit Teraja is a relatively small piece of land (ca. 2500 ha) but would be of particular value because it has high biodiversity value and great eco-tourism potential. It is a piece of fairly undisturbed forest that is accessible by road and has many hiking opportunities. The area holds various habitats: swamps, ridges, waterfalls, rivers - therefore a diverse flora and fauna. Several new species and endemics have been described from the area and researchers value the site. The area is used by local people who still hold the traditional knowledge & legends. It is under threat by developments. The proposed Protected Area extension will provide a connection from Bukit Teraja to the Ulu Mendaram Conservation Forest resulting in one large connected virgin rainforest with habitats varying from Peat swamp to Mixed Dipterocarp hill forest. This forest connectivity is important for forest plants and animals.

The survey purpose is to gather information on the conservation value and ecotourism potential of the area in order to help the authorities concerned in taking the most judicious decision concerning the development, management, and long-term conservation of the Teraja area.

The survey targets the appraisal of its flora, fauna, folklore, as well as an evaluation of its eco-tourism potential, in specific:

1. Highlight the flora and fauna in the area that are of ‘special interest’ either because of its rarity or its ecotourism interest. The output is an annotated checklists of biota, highlighting the biodiversity of the site, the species of conservation concern and the common species (likely to be spotted by tourists). Photographs and short description (aspect and habitat) of selected species is added.
2. Create maps of the sites of ecotourism interest and the trail system between the Teraja and the Rampayoh waterfalls.
3. Provide a report to the Heart of Borneo Council.
The survey was executed over various weekends in 2010 by PNHS members and some scientific experts (e.g. UBD students/staff). The Teraja longhouse provided a very friendly base camp and overnight stay. Groups of 3 or 4 went out to explore the rivers and ridges for interesting nature observations and to capture plant / wildlife photographic evidence.

*Photos of the activities during the survey, by various PNHS members*
Teraja area highlights

**Waterfalls and trails.** We have found 40 waterfalls and many trekking opportunities in the Teraja area. Within the proposed protection forest extension, the small Sungai Teraja basin just upstream from the Teraja longhouse has at least 11 waterfalls. The paths to the Teraja and Belaluk waterfalls are well trodden but unmarked. Pushing on from these paths through the rivers brings you to many more beautiful waterfalls. *The fourth Sungai Teraja waterfall, P. Engbers*

**Frogs.** Researchers from UBD recently found 36 species of frogs during a survey. Five frog species (Brown Bullfrog, Least Narrow-mouthed Frog, Peat Swamp Frog, Cricket Frog and Rough Guardian Frog) had never been recorded in Brunei. This brings the total number of frog species in Brunei to 81. *Pothole Narrow-mouthed Frog (left) and Least Narrow-mouthed Frog (right), Hanyrol*

**Reptiles.** About 10 species of snakes including Mangrove Cat Snake and Bornean Flatnose Pitviper were spotted at streams and on the road. Also seen were several Lizards and Turtles (e.g. the Softshell Turtle and Asian Leaf Turtle). Crocodiles are irregularly seen in the river next to the longhouse by the habitants. *Juvenile Mangrove cat snake, N. Yus*

**Mammals.** Among the mammals encountered in Teraja are the Gibbon, Red leaf monkey, Banded Palm Civet, Yellow Throated Marten, Longtailed porcupine, Slow Loris, Maroon Langur, and the Wild boar. Several deer species are known from the area. *Banded Palm Civet, S. Goutte*

**Plants.** The Teraja area shelters 19 plant species that are only known from Brunei (endemic), including 7 that, of the whole world, are only found there (‘hyper endemic’). Six new species recently discovered in Teraja are in the process of being described, they will raise further the number of known endemic plants from the Teraja area. *A species of Hoya probably new to science, J. Henrot*

**Fishes & shrimps.** Fish species were distributed unevenly along the course of the streams, reaching a maximum in shallow forest streams downstream of the waterfalls. Diversity of fish decreased up stream above the waterfalls. Shrimps are abundant above waterfalls and less so below. This might be related to the presence of predatory fish species. *Fresh water shrimp, Hanyrol*

**Butterflies.** A total of 233 butterfly species have been recorded from the study area. The most significant butterflies on the current list are Rajah Brooke’s Birdwing and Miranda Birdwing. These are both protected species according to the CITES treaty. Butterflies are known to be environmentally sensitive organisms, hence their use for conservation of Forest Reserves project. *Fivebar Swordtail, V. Hitchings*

**Birds.** The Teraja forests are very good areas for seeing forest birds in Brunei. A great variety of forest birds can be encountered with a recorded diversity of well over 150 species, from the common to the more elusive and rare. The forests are not the easiest habitat for bird-watching. However, the Labi ridge allows good views on the forest edge, but also undisturbed and close views on the forest canopy. *Bornean Bristlehead, endemic to Borneo attracts bird watchers from all over the world, F. Hindriks*
Biological highlights

Plants
J. Henrot

The Teraja area has been for a long time a favorite for botanical exploration, with many species first described from the area, some not yet found elsewhere in the world: 19 of the plants endemic to Brunei are found in the Teraja area, including 7 with a distribution limited to Teraja. The area remains, however, under-documented, with only 650 plant species collected from the larger Teraja area (table 4, Checklist from 1996).

In addition to the well developed streams and the sandstone layers, what makes Teraja botanically interesting is also what makes it vulnerable: its topography. The PTPFE in particular stretches on a steep slope reaching 415 m of altitude, a topography unique in the Belait district. The implications for the site are 2-fold: a large variety of plant habitats like waterfalls, sandstone cliffs, river banks, and ridges but also a fragile area, prone to landslides if disturbed.

Waterfalls and cliffs have a distinct flora, with a diversity of aroids, gingers, gesneriads and begonias, all groups with a high level of endemic species. With further exploration, species new to science are expected from the area; a 3 day visit by an Aroid specialist last December yielded 4 new species, including 3 endemic to Teraja (a.o., Homalomena terajaensis). Several species encountered in the course of the PNHS survey might be new to science, including a peculiar species of Hoya which is under study.

Topography of the PTPFE: because of the steep slope, the site is particularly rich in plant habitats but also prone to dramatic landslides if disturbed.

The ‘Teraja area’ (Teraja Protection Forest and HoB Proposed Extension) is almost entirely covered by ‘Mixed Dipterocarp Forest’ (MDF), with only 325 ha of the 7500 ha under Peatswamp forest (borders the Mendaram conservation area).

Apocynaceae: A peculiar Hoya. Most probably new to science and endemic to Brunei.

Hanguanaceae Hanguana sp. novo a aff Hanguana bogneri Ticch & Sill. Not yet described.

Commelinaceae Amischotolype sphagnorrhiza. Endemic to Brunei
Zingiberaceae *Boesenbergia armeniaca*, described from Rampayoh, regional endemic

Zingiberaceae *Tamijia flagellaris*. Regional endemic, not on record yet at the Brunei Herbarium

Orchidaceae *Claderia viridiflora*. Although common, orchids are rarely seen in flower

Araceae *Rhaphidophora typha*, Regional endemic (Brunei & Sarawak)

Triuridaceae *Sciaphila sp.* A delicate parasitic plant (no chlorophyll)

Moraceae *Ficus hemsleyana*. Wild figs, important food source for the wildlife. A touch of color.

*Orchidantha holtumii*: regional endemic

*Tacca bibracteata*: regional endemic

Some special plants.

All photos by J. Henrot
**Frogs**

*Hanyrol, S. Goutte, U. Grafe*

As part of their Master project, Sandra Goutte from France and Hanyrol from UBD, Brunei conducted 48 frog surveys at six selected streams within the proposed Teraja protection forest extension. The project started from the 1st of April 2010 to the 2nd of January 2011. Also joining the research team were supervisor, Dr Ulmar Grafe, UBD students, PHNS enthusiasts, and others.

They found 36 species of frogs during the survey belonging to 7 families (Table 1). Excitingly, 4 frog species (Brown Bullfrog, Least Narrow-mouthed Frog, Peat Swamp Frog, and Cricket Frog) that have never been recorded in Brunei were spotted during the survey. Two of these species were found just behind the Teraja Longhouse! This brings the total number of frog species in Brunei to 81.

More wildlife surveys will hopefully be conducted in the future to uncover more of the hidden treasures of the great Teraja area.

*(Special thanks to field assistants; Farhan, Helfi and Kalmy)*
Reptiles
Hanyrol, H. Dols

Among the reptiles encountered in Teraja were many snakes and several lizards and turtles (table 2). About 10 species of snakes including Mangrove Cat Snakes, and Bornean Flatnose Pitviper were spotted at streams and on the Labi road bordering the Teraja protection forest extension. Also worthwhile to mention are the Malayan Softshell Turtle and the Asian Leaf Turtle. Teraja longhouse inhabitants report crocodiles irregularly in the river next to their longhouse (as recent as in 2010).

Snakes were found when fishing in the pond under Beluluk waterfall. We specifically found there the Ular Kendawan = Reedsnake (Calamaria Lumbricoidea). A particularly beautiful snake is the Waglers Pit Viper (Tropidolaemus wagleri) locally called the Ingkerudu = stupid snake since it sits in the same spot for a long time. The Kongkangmau = Mangrove snake Mangrove snake = Gold ringed cat snake (Boiga dendrophila) strikes at the light when approached to closely. It is found quite often in the Teraja river. Locals use yellow foil over a flashlight to hunt the snake. Although, there are many snakes, they are not so often seen. Most are not dangerous, and the chance of being bitten is very small.
Butterflies
V. Hitchings

A total of 233 butterfly species have been recorded from the study area. The most significant butterflies on the current list are *Trogonoptera brookiana brookiana* - Rajah Brooke’s Birdwing and *Troides miranda Miranda* - Miranda Birdwing. These are both protected species according to the CITES treaty. Butterflies are known to be environmentally sensitive organisms, hence their use in the Conservation of Bornean Forest Reserves project. The list of species in this study provides a baseline for any future butterfly studies for Labi-Teraja.

**Historical Records** provide a wealth of data on the butterflies of the Teraja-Labi area and provide data from more field hours than could otherwise be undertaken in a short space of time. In 1986 R.R. Herd prepared a volume entitled ‘A Photographic Reference List to Bruneian Butterflies’. The information was compiled to generate the list of the butterflies presented in the appendix. The list is not exhaustive and without doubt more species are to be found and recorded.

Caterpillars are often fascinating, but be aware, do not touch these hairy beasts.
Birds
F. Hindriks

The dipterocarp forests surrounding Labi and Teraja are one of the key areas for seeing forest birds in Brunei, as they still offer a relatively undisturbed habitat for typical lowland birds as well as birds that prefer hill forests. At the same time the area is relatively easily accessible from Bandar and Seria. The primary lowland dipterocarp forest is the richest ecosystem in Borneo and accounts for the greatest biodiversity. The Brunei forests around Teraja are no exception, and a great variety of forest birds can be encountered.

As only limited data was gathered in the Teraja area within a 1 year period no complete bird list of the area can be provided. For a more extensive record far more dedicated research should be conducted over a longer period of time. Nevertheless, recordings based on frequent visits to the Labi road area and records of former PNHS members clearly illustrate the diversity with well over 150 species recorded, from the common to the more elusive and rare.

Highlights include sightings of the Bornean Bristlehead, an endemic species to Borneo, that attracts bird watchers from all over the world. Asian Paradise Flycatcher, more common, but often elusive. Red-throated barbet, an uncommon barbet species that is still often heard in the forests surrounding Labi and Teraja.

The forests are not the easiest habitat for bird-watching as the view is often obstructed and most birds are restless and allow the bird-watcher only a brief view. For many birdwatchers the forest edge is therefore a preferred location, as it allows a wider view to spot species. The Labi ridge, and likely the new Forestry road to Bukit Teraja, are also unique in this respect as there are numerous locations along this road that not only allow good views on the forest edge, but also undisturbed and close views on the forest canopy.

One concern is for bird-watching is the increased activity and development activities along the road. For now, Labi and Teraja remain still excellent areas for bird-watching, as long as one is prepared to have an early rise.

Jeremy Moore is greatly acknowledged and his bird documentation is used and quoted throughout this section, see link to his extensive Brunei birdwatching document below.

Labi Ridge
This is one of the best bird-watching sites in Brunei. The view from the ridge is stunning and gibbons are still heard on every early morning visit. The access road to the ridge has been made much more accessible recently. See here a picture from a red-billed malkoha which, according to Myers Birds of Borneo, is the rarest of the 5 bornean malkoha species. This bird flew almost right up to me, and unlike most malkoha’s allowed me a good view instead of quickly hiding away in the dense foliage.

Jeremy Moore provides the following description of the Labi ridge area:

“About 2 1/2 km before Labi village, there is a small red temple on the corner of a junction with a sandy track. This is the entrance to the Labi Ridge walk which is one of the best known access routes to the forest in the Labi area, although a solid fourwheel drive vehicle is essential. The track first crosses a small clearing (exit at the far righthand side) and then climbs very steeply for just over a km where there is a smaller track on the lefthand side. This is the best birdwatching route and can be driven with care unless the route is affected by rain. An alternative is to walk this route, parking directly opposite the entrance or about 200m further up the main route in a clearing at the top of the hill. This area can be very busy with logging trucks and in 2009 also with vehicles for the seismic survey so care is needed when driving and walking as these large vehicles cannot always stop easily on loose slopes. The side track is drivable for about 3km and a walking path continues further. Birdwatching is good at almost any point along the path and generally birds seen are similar to the ‘seismic track’ area although slightly easier to see due to the higher elevation of the path. Specialties seen here include Streaked Bulbul, Scarlet-rumped Trogon, Darkthroated Oriole, Brown Fulvetta, Verditer Flycatcher, Mountain Leaf Warbler, Asian Paradise Flycatcher and Yellow-breasted Flowerpecker. Rhinoceros and Bushycrested Hornbills are fairly common here too while Wreathed, White-crowned and Helmeted (only heard) have been recorded once each. Birds seem to be most active here in May and June when mixed flocks of feeding birds can be so large and active that it is impossible for one observer to look at everything.”

Red-billed malkoha
Fish species were distributed unevenly along the course of the streams, reaching a maximum in shallow forest streams downstream of the waterfalls. Diversity of fish decreased upstream above the waterfalls. Shrimps are abundant above waterfalls and less so below. This might be related to the presence of predatory fish species. It is likely that we did not achieve a representative sampling of fish species, due to limited duration of fishing and sampling (fishing) techniques. More surveys are needed to support the result of the first quicklook survey.

Excitingly, the 'Brunei Beauty', scientific name Betta Macrostoma was found. The fish has so far only been found in the Teraja and Marudi area. This extremely restricted area of distribution underlines the importance of protecting the Teraja forests. The rare 'Brunei Beauty' has has been classified as threatened in the IUCN listing.

The presence of shrimp in Beludok waterfall is quite high as opposite to fish that were nearly absent. Upstream from the Teraja waterfall has quite high shrimp population while fish population was extremly low and only unique fishes are found here, such as Forest Snakehead fishes. Forest snakehead fish is found in young group of more than 20 fishes, at upstream area but not found in downstream river. They adapt very well to strong currents. As snakehead can have eggs in big numbers they might be a source of food for insect and shrimps in this area.

The difficult access to the forest area and small size of most fish make it unattractive as an economic resource of food fish. However the river near Teraja Longhouse is actively netted by villagers. Potentially there would be a source of fish for the freshwater aquarium trade.

There has not been much research on the freshwater fish in Brunei, and forest streams even less studied than brackish water and coastal resources.
Mammals
A. Geisslinger, H. Dols, P. Engbers

Mammals are more difficult to spot than most other animals. Nevertheless quite a few species could be observed during the Teraja Survey work, particularly at night: Red leaf monkey, Banded Palm Civet, Yellow Throated Marten, Longtailed porcupine, Slow Loris, Maroon Langur, Wild boar, Plantain squirrel. The Gibbon calls were heard but no individuals spotted during the survey. Making photos is very difficult as they are often far away and flee at any noise. The best way to capture a good photo would be by installing camera traps.

Many animal traps are observed along the animal trails, particularly on the ridges. Hunting and poaching is actively going on. As recent as Dec 2010, the Brunei Times reports of a Clouded Leopard skin hung out to dry in one of the Belait Kampons. This nocturnal cat is believed to be Borneo's largest cat, and is hunted for its cloud-patterned skin as well as its meat and bones. It is vulnerable to extinction, and is one of 34 species protected by Brunei law (protected animals include 2 mammals known from Teraja). Another recent sighting by a local man reported by Brunei Times is of a Clouded Leopard during daylight in a populated neighbourhood in Labi. It shows that this cat is disturbed and faces habitat loss.

An interview with Pak Jamit Ketua Rpar Teraja and His son Kemarau anak Jamit of the Teraya longhouse regarding what animals they do observe in the forests produced an impressive list of mammals (including local names):

- Longtailed porcupine (*Trichys fasciculate*) = Ankis = like Landak. Short haired looks like a very large rat.
- Common Porcupine (*Hystrix brachyura*) = Landak Dudul. This is the one we spotted when frogging.
- Moonrat (*Echinosorex gymnurus*) = Haji Bulan. Like white haji cap. All white, very smelly.
- Yellow-throated Marten (*Martes flavigula*) = Menaleh
- Banded Linsang (*Prionodon-linsang*) = Pangkong Alang = Tupai like a Zebra
- Sunbear (*Helarctos malayanus*) = Beruang. Sometimes caught locally. 4 years ago at Sg Beluluk one reputedly as tall as a man was caught killed and eaten. Regularly marks are found on fruit trees close to the longhouse.
- Clouded Leopard (*Neofelis diardi*) = Benkuli = Harimau Bulan (protected under Brunei’s Wildlife Protection Act).
- Short tailed Mongoose (*Herpestes brachyurus*) = Dumbang. Found in Rampayoh.
- Banded Palm Civet (*Hemigalus derbyanus*) = Bankang along = Musang. Small Civet cat often seen near Rp Teraja.
- Common Palm Civet (*Paradoxurus hermaphrodites*) = Musang malang. Many around the longhouse eating fruit.
- Sambar Deer (*Cervus unicolor*) = Rusa or Payau. Status unknown will have to recheck if has been sighted there.
- Common Barking deer (*Muntiacus muntjak*) = Kijang = Red Muntjac. Still sighted frequently.
- Smaller (Lesser mouse deer) (*Tragulus javanicus*) = Pelanduk Simpur. Often caught close by the longhouse.
- Oriental small clawed Otter (*Aonyx cinerea*) or smooth Otter (*Lutra perspicillata*)= Ringin. Often seen eating fish.
- Slow Loris (*Nycticebus coucang*) = Inkat. Often seen (protected under Brunei’s Wildlife Protection Act).
- Bearcat (*Arctictis binturong*) = Anturan = Binturong. Unclear if these have been spotted near the longhouse or not.
- Bornean Bearded Pig or Wild boar (*Sus barbatus*)
- Longtailed Macque (*Macaca facicularis*), Red leaf monkey (*Presbytis rubicunda*), Silvered Langur (*Presbytis cristata*)
- Gibbon (*Hylobates muelleri*)
Spiders
J K H Koh

Even without a more definite tabulation of spiders found in the Teraja-Rampayoh area, it is already obvious that the area is high in species richness, conservatively estimated at a minimum of 40 species falling under at least 11 families. Among them are numerous spiders recorded for the first time in Brunei Darussalam.

Spiders recorded for the first time in Brunei Darussalam include the strikingly coloured *Acusilas malaccensis* Murphy & Murphy 1983 which hides inside a rolled leaf shelter suspended in the hub of a sparsely spaced and incomplete orb web amongst low vegetation in moist areas in the forest. The discovery of the spiny *Phoroncidia lygeana* (Walckenaer 1841) along the trail towards the Wasai Rampayoh is another new record in Brunei. An active hunter that is noted for the first time in Brunei is the brown jungle lynx spider *Hamataliwa incompta* Thorell 1875. There are many more species that are probably new to science. There is also a possibly undescribed spitting spider closely related to *Scytodes pallida* Doleschall 1859. Among the more spectacular species that may not have been described previously is a large orange jungle huntsman spider of the highly diverse genus of *Heteropoda*, seen below here consuming a leech at night.

*All above spider photos by J. KH Koh*

*New species of Heteropoda.*  
*Female of Heteropoda species*  
*Heteropoda boei, male, uncommon*

*Above spider photos by Hanyroll*
No systematic survey of the insects and other arthropods of Teraja has yet been undertaken but chance sightings produced photographs representing a range of families. Butterflies (see separate section) dance around the longhouse and padi fields, a trilobite beetle may be sitting on a log across your path and a firefly signals for a mate after nightfall. A late evening walk will also yield a variety of phasmids and centipedes, emerged from the leaf litter for a night’s browsing or hunting. Dragonflies are abundant along the old Marudi road and around the padi fields while water boatmen and other aquatic arthropods may be seen in the many streams. Termite mounds and tubes advertise the presence of these essential insects. Other insects secrete themselves in crevices or under bark, and have to be sought out. The mosquitoes will of course always welcome you, so take some repellent. Interestingly enough, mosquitoes are quite limited through the Mixed Dipterocarp Forest (most of Teraja) but are abundant and fierce in the Peat swamp part of Teraja.

Selected insect photos. Left under is Lampyridae sp., a larval form of a firefly or glow worm also known as a lightning bug - because of the way some adults attract a mate (producing flashes of light from luminous organs in a pattern specific to their species). As this individual was actively producing light from the pale yellow patch near the end of the tail, it may be that it belongs to a species in which the female does not change from the larval form. They are in fact beetles, and adult males are more typically beetle-shaped. All photos by J. Henrot except the top left by Hanyrol.
Trail system, eco tourism, and natural highlights

**Trail system**
P. Engbers, H. Dols

The whole Teraja area, but particularly the proposed Protected Area extension of Bukit Teraja has many hiking opportunities. It has great eco-tourism potential. It is a piece of fairly undisturbed forest that is accessible by road. The area holds various habitats: swamps, ridges, waterfalls, rivers - therefore a diverse flora and fauna.

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**Warning:** Trails are not signposted. There are some difficult sections. Conditions change continuously. Orientation is difficult in forest. Use this map at own responsibility, only for the experienced rainforest hiker.

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Teraja Trail Map, to open click [https://sites.google.com/site/peterengbersbrunei/important-documents/TerajaTracks.kmz](https://sites.google.com/site/peterengbersbrunei/important-documents/TerajaTracks.kmz)

This above map shows the explored trekking system. The Bkt Teraja Protection forest reserve and proposed extension area are in between the Labi road and LoggingRoadEast. There are many waterfalls and hiking treks (Brown = unmarked path, Orange = more difficult hike or animal trail, Red = hard trek, Blue = river scramble). Nearly all ridges have a kind of trail (orange) that is or has been used by seismic survey staff, military, border patrol, poachers, or animals.
**Waterfalls**

**P. Engbers**

Sofar, we found 40 waterfalls in the Teraja area. 39 of these are in the proposed conservation forest. The small Sungai Teraja basin just upstream from the Teraja longhouse is of particular interest. We have explored the area extensively and found it particularly diverse, with at least 11 waterfalls (Waypoints with W=Wasai or Waterfall) and many trekking opportunities. The paths to the Teraja and Belaluk waterfalls are well trodden but unmarked. Pushing on from these paths through the rivers brings you to many more beautiful waterfalls. These river scrambles, climbing over rocks and swimming the many pools are great fun for the adventurous family. Most ridges have a kind of hiking or animal trail providing connection towards Bkt Teraja and other areas.

**Enjoying a rest and a swim at the Rampayoh Waterfalls, a 2.5 hrs forest walk from the Labi road.**

H. Dols

See appendix 1 for a map and photos composition of all 40 waterfalls.
Ridges and Viewpoints
P. Engbers

The Teraja area is dominated by the Teraja ridge reaching to a height of 415 m at Bukit Teraja. Various viewpoints provide great views from the main Teraja ridges to the East or West. To the West, one can see over the Mendaram peat swamp forest up to the Lambir hills at clear sky. Towards the East, we see the whole Belait – Tutong basin up to the Limbang border. Towards the Southeast, the high Mulu Mountains are very impressive.
Sandstone Rocks and cliffs
P. Engbers

Many sandstone rocks can be found in the Teraja area. They are on ridges as cliffs or labyrinths and in the valleys where the hard sandstone layers either steer the river bends or cause the many waterfalls.
Eco-tourism activities

P. Engbers, J. Henrot

Many activities are possible in the Teraja area. They vary from following rivers by foot, inflatable, or inner-tubes, scrambling the rocks or trees like in canyoning, as well swimming the pools and jumping, sliding, or abseiling the rock faces. Camping or bivaccing can be done in many places. Various multi-day hikes are possible setting up your own camp for the night. It is also possible to design and string together various multi-day eco-tourism activities in the forest and combine them with other activities in the Labi area (rice paddy visits, cycling, cultural visits, etc).

Floating down river with inner tubes and in inflatable boats.

Following the rivers, climbing the rocks and trees is not always easy, but big fun for adventurous family.

Going down the rivers, jumping or sliding the rocks needs some safety attention, but is fun.
Going down the rivers, abseiling the waterfalls is challenging and fun for the kids.  

Setting up camp for the night. Hammocks are light, comfortable, and well protected with rain flysheet.

Trekking through the rainforest, enjoying impressive trees and varying undergrowth.
Labi-Teraja Longhouses and its traditions
P. Engbers, H. Dols (adapted from “Brunei Darussalam; a guide” by BSP, 2000)

Labi is a rural settlement with houses scattered on either side of the road. It is a centre for fruit production and other agriculture. Lime, orange, rambutan, jackfruit, cempedak, durian, and other tropical fruits are all grown in the area.

Along the road from Labi to Teraja are four Iban longhouses, the principal ones being Rumah Panjang Mendaram Besar (Rumah Panjang means longhouse) and Rumah Panjang Teraja. Longhouses are not permanent. When they start falling apart, the inhabitants simply build another a short distance away choosing a new site because they have to live in the old longhouse until the new one is complete. Each family member plays a part in the construction and each family is responsible for the building of its own 'door'. Longhouses in Labi are no longer built with palm leaves and the last traditional one in the area disappeared in the mid-1980s. Now longhouses are made from wooden planks with corrugated iron roofs. Modern staircases have replaced the traditional notched log that used to be common. Built to accommodate many families, the longhouse is divided into two main areas - a series of family rooms and a large open verandah which looks like a public thoroughfare but in fact is not. The public walkway is a metre wide path along the front of the building, of which lead all the 'family-room doors'.

Rumah Panjang Mendaram Besar has 12 doors and is home to some 100 people. It still has a wooden roof and the floor area comprises planks and split nibong palm.

The six-door Rumah Panjang Teraja at the end of the Labi road was constructed in 1987 and is now home for 30 people. It is an interesting blend of old traditions and modern influences. If you are lucky to be granted a look inside you will find the place equipped with all thinkable modern facilities. It is quiet during the week with most men away working in Seria and Kuala Belait. It has a full complement only for important celebrations such as Gawai, the rice harvest festival, at the beginning of June when celebrations go on for a week and visitors are welcome. Children go to the local primary school but when they reach lower secondary level they have to go to school in Kuala Belait and live in hostels. The longhouse has its own generator and in 1991 completed a project to draw water from the first Belulok waterfall. The residents grow their own fruit and vegetables including pineapples, pumpkins, beans, durian, mangosteens and bananas and rear pigs and chickens. They also plant padi rice.
"When approached from the west, the Labi ridge rises abruptly from the absolute flatness of the Belait peatswamps. There is no significant range of Hills between Labi and Lambir National Park xkm away to the west in Sarawak and the views looking to the west from the logging track at Bukit Talingan are breathtaking. The eastern side of the ridge, dissected by steep gullies, dips more gently towards the floodplain and swamps of the Belait-Tutong drainage basin. From the ridge of the hill range, a 360 degree panorama is possible, encompassing all significant geomorphological features in Brunei and beyond, including Gunung Mulu, perhaps the most distinctive mountain within view.

The Labi Hills have a marked asymmetry in cross section with an escarpment slope forming the steep western side and the eastern slopes representing a deeply eroded dip slope. The steepness of the western slope has a recent geological origin, being formed as the result of reverse fault movement along a pre-existing fault zone. The mountain building episode that affected all current hill ranges in Brunei can be demonstrated to have occurred up until very recently in geological time, perhaps less than 1 million years B.P. As a result of continued pulses of mountain building over the past 10 million years or so, the Labi hills have remained a young range of hills, with uplift keeping up with natural erosive processes.

The numerous steep gullies that dissect the range reflect the nature of the rock sequence that forms them. Along many parts of the logging trails outcrops of rock reveal sandstone and sandstone-claystone sequences of sedimentary rocks. In detail, depositional features indicate that these rocks were laid down in shallow water conditions, similar to those seen in the present Brunei bay.

In many of the narrow valleys that dissect the hills the natural processes of erosion can be seen in action. The main two processes are water erosion / chemical dissolution and rockfall / landslide. The first process is a continual one difficult to detect on the human scale. However rockfalls are instantaneous events and have a significant visual impact on the forest, causing tree falls, blocking jungle tracks and occasionally damming rivers. The breaks in the forest canopy are very quickly occupied by the rapid growth of tree saplings and such rockfalls are often difficult to detect five years after the event. Rockfalls are also a feature along some of the ridge tracks where natural fractures in the geological formations encourage the process.

One process that has a significant impact on erosion is human forest clearance. Along most logging tracks, the impact of forest clearing is very visible. Erosion is instantaneous following clearance and the sediment is delivered into the forest valleys very rapidly over a short period of time. The impact of this is very significant on local valley ecosystems, resulting in the silting up of forest streams and valleys and often death of a significant part of the valley bottom forest.

The sandstone and claystone rock layers dip gently to the west on the western slopes and gently to moderately to the east on the eastern slopes of the hill ranges; thus the hills are formed of a geological structure termed an anticline. Along the main logging track where bulldozing has exposed the rocks, discrete narrow zones can be seen where the rock layers are deformed vertically. These are the main faults that break up the geological layers throughout the Labi Hills. As more logging tracks are excavated, more fault zones can be discerned. Thus we can interpret the Labi Hills as a faulted anticline structure. In the future, with increased resolution of the digital
elevation data (e.g. LIDAR images), it may be possible to further map the geological fault zones across the Labi Hills by imaging through the forest canopy.

Evidence of the most recent uplift of the hills can be seen along the west boundary of the hills, where sand and clay eroded from the hills have been deposited as large alluvial fans (google earth image in here). These fans have spread over the peat swamp, resulting in a subtle change of forest. These fans have been exploited by the local communities who now grow a wide range of fruit, vegetables and rice on the deposits of the eroded hills. Observations in rivers and streams that flow through these fans indicate that the rivers now cut down through these deposits by up to two metres; the rivers must have originally been flowing on the surface of these deposits but have eroded down into them as the land they were deposited on them has uplifted."

Labi area Exploration History

Eighteen wells have been drilled in the Labi area between 1912 and 1988, but only the last ten (post-1953) were drilled deeper than 1300 metres. Well 2 was the only significant producer. Reservoirs are very thick coastal plain sands with few marine intercalations. The Miocene sedimentary sequence is overall regressive from the deep marine, Setap Shale Formation at the base to the coastal plain sediments of the Belait Formation at the top.

Most exploration activity was in the Talingan area. The very sandy (main objective) sequence of the Belait Formation and the main regional cap rock, the Belait Clays, both crop out in the anticline. The structure is therefore prone to leakage in these areas as shown by numerous oil seeps. All parts of the Belait structure connect with potential oil kitchens on both flanks in the Badas and Belait synclines. These synclines contain thick coaly horizons (locally true coals) which are excellent source rocks. The deeper basinal Setap Shales could also contain good source rocks.

In the extreme south of the structure around Bukit Teraja, where well Belait 14 was drilled, uplift on the fault-zone is very considerable, as is removal of former overburden by erosion. Geological exploration of the Belait anticline began about 1911, with geologists of the British Borneo Petroleum Syndicate, mapping the area as far south as Bukit Teraja. The first well was spudded in 1912 at Bukit Puan, on the south bank of the Belait river, to satisfy license obligations. In 1913, the syndicate acquired the Rampayoh Mining Lease, covering an area of strong surface hydrocarbon indications. They started drilling at sites no. 2 and no. 3 in the Talingan area, at the crest of the Belait anticline, with oil impregnated outcrops nearby. The Anglo-Saxon Petroleum Company (part of the Shell group of companies) took over the drilling operations in 1914. They struck oil in well no. 2 at a TD of 559 metres; the first oil in Brunei.

The British Malayan Petroleum Company (Shell) took over the British Borneo Petroleum Syndicate concessions in 1924. Subsequently the area was remapped. Well no. 2 was put on production in 1924. Between 1924 and 1931 some 5,000 m3 of oil was transported by rail to Kompas and from there shipped down the Belait river. The company drilled six more wells from 1924 to 1931. Wells no 5, 8 and 9 appraised the producing Talingan area. They discovered mainly gas. Wells no. 6, 7 and 10 found new hydrocarbons, but none was considered commercial. Production and exploration activities stopped in 1931. The Seria oilfield provided better opportunities. Exploration returned in 1948 with a seismic survey at Medaram and Teraja, but without delineating new prospects. Wells Belait-11 to 14 drilled between 1953 and 1955 failed to find hydrocarbons. Exploration turned to the offshore in the late 1950's and only returned to the Belait area in the early 1970's. New seismic was acquired between 1975 and 1977 and two wells (Belait 15 and 16) were subsequently drilled in 1978. Belait 16 found interesting gas shows, but could not be tested because of technical problems.

The Talingan area appeared to be the only one with further opportunities. New seismic was shot over this area in 1985 and Belait-17 was spudded in 1987 as a twin well of Belait-5. Belait-18 spudded in 1988 as a sidetrack of Belait-17 to evaluate the east flank of the Talingan accumulations. This well was the first one in 60 years with new, but non-commercial, hydrocarbons in the Belait area.
The PNHS proposes the establishment and gazetment of a Teraja Conservation Forest, with a purpose and outline slightly different from the earlier HoB proposed protection forest extension. A Conservation forest is an undisturbed forest set aside to preserve and conserve biodiversity for scientific, educational, and/or ecotourism purposes. The ecotourism should be low impact, small scale, and benefit the economic development of the local communities.

The suggested outline of a Teraja Conservation Forest is shown in below map with a transparent brown-yellow fill. The proposed conservation forest would provide a crucial connection between the existing Teraja Protection forest and the Mendaram conservation area (transparent green) and form a buffer zone between the more intensively used areas along the Labi road and the Teraja protection forest.

Map of suggested outline of a Teraja Conservation Forest (transparent brown-yellow fill). The proposed conservation forest would provide a crucial connection between the existing Teraja Protection forest and the Mendaram conservation area (transparent green) and form a buffer zone between the more intensively used areas along the Labi road and the Teraja protection forest.
Ecotourism development suggestions for the Labi-Teraja area
P. Engbers, H. Dols, J. Henrot, A. Geisslinger

A definition of Ecotourism: Ecotourism is travel to fragile, pristine and usually protected areas that strives to be low impact and is small scale. It helps educate the traveler; provides funds for conservation; directly benefits the economic development and political empowerment of local communities; and fosters respect for different cultures and for human rights.

Recommendation for Teraja ecotourism development: We recommend starting small. Development should fully involve and align with the wishes of the local inhabitants. The people need training on how to deal with tourist and manage projects. It is advised to develop an ecotourism master plan for the area. Look at the example of very successful low impact local development of homestay trekking in Nepal and Ladakh and of nature tourism in Sabah. There is the opportunity to re-employ current poachers / hunters as committed and knowledgeable guides after they have been retrained. Ideally it should be entirely run by the local community with some support from the government and interested parties. The master plan and its implementation need expert consultant steer and advice to ensure low impact and environment/tourist friendly development.

Accommodation options: Homestays in local homes, rice paddy stay (see Bali examples), longhouse stay, and a Labi guesthouse.

Possible activities:
- Cultural shows (longhouse).
- Rice paddy and agricultural demonstrations.
- Cycling Labi area and biathlon (cycle and walk) up Bukit Teraja.
- Short and easy jungle walks (can be done without guide). These are the brown trails on our map.
- Longer and more difficult jungle treks (need guide). These are the orange trails on map.
- River experiences (follow river, see blue tracks on map, need guide). Waterfall visits and swim in pools.
- Rainforest camping and/or bivac experiences. Rainforest survival training camps (need guide).
- Multi-day rain forest experience from Teraja longhouse to Rampayoh river (combine all trails from map) and includes rainforest bivac (need guide).
- Topical nature experiences (e.g. bird watching, butterflies, fish exploration, botanical walks, nightwalk for insects/frogs, need guide).

Development suggestions:
- Maintain and signpost the easy trails (brown trails on map).
- Facilitate building of guesthouse in local style in labi (example Telamba homestay near sg Telamba)
- Develop Bkt Teraja forestry road as a low impact tourist road with facilities at top. Desperately needs control (against poaching) now.
- Work together with Brunei Tourism. Set up Eco tourism support and advertisement (e.g. websites), but don’t publicize before implementing basic protection measures and local guides.
- Provide Green guide training. Provide eco tourism training to interested locals (longhouse, etc) and help longhouses to set up for tourism.
- Work with all stakeholders and a consultant to make ecotourism master plan for the area. Have an experienced consultant who can steer activities and advise on what kind of environment the international visitors do expect before changing the natural environment (path clearing, big structures, etc.).
- Set up information corners and cultural displays in the two longhouses. This would turn the longhouses into impromptu visitors’ centres where tourist can collect information before setting off.
Appendix 1. Map, Waterfall composites, Tables, Reports
Map 1. Waterfalls and potential trekking system in Teraja area. There are many waterfalls (Waypoints with W=Wasa) and hiking treks (Brown = unmarked path, Orange = more difficult hike or animal trail, Red = hard trek, Blue = river scramble). Warning: There are many difficult sections. Conditions change continuously. Orientation is difficult in forest. Only for the experienced rainforest hiker. Use at own responsibility. Prepared and walked by Peter Engbers, Jaqueline Henrot, and friends in the period 2007-2011.
Talingan - Rampayoh – Mendaram; The 14 Northern Waterfalls out of a total of 40
Teraja – Belulok; The 12 Southern Waterfalls out of a total of 40
Kapu – Burong (Western slope of Bukit Teraja); The 14 Central Waterfalls out of a total of 40
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common name</th>
<th>Conservation status</th>
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</thead>
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<tr>
<td><strong>Bufonidae</strong>&lt;br&gt;(True Toads)</td>
<td><em>Phrynoidis aspera</em>&lt;br&gt;<em>Phrynoidis juxtaspera</em>&lt;br&gt;<em>Ingerophrynus diversgens</em>&lt;br&gt;<em>Ansonia albomaculata</em></td>
<td>River Toad&lt;br&gt;Giant River Toad&lt;br&gt;Crested Toad&lt;br&gt;White-lipped Slender Toad</td>
<td>LC&lt;br&gt;LC&lt;br&gt;LC&lt;br&gt;NT</td>
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<td><strong>Megophryidae</strong>&lt;br&gt;(Litter Frogs)</td>
<td><em>Leptobrachium abbotti</em>&lt;br&gt;<em>Leptolalax gracilis</em></td>
<td>Lowland Litter Frog&lt;br&gt;Sarawak Slender Litter Frog</td>
<td>LC&lt;br&gt;NT</td>
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<td><strong>Microhylidae</strong>&lt;br&gt;(Narrow-mouthed Frogs)</td>
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<td>Saffron-bellied Frog&lt;br&gt;Tree Hole Frog&lt;br&gt;Least Narrow-mouthed Frog&lt;br&gt;Least Narrow-mouthed Frog&lt;br&gt;Borneo Narrow-mouthed Frog&lt;br&gt;Brown Bullfrog</td>
<td>LC&lt;br&gt;LC&lt;br&gt;NT&lt;br&gt;NT&lt;br&gt;LC&lt;br&gt;LC</td>
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### Table 3. Taxonomic List of the Butterflies of the Labi-Teraja Area

**Family: Papilionidae – Swallowtails and Jays.**

- *Trogonoptera brookiana brookiana* – Rajah Brooke’s Birdwing
- *Troides miranda miranda* – Miranda Birdwing
- *Atrophaneura neptunus doris* – Yellow Clubtail
- *Atrophaneura nox noctis* – Malayan Batwing
- *Pachliopta aristolochiae asteris* – Common Rose
- *Chilasa paradoxa telesicris* – Great Blue Mime
- *Papilio demolion demolion* – Banded Swallowtail
- *Papilio helenus engiarius* – Red Helen
- *Papilio nephelus albolineatus* – Black & White Helen
- *Papilio helenus engiarius* – Red Helen
- *Papilio iswara* – Great Helen
- *Papilio fuscus daycus* – The Fuscous Swallowtail
- *Papilio memnon memnon* – Common Bluebottle
- *Papilio achero* – Bornean Mormon
- *Papilio karna carnatus* – Jungle Jade
- *Papilio palinurus* – The Banded Peacock
- *Pachliopta aristolochiae asteris* – The Common Rose
- *Graphium agamemnon agamemnon* – Tailed Jay
- *Graphium sarpedon luctatius* – Common Bluebottle
- *Graphium doson evemonides* – Common Jay
- *Graphium empedovana*
- *Graphium bathycles bathycloides* – The Striped Bluebottle
- *Graphium ramecus ramecus* – Pendlebury’s Zebra
- *Pathyssa antiphates itamputi* – Fivebar Swordtail
- *Parantocissus delessertii delessertii* – The Malayan Zebra
- *Parantocissus ramecus ramecus*
- *Meandrusa payeni bruni* – Yellow Gorgon
- *Lamproptera curius* – The White Dragontail

**Family: Pieridae – White, Sulphurs and Yellows**

**Subfamily: Pierinae**

- *Leptosia nina malayana* – The Psyche
- *Prioneris cornelia*
- *Cepora ludith hespera* – Orange Gull
- *Appias nero chelidon* – Orange Albatross
- *Appias paulina Athena* – Common/White Albatross
- *Appias cardena cardena* – Malay Puffin
- *Appias inandra aemila* – Plain Puffin
- *Appias nero chelidon* – Orange Albatross
- *Appias paulina athena* – The Common Albatross
- *Sateara liberia distantia* – Malaysian Albatross
- *Hebomoia glaucippe borneensis* – The Great Orange Tip
- *Pareronia valeria lutescens* – The Wanderer
- *Prioneris philomone vollenhovi*
- *Sateara panda* Malaysian Albatross

**Subfamily: Coliadinae**

- *Dercas gobrias* – Notched Yellow
- *Catopsilia pomona pomona* – The Lemon Emigrant
- *Catopsilia pyranthe* evangelina – The Mottled Emigrant
- *Eurema hecabe latilimbata* – Common Grass Yellow
- *Eurema ada ada*
- *Eurema sari sodalista* – The Chocolate Grass Yellow
- *Eurema taliaha gradiens*
- *Eurema alitha* – Scalloped Grass Yellow
- *Eurema andersonii andersonii* – One-spot Grass Yellow
- *Eurema nicevillei nicevillei*

**Subfamily: Limenitidinae**

- *Moduz a procris agnata* – The Commander
- *Neptis hylas sopatra* – The Common Sailer
- *Neptis duryodana duryodana*
- *Neptis nata nata* – Clear Sailer
- *Neptis leucophoros cresina* – Grey Sailor
- *Neptis harita mingia* – Chocolate Sailor
- *Neptis clinia* – The Clear Sailer
- *Neptis nata nata* – The Clear Sailer
- *Neptis omeroda omeroda*
- *Neptis magadh plautia* – The Spotted Sailer
- *Pantoporia hordonia dora* – Common Lascar
- *Pantoporia paraka paraka* – Perak Lascar
- *Pantoporia aurelia aurelia* – The Baby Lascar
- *Lasippa heliodore dorelia* – Burmese Lascar
- *Lasippa tiga* – Burmese Lascar
- *Athyma kanwa kanwa* – Dot-dash Sergeant *Athyma nefte matthioia* – Colour Sergeant
- *Athyma larymna elisa* – The Great Sergeant
- *Pandita sinope sinope* – Orange Band
- *Lebadea martha paduka* – The Knight
- *Parthenos sylvania borneensis* – The Clipper
- *Tanaeia aruna pardalis*
- *Tanaeia munda munda*
- *Tanaeia clathrata caerulescens*
- *Tanaeia iapis ambalika* – Horsfields-Baron
- *Tanaeia godartii vacillaria*
- *Tanaeia orphne*
- *Tanaeia pleia vikrama*
- *Euthalia monina bipunctata* – Malay Baron
- *Euthalia canescens*
- *Euthalia evelina*
- *Dophia (Euthalia) evelina eopmata* – The Redspot Duke

**Subfamily: Cyrestinae**

- *Cyrestis nivea nivalis* – Straight Line Mapwing
- *Chersonesia rahria rahria* – Wavy Maple
- *Chersonesia intermedia intermedia* – Intermediate Maplet
- *Dichorragia nesimachus derdas* – The Constable

**Subfamily: Apaturinae**

- *Eulaceura osteria jembola* – The Purple Duke
- *Euripus nycetelius pfeiffarae* – The Courtesan

**Subfamily: Charaxinae**

- *Polyura hebe ganymedes* – Plain Nawab
- *Charaxes solon echo* – The Black Rajah
- *Charaxes distanti thespius*
- *Charaxes borneensis borneensis*
- *Charaxes bernardus pseudoferrens* – The Tawny Rajah
- *Polyura athamas uraeus* – Common Nawab
- *Polyura moori saida* – The Malayan Nawab
- *Agatasa calydonia mahasthama* – The Glorious Begum

**Family: Riodinidae – Silvermarks**

- *Zemeros emesoides eso*
- *Paralaxita telesia telesia* – the Red Harlequin
- *Paralaxita orphna orphna* – The Banded Red Harlequin
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<thead>
<tr>
<th>Family: Nymphalidae – Brushfoot Butterflies</th>
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<tbody>
<tr>
<td><strong>Subfamily: Danaeidae</strong></td>
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<tr>
<td><em>Parantica agleoides terilus</em> - The Dark Glassy Tiger</td>
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<td><em>Parantica aspasia sheford</em> - The Yellow Glassy Tiger</td>
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<td><em>Ideopsis (Radena) vulgaris interposita</em> - Blue Glassy Tiger</td>
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<tr>
<td><em>Ideopsis gaura daos</em> - The Smaller Wood Nymph</td>
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<tr>
<td><em>Idea stoll virgo</em> - Common Tree-nymph</td>
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<td><em>Euploea sylvestre tyrianthira</em> - The Double-branded Crow</td>
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<td><em>Euploea camaralzeman scudder</em> - Malayan Crow</td>
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<td><em>Euploea algea zonata</em> - Long branched Blue Crow</td>
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<td><em>Euploea eynhovii stryx</em> - Striped Black Crow</td>
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<td><em>Euploea cameri cameri</em> - Spotted Black Crow</td>
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<td><em>Euploea diocletianus (radamantus) lowii</em> - Magpie Crow</td>
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<td><em>Euploea midamus clorinde</em> - Blue Spotted Crow</td>
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<td><em>Euploea modesta lorzae</em></td>
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<td><em>Euploea multiciber porita</em> - Striped Blue Crow</td>
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<td><em>Euploea sylvestre tyrianthia</em> - Double-branded Crow / Two-brand Crow</td>
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<tr>
<th>Subfamily: Satyrinae</th>
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<tr>
<td><em>Elymnias panthera labuana</em> - Tawny Palmfly</td>
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<td><em>Elymnias hypermenstra nigrescens</em> - Common Palmfly</td>
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<td><em>Elymnias nesaea hypereides</em> - Purple Bush Brown</td>
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<td><em>Elymnias panthera labuana</em> – The Tawny Palmfly</td>
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<td><em>Elymnias penang a kongo</em> - Pointed Palmfly</td>
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<td><em>Lethe delila</em></td>
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<td><em>Neorina lowii lowii</em> - Malayan Owl</td>
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<td><em>Mycalesis marginata</em> - The Common Bush Brown</td>
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<td><em>Mycalesis patiana</em> - Malayan Bush Brown</td>
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<td><em>Mycalesis anapita</em></td>
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<td><em>Mycalesis maianes</em></td>
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<td><em>Mycalesis mnisceles</em></td>
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<td><em>Mycalesis oris borneensis</em> - Purple Bush Brown</td>
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<td><em>Mycalesis fusca adustata</em> - Malayan Bush Brown</td>
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<tr>
<td><em>Mycalesis mineus macromalayana</em> - Dark Brand Bush Brown</td>
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<td><em>Mycalesis intermediam</em> - Intermediate Bushbrown</td>
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<td><em>Erites argentina argentina</em></td>
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<td><em>Coelites euptychioides euptychioides</em></td>
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<td><em>Ragadia makuta umbrata</em> - Striped Ringlet</td>
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<td><em>Ypthima pandocus Sertorius</em> - Common Three-Ring</td>
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<td><em>Ypthima fasciata</em> - Small Ring</td>
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<td><em>Xanthotaenia busiris burra</em> - The Yellow-barred/ The Uncertain Satyr</td>
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<th>Subfamily: Morphinae</th>
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<td><em>Amathusia schoerbergi</em></td>
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<td><em>Thaumantis odana panwila</em> - Godart's Jungle Glory</td>
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<td><em>Thaumantis klugius</em> – The Dark Blue Jungle Glory</td>
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<td><em>Thaumantis noureddin chatra</em> – Dark Jungle Glory</td>
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<td><em>Discophora necho cheops</em></td>
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<td><em>Faunis kira</em> – The Dark Faun</td>
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<td><em>Faunis stompax</em></td>
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<td><em>Ariadne ariadne ariadne</em> - Angled Castor</td>
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<th>Subfamily: Heliconiinae</th>
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<td><em>Laxita teneta</em></td>
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<td><strong>Family: Lycaenidae – Gossamer-wings</strong></td>
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<td><strong>Subfamily: Poritiinae</strong></td>
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<td><em>Simiskina phetria mama</em></td>
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<tr>
<td><em>Liphyra brassolis abbreviate</em> - The Moth Butterfly</td>
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<td><em>Miletus gopara eustatius</em></td>
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<td><em>Spaligis epius epius</em> - The Apefly</td>
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<td><em>Allotinus apires</em></td>
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<td><em>Allotinus horsfieldi nessus</em> – Horfield’s Darkie</td>
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<td><em>Allotinus leognor normani</em></td>
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<td><em>Logania malaya malaya</em> - Malayan Mottle</td>
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<td><em>Logania regina regina</em></td>
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<td><em>Logania massalia drucei</em> - Pale Mottle</td>
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<th><strong>Subfamily: Curetinae</strong></th>
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<td><em>Curetis tagalica jopa</em></td>
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<td><em>Curetis regula</em></td>
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<th><strong>Subfamily: Polyommatinae</strong></th>
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<td><em>Discolampa ethion icenus</em> - Banded Blue Pierrot</td>
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<td><em>Caleta elna elvira</em> - Elbowed Pierrot</td>
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<td><em>Neopithecops zaloma pertimicus</em> - The Quaker</td>
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<td><em>Megisba malaya sikkima</em> - The Malayan</td>
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<td><em>Jamides celena luwasa</em> - The Common Cerulean</td>
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<td><em>Jamides talinga</em></td>
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<td><em>Jamides celerus caeruleus</em> - Sky Blue</td>
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<td><em>Jamides epli virgulatus</em> - Glistening Caerulean</td>
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<td><em>Jamides alecto ageladas</em> - The Metallic Cerulean</td>
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<td><em>Nacaduba kurava nemana</em> - The Transparent Six-line Blue</td>
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<td><em>Nacaduba berenice akaba</em> - The Rounded Six-line Blue</td>
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<td><em>Prosotas dubiosa lampura</em> - The Tailless Lineblue</td>
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<td><em>Catopyrops ancyra almosa</em> - Ancyra Blue</td>
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<td><em>Anthene emolus goberus</em> - The Ciliate Blue</td>
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<td><em>Arhopala pseudocentaurus cervidius</em> - Centaur Oak Blue</td>
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<td><em>Arhopala lurida</em> - Lesser Disc Oakblue</td>
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<td><em>Flos anniella anniella</em> – The Darky Plushblue</td>
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<td><em>Iraota distanti nilelia</em> - Distant’s Silverstreak</td>
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<td><em>Amblypodia narada sylvia</em></td>
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<td><em>Spindasis syama frigidus</em> - Club Silverline</td>
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<td><em>Drina cowani</em></td>
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<td><em>Loxura cassiopeia amatica</em> - The Larger Yamfly</td>
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<td><em>Cheritra freja ochracea</em> – Common Imperial</td>
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<td><em>Ritra aurea aurea</em> - Orange Imperial</td>
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<td><em>Drupadia theda umara</em> - Dark Posy</td>
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<td><em>Drupadia cinesia</em></td>
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<td><em>Horaga syrynx maenada</em> - The Yellow Onyx</td>
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<td><em>Dacalanana vidura azaya</em> - The Double Tufted Royal</td>
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<td><em>Britomartis cleoboides igarashii</em></td>
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<td><em>Manto hypoleuca martina</em> - Green Imperial</td>
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<td><em>Hypolycaena mergua skapane</em></td>
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<td><em>Bindahara phocides phocas</em> - The Plane</td>
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</tbody>
</table>
Vagrans egista creaghana – The Vagrant
Vindula dejone dajakorum – The Cruiser
Cirrochroa emalea ravana - The Malay Yeoman
Cirrochroa malaya calypso
Cirrochroa satellita ilergeta - Satellite Yeoman
Cirrochroa aurissi orissides - The Banded Yeoman
Cethosis hypea hypea - Malay Lacewing
Phalanta alcippe alcippe –The Small Leopard
Terinos clarissa nympha
Terinos terpander terpander – Royal Assyrian

Subfamily: Nymphalinae
Hypolimnas bolina bolina- Blue Moon Butterfly/ Common Eggfly
Hypolimnas anomola olada - Malayan Eggfly
Bassorana dunya mahara – String of Pearls
Bassarona teuta – The Banded Marquis
Lexias canescens canescens - Yellow Archduke
Lexias pardalis dirteana- The Archduke /Common Archduke
Rapala varuna saha - The Indigo Flash
Araotes lapithis uraweila - The Witch

Family: Hesperiidae - Skippers

Subfamily: Pyrginae
Tagiades japetus balana – The Common Snow Flat

Subfamily: Hesperiinae
Pithauria marsena - Banded Straw Ace
Iambrix stellifer – The Starry Bob
Koruthaialos rubecula rubecula
Ancistroides nigrata muru - Chocolate Demon
Notocrypta paralysos varians - Common Banded Demon
Notocrypta curvifascia - Restricted Demon
Quedara monteithi
Isma protoclea iapis
Taractrocera ziclea
Potanthus omaha moesina - Lesser Dart
Potanthus confucius yojona - Chinese Dart /Confucian Dart

Notes:
The taxonomy used above follows that of Corbet and Pendlebury, 1978 with the exception that the Nymphalidae classification has been updated to follow currently accepted arrangements.
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<th>Family</th>
<th>Genus</th>
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<td>Gynura</td>
<td>sp. 4</td>
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</table>

**Table 4. Plant taxa from Teraja + Rampayoh + Mendaram**

Data from: 'A Checklist of The Flowering Plants and Gymnosperms of Brunei Darussalam'. 1996. Coode MJE, Dransfield J, Forman LL, Kirkup DW, Idris m Said
Icacinaceae
Phytolacca sp. indet.
Myristicaceae
Myristica volkameriana
Rubiaceae
Aida sp. nov.
Icacinaceae
Sarraciniaceae sp. indet.
Myristicaceae
Ardisia borneensis
Rubiaceae
Argostemma hamelii
Lauraceae
Actinodaphne borneensis
Myristicaceae
Ardisia breviflora
Rubiaceae
Argostemma sp. 5
Lauraceae
Actinodaphne glomerata
Myristicaceae
Ardisia korthalsiana
Rubiaceae
Canthium confertum
Lauraceae
Cryptocarya sp. indet.
Myristicaceae
Ardisia sp. 1
Rubiaceae
Canthium heridi
Lauraceae
Endandra sp. indet.
Myristicaceae
Ardisia sp. 2
Rubiaceae
Chosallo chartacea
Lauraceae
Litsea acadiens
Myristicaceae
Ardisia sp. 3
Rubiaceae
Chosallo sp. indet.
Lauraceae
Litsea cf. pathelisflora
Myristicaceae
Ardisia sp. indet.
Rubiaceae
Diplopora sp. indet.

Goetghere vaginatis sp. junguhhians

Lauraceae
Litsea ferruginea
Myristicaceae
Ardisia steineriana
Rubiaceae
S. j.
Lauraceae
Litsea grandis
Myristicaceae
Embelia sp. indet.
Rubiaceae
Geophila pilosa
Lauraceae
Litsea lanceifolia
Myristicaceae
Labisia pumilla
Rubiaceae
Gynopachis jambosoides
Lauraceae
Litsea oppositifolia
Myristicaceae
Meosa ramentacea
Rubiaceae
 Hedysiotis capilliflora
Lauraceae
Litsea rubiconula
Myristicaceae
Meosa sp. indet.
Rubiaceae
Hedysiotis congesta
Lauraceae
Litsea sessilis
Myrtaceae
Syzygium castaneum
Rubiaceae
Ixora brachyantha
Lauraceae
Litsea sp. indet.
Myrtaceae
Syzygium caudatum
Rubiaceae
Ixora caudata
Lauraceae
Nothaphanohedra heterophylla
Myrtaceae
Syzygium confertum
Rubiaceae
Ixora pyrantha
Lauraceae
Pseudoxylon metapangga
Myrtaceae
Syzygium fastigiatum
Rubiaceae
Ixora sp. indet.

Syzygium

Lycidithaceae
Barringtonia acutangula sp. acutangula
Myrtaceae
Syzygium incarnatum
Rubiaceae
Lasiathanus borneensis
Leguminosae
Bauhinia campanulata
Myrtaceae
Syzygium linearum
Rubiaceae
Lasiathanus chrysaeus
Leguminosae
Bauhinia sp. indet.
Myrtaceae
Syzygium megaphyllum
Rubiaceae
Lasiathanus longifolius
Rubiaceae
Lasiospathus reticulatus
Verbena species
Sphenodesme triflora var. riparia
Rubiaceae
Lasiospathus species
Verbena species
Tejmanniodendron simplipilis
Rubiaceae
Morinda jambos
Verbena species
Tejmanniodendron sp. indet.
Rubiaceae
Morinda sp. indet.
Verbena species
Vitex sp. indet.
Rubiaceae
Myrmeconauclea crassipes
Vitaceae
Ampelocissus imperialis
Rubiaceae
Nasella sp. indet.
Vitaceae
Ampelocissus winleri
Rubiaceae
Nasella subtilis
Vitaceae
Cissus sp. indet.
Rubiaceae
Neonauce sp. indet.
Vitaceae
Pteris antunesi grands
Rubiaceae
Ophiocarpha winkleri
Vitaceae
Pteris antunesi polita
Rubiaceae
Pavetta multiflora
Vitaceae
Tetrastigma pedunculare
Rubiaceae
Pleionocardia paniculata
Zingiberaceae
Alpina giraba
Rubiaceae
Porterandia anisophylla
Zingiberaceae
Alpina hainanensis
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Porterandia pauciflora
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Tarenna sp. indet.
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Zingiberaceae
Etingera velutina
Rubiaceae
Timonox flavescens
Zingiberaceae
Globba atrorsanginacea
Rubiaceae
Uimpania gambir
Zingiberaceae
Globba brachyandra var. rubra
Rubiaceae
Uimpania sp. indet.
Zingiberaceae
Globba sp. indet.
Rubiaceae
Uimpania sp. indet.
Zingiberaceae
Globba sp. indet.
Rubiaceae
Unophyllum arboeum
Zingiberaceae
Hedychiyum muluense
Rubiaceae
Unophyllum hirsutum
Zingiberaceae
Hornstedia reticulata
Rubiaceae
Unophyllum nigricans
Zingiberaceae
Hornstedia scottiana
Rubiaceae
Unophyllum sp. indet.
Zingiberaceae
Plagioastrachys crassodendry
Rubiaceae
Xanthophyllum brookei
Zingiberaceae
Plagioastrachys strabiflora
Rutaceae
Azarocha sp. indet.
Zingiberaceae
Zingiber longipendulcamum
Rutaceae
Euodia latifolia
Zingiberaceae
Zingiber sp. D

Rutaceae
Tetractonia tetrandrum
Rutaceae
Allophyllus cobbe

Theaceae
Gordonia sp. 5
Rubiaceae
Aida sp. nov.

Thymelaeaceae
Amyua plicanisia

Rutaceae
var crenata
Thymelaeaceae
Aquillonia beccariana

Rutaceae
Gonystylus borneensis

Trigoniaceae
Trigonium punctatum

Rutaceae
Tubuliflorus sp. indet.

Trigoniaceae
Trigonostemon rubra

Rutaceae
Uncaria sp. indet.

Trigoniaceae
Tristagma sp. indet.

Rutaceae
Vernonia sp. indet.

Trigoniaceae
Widgirothia sp. indet.

Rutaceae
Xanthoxylum sp. indet.

Trigoniaceae
Widgirothia sp. indet.

Rutaceae
Zizyphus sp. indet.

Trigoniaceae
Widgirothia sp. indet.

Rutaceae
Zingiberaceae

Trigoniaceae
Widgirothia sp. indet.

Rutaceae
Zingiberaceae

Trigoniaceae
Widgirothia sp. indet.

Rutaceae
Zingiberaceae

Trigoniaceae
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Rutaceae
Zingiberaceae

Trigoniaceae
Widgirothia sp. indet.

Rutaceae
Zingiberaceae

Trigoniaceae
Widgirothia sp. indet.
Full Reports

Butterflies by V. Hitchings

Two data sources have been used to compile a list of butterflies for the Teraja-Labi area, field visits and a review of historical data. The information was compiled to generate the list of the butterflies presented here.

The field visit was made on 18th April 2010 from 09.30 to 16.00. The area examined was chiefly around the Teraja Longhouse and the adjacent forest along the river and the paddy fields.

Historical Records provide a wealth of data on the butterflies of the Teraja-Labi area and provide data from more field hours than could otherwise be undertaken in a short space of time. In 1986 R.R. Herd prepared a volume entitled ‘A Photographic Reference List to Bruneian Butterflies’. This volume compiled a photographic record of set specimens from the butterfly collections of R.R. Herd, Gys Boot, Rodger Fullbrook, Mickle Schreurs, Richard Stewart and Alan Stubbs. Nine of the locations in the volume are encompassed by the current area of interest or are sufficiently close to be significant. The locations are as follows:

1. Labi Road - Belait River, 60m, all the collecting that I have done here was along the dirt road. The surrounding vegetation is secondary forest and scrub.
2. Kampong Ubok Ubok, 60m
3. Milestone R.10 (Sungai Rampayoh milestone), 100m, an area of primary forest bordering a logging track
4. Labi Ridge, 200m, Primary lowland forest.
5. Labi, 60m, A cultivated area amongst secondary forest and scrub
6. Labi - Rv. Rampayoh, 60m, there is a path here that leads to ‘the waterfall’ - both lowland primary and secondary forest is located here.
7. Labi - Rv. Menderam, 60m, there is a path here leading to two waterfalls. Both lowland primary and secondary forest is located here. Past Labi on Roadside, 60m. Once the Labi Road crosses Sungai Rampayoh it becomes a dirt road, bordered by scrub and secondary forest. Behind this vegetation lies swamp forest to the west and lowland primary forest to the east.
8. End of Labi Road and Sungai Teraja, 120m, lowland primary forest.
9. Bukit Teraja, 442m, lowland primary forest.

The species list that includes the locations above includes a list of 170 butterflies in the area. Under the Darwin Initiative a collaborative project was undertaken between the Universities of York and Leeds, in the U.K., the natural History Museum in London, the Institute for Tropical Biology and Conservation Universiti Malaysia Sabah and the Forest Research Centre Sabah Forestry Department. The aim was to develop predictive tools for targeting Conservation Efforts in Bornean Forest Reserves. As part of the initiative a database, dubbed D2B2, was created with distribution information for butterflies on Borneo (i.e. Malaysia (States of Sabah and Sarawak), Indonesia (Kalimantan) and Brunei Darussalam). Data contained within the database were extracted from information on the labels of museum specimens. Data were collected in 2006-07 from a total of 10 museums in Malaysia, Brunei, UK, and the Netherlands. Additional information was also obtained from 12 published Journal papers, two field reports and two University PhD theses. It should be noted that these data cover three butterfly families, the Papilionidae, Pieridae and Nymphalidae). Three locations occur within the Labi-Teraja area:

1. Rampayoh mixed dipterocarp forest
2. Labi Road [adjacent to Rampayoh]
3. Bukit Teruja

The list of butterflies from these locations has been extracted from the database (table 3). Field work by the author added several species to the list from historical records and these are marked [VHH]. In total 233 species have been recorded from the study area.
Conclusions

✓ A total of 233 butterfly species have been recorded from the study area. It should, however, be noted that this list is not exhaustive and without doubt more species are to be found and recorded.

✓ The most significant butterflies on the current list are *Trogonoptera brookiana brookiana* Rajah Brooke’s Birdwing and *Troides miranda Miranda* The Miranda Birdwing. These are both protected species according to the CITES treaty.

✓ Butterflies are known to be environmentally sensitive organisms, hence their use in the Conservation of Bornean Forest Reserves project. The list of species in this study provides a baseline for any future butterfly studies for Labi-Teraja.

References


PREDICTIVE TOOLS FOR TARGETING CONSERVATION EFFORT IN BORNEAN FOREST RESERVES. http://www-users.york.ac.uk/~jkh6/index.htm
Teraja Fish survey 17-18 April 2010 recorded by Novi Yus

Team led by Etienne. Participants: Nick, Novi, Amelie, Rainette

Program:

Wasai Teraja 17 April. Stop at 4 different fishing areas
Time: 13:00 pm finish at 15:00 pm; cloudy and some times rain.

Wasai Beludok 18 April. Stop at 3 different fishing areas.
Time 9:00 am finish at 11:00 am

Equipment:

Small net held by 2 long poles, 1 m wide; wide throw net, 2,5m long and 5m wide, with long rope at the end of the net; 2 small round nets, each 30 cm wide, 40 cm high; 2 buckets

Ecology and Habitat:

Wasai Teraja

Wasai Teraja is fed by several streams with waterfalls from the drainage area up to the watershed between Teraja Protection forest and Brunei national border. The forest beside the river was rich in vines and undergrowth, Plant debris litters the forest floor and many big log have fallen across the river. The canopy is thick and continuous, the soil damp and sandy in most places. Stream was clear but in some places slightly muddy from soil erosion.

We started to walk from Teraja Longhouse follow the foothpath to the forest, first stop in the wide river near the landslip that exposed a rocky slope. Then continue to sandy area where the path crosses the sg not far from the first stop. The third stop was at the first Teraja waterfall which is quite far from the first and second sample area’s. The fourth stop is immediately upstream from the waterfall, which required a short climb.

1. First stop, after the secondary forest mix with bamboo forest. Soil and rock erosion is prevalent. Several treefalls both on the land and in the river resulted in stagnant water ponds, that form a safe hiding place for the fish. We used a large throw net and caught many fishes from 1 family. 3 times netting with the same result we decided to move on.

One family, 8 fish specimen, size from 4 to 7 cm. Family: Cyprinidae Genus Puntius

2. Second stop, resembled a sandy beach area, with sandy soil at the flat open area and muddy fine clay on the sides and bottom river, here the forest had opened up. The river runs clear, 30cm to 1 meter deep and 2-4 m wide river. Low current were some places along the river are calm and near stagnant. We used both the throw net and fish net here. The halfbeak fishes were caught easily by small net, after observing its movement from above. The bigger fish from Cyprinid family were caught in deeper water using the throw net.

Two different families, have 3 different species and more than 10 specimens. Fishes range from 5 cm to 17 cm. Family: Hemiramphidae and Cyprinidae

3. Third stop, at the Teraja waterfall. The bottom stream is silt, with rounded sandstone pebbles and smooth porous friable sandstone rocks covered with algae. The water is slightly muddy. Wide open area and on both sides the waterfall has thick forest canopy. We used the bottom net; (a long net weighed down with stones, resting on the bottom of the river). Leave it for an hour and collect it later. Also use throw net and netting. We didn’t find any fish here. In front of the deep pool, the river passes a shallow rocky, stoney area were water become clear and in some places had strong current especially at narrow stream where the turbid water moves around big rocks. The water vegetation with wide spread branches and small leaves, has strong spread roots rooting in the rocky soil under the water. Etienne throw net several times at several places on this area. But we didn’t catch any fish here.

Note: when swimming in the waterfall several times previously, we saw small fishes and shrimp in the water nearby us and felt the pinch from their bites, the absence of the fish on the research day probably due to a flash
flood caused by the heavy rain the night before on 16 April 2010.

4. Fourth stop upstream above the waterfall. Here few cascading small waterfalls and calm stream. The bottom of the stream is smooth sandstone, slippery from algae. As the stream near to the end of waterfall the movement of the water is quite fast as a result is no detritus found in the bottom, only in a few places were it caught by roots. Observed from above it has small prawn and small fishes which we can’t identify and could not catch as they were very agile. We uses throw net and catch school of young fish.

Family: Channidae, more than 20 specimens some we released back to the water.

**Beludok Waterfall**

Is a more than 30m meter high rocky waterfall with debris of logs, branches, stones and big rocks at the bottom, no distinct pool, the stream is not wide with shallow water about 20 cm to 60 cm deep. Surrounded by large rocks and thick forest. We start from the waterfall as the first sample location, then the small stream nearby. The third stop is nearby the waterfall as well but at wider stream.

1. First stop is on the Beludok Waterfall area, the area is littered with many logs and rocks, and the stream water is shallow, clear and appears calm. The bottom of the stream is rocky, subrounded gravel, at some part under the big rocks area is sandy soil about 20cm to 40 cm deep, were small shrimps and small fish find a hiding area. We observed the fish from above and caught using the small net.

One Family: Cyprinidae 1 specimen; 4 cm long and we released the specimen back to the water after taken a photograph. Later we can’t determine the genus of this small specimen, should keep the specimen for further identification. The other fish is Genus: Rasbora

2. Second stop not far from the waterfall, has a lot of logs, branches and debris. The bottom is rocky, stone as well gravel and falling trees

1 family: Cyprinidae, 1 specimen and we released back to the water after photograph.

3. Third stop is on the stagnant water like a pond, the canopy is open up with many palm and rattan trees. The water is calm; the bottom of the stream is muddy, clay soil with debris from florest floor, many fallen leaves and dead branches. This area is rich with small fishes as many detritus at the bottom of the stream. It is a deep stream with many hiding places for the fishes making it very difficult to catch, try several times with throw net but the net was caught by spiny vegetation and dead branches beside the narrow river. We should use different method and equipment in the future. Caught 1 juvenile, possible halfbeak fishes and released back after the photograph. Didn’t determine the family of this fish as it is difficult to identify the juvenile fish’s size less than 1 cm.
Appendix 2. Preparation and HSE

PNHS Teraja survey weekend April 17-18 2010 preparation notes

Meeting point: Teraja longhouse at 10.30 on Saturday

Program for the weekend April 17,18 (times are indicative/flexible):

On the weekend April 17,18, we plan a short program discussion at the Teraja longhouse, an initial screening of the area, and we will start the survey. The survey can be continued in follow-up weekends as appropriate per survey topic.

10.30 Arrive at longhouse: Discussion of objectives, program, area and organization of survey
12.00 Lunch at longhouse
13.30 Easy walk to waterfalls and start of survey by participants
17.30 End of main program and option to return home

For those who stay overnight:
Dinner
Possibility of night walk
Next day: Continue initial survey.

Organisational responsibilities

Overall coordination Peter Engbers & Jacqueline Henrot & Hans Dols
Longhouse liaison Hans Dols & Novi Yus
Scientific program coordination Jacqueline Henrot
HSE coordinator David Mendes
Journey Management & Welcome Silene Engbers
Food managers Folkert Hindricks, Tom Crampin

Expected outputs of the survey:

1. Annotated checklists of biota, highlighting the biodiversity of the site, the species of conservation concern and the common species (likely to be spotted by tourists. Photographs and short description (aspect and habitat) of selected species.
2. Annotated trail maps of the Teraja area, with length, hardship, habitats, highlights etc.
3. Teraja biodiversity photo album, checklists and selected trail maps (printer friendly) downloadable maps from the PNHS website.

Goals of the survey:
The survey should result in an appraisal of its flora, fauna, folklore, as well as an evaluation of its eco-tourism potential, in specific:

- raise the profile of the area to promote its conservation,
- gather scientific evidence of its value for conservation,
- provide an overview of the ecotourism potential of the area
- involve the local community in the conservation effort and the ecotourism development

By explicitly describing its value in terms of biodiversity and potential for ecotourism, we hope to have leverage material to lobby for its conservation/protection.

Significance of the Teraja area:

- It is a piece of fairly undisturbed forest that is quite accessible and eco-touristically interesting
- It is used by local people who still hold the traditional knowledge & legends
- New plant taxa have been described from the area and researchers value the site.
- It holds various habitats: swamp, ridge, waterfalls, rivers - therefore a diverse flora and fauna.
- It is under threat by developments as highlighted in PNHS report to the HoB council
Participation for weekend April 17,18 (status as per April 10)

Role of the PNHS:
- liaise with the Teraja longhouse (which would host the survey and will be paid for their help)
- contribute as field assistants
- compile & if necessary edit the survey reports
- publish the survey results on its website
- map the trail systems

Team composition for April 17/18

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<th>Teams</th>
<th>Team suggestion April 17-18</th>
<th>Trail mapping (HS GPS)</th>
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<td>In field</td>
<td>Team composition</td>
<td>Mapping + Track</td>
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<td>Butterflies + Plants</td>
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<td>David Mendes, Jackie Maskall</td>
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<td>Dedicated Trail mapping Team 2</td>
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| At longhouse | |
| Geology & history | Nick Hoggmascall, Hans Dols |
| Forest use (food, medicine, crafts) | Novi Yus, Jackie Maskall |
| Local folklore /legends | Novi Yus, Jackie Maskall |
Cost
Participants are expected to volunteer their time, expertise, survey equipment, and make own transport arrangements (car pooling!?). The PNHS will cover the cost of food & accommodation & services as provided by the longhouse (for weekend April 17-18)

Organisation
All participants are responsible for own transport to longhouse. Suggest to car pool. We can make arrangements on pre-meeting.

All people should take their own survey material and tour/safety provisions. All teams should take first aid equipment, safety provisions, some food, and water.

The night at longhouse is on the public front area floor. Please take your own mattress and sleeping needs. There is no shower. Washing can be in the river.

PNHS will together with longhouse take care of lunches, breakfast, and dinner.

Suggested Items to bring:
1. Global Positioning System (GPS)
2. Personal First Aid Kit
3. Whistle and Pocket knife
4. Insect repellent
5. Flashlight (spare bulb and extra batteries) or Head lamps, strong night lamp
6. Camera (extra batteries), binoculars
7. Leech Socks and extra socks
8. Hat and Rain Coat
9. (Long) Sleeved T-Shirts, (Long) Pants for during trekking, Swim wear, and towel
10. Extra clothes
11. Slippers, Trekker Boots
12. Spare Plastic Bags (to store camera in case of rain and to pack clothing)
13. Drinking Water
14. Garbage Bags, Water tight proof bags
15. Backpack
16. Mattress and sheet bag (blanket/sleeping bag for cold blooded)
17. Personal Toiletries (tooth brush, paste, body soap, shampoo, toilet paper and etc.)
18. Personal Items (plastic food container i.e. plate, fork, spoon and cup?)
19. High energy snacks (+lunch box?)
20. Survey equipment

Suggested shopping list (1 dinner, 1 breakfast, 2 lunches) for food management team
- Water
- Coffee/Tea/Sugar/Milk
- Juice
- Drinks
- Bread
- Jam
- Peanut butter
- Carrots
- Apples
- Snacks and energy bars
- 1 Evening meal (together with longhouse food??)
- Toilet Paper

Trails recommended for survey and trails to explore

Trails recommended for survey (see maps). These are recorded and available for download to GPS:
- Teraja waterfalls
- Bkt Teraja from road and from Teraja waterfalls
- Mendaram waterfalls
- Rampayoh waterfalls
- Telingan waterfalls
Trails to explore and record:

- Beludok waterfall from longhouse
- Further continue along Teraja river past waterfalls towards border
- Confirm trail from Teraja waterfalls upto ridge on way to Bkt Teraja
- Old Teraja-Marudi log walk (tracks into peat swamp)
- Tracks through rice paddies opposite longhouse
- Bkt Teraja- Rampayoh waterfalls (full day)
- Mendaram- Rampayoh waterfalls
- Record new Bkt Teraja forestry road
- Any entrances from East (Belait ridge logging road)?
- Any other?

Trail info to prepare:

- GPS track
- Category
- Length and time
- Points of interest (viewpoint, waterfall, etc)
- Habitat and natural history points of interest
- Special points (warnings, risks, highlights)

Participants & Topics

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<tr>
<td>Jacqueline Henrot</td>
<td>plants</td>
<td>Intan Dols</td>
<td></td>
</tr>
<tr>
<td>Nick Hoggmascall</td>
<td>fishes</td>
<td>Coenraad Dols</td>
<td></td>
</tr>
<tr>
<td>Novi Yus</td>
<td>forest use, fishes</td>
<td>Intan Dols</td>
<td></td>
</tr>
<tr>
<td>Jackie Maskall</td>
<td>Insects, forest use</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Best regards,

For PNHS,

Peter Engbers, Jacqueline Henrot, Hans Dols,
HSE Plan prepared by David Mendes

Emergency contact directory:

Gov. Ambulance emergency - 991 – coordinated by KB hospital – nearest ambulance
BSP emergency 337-2999 or 3229999
Panaga Medical emergency 337 2200 – can coordinate a medical emergency
Government BOMBA - 995
Search and rescue coordination center (army) 998
Switchboard 2423901 / 2459500

Other contacts:

SG Liang Clinic 32304287 /438
24 hours ambulance; Doctor –office hours
Labi Clinic (Thursday s only) 3233210 /216
Panaga Duty Doctor 337 3779
BSP Bomba-Control Room 337-4116
Belait District Officer
Hj Jamain B Hj Office :3334566
Momin (D/L) 3331600
Home :3334269
Fax :3331848

What to do in case of emergency @ location? Personal injury.

- Raise alert to base camp if possible
- Make area safe and ensure your own safety before intervening
- carry any injured person to safety
- Take your position on GPS and try to establish contact with base camp via sms / radio providing details of emergency and GPS coordinates
- Assess situation and best course of action (head back / wait for help)
- Communicate your decision to base camp and plan.
- You may have to look for signal in high areas or call for help in no communication possible – care should be taken not to get lost.
- Any victim should be accompanied by another person at all times
- Stretcher available at base camp
- Bomba and search and rescue team can be activated in serious case

What to do in case of emergency @ base camp

- Obtain details of injury and exact coordinates (confirm by repeating back)
- Assess situation and call for ambulance / bomba if required.
- Obtain information from medical team if needed on what to do.
- Call all teams to base camp to head count and support any rescue.
- Ultimately Search and rescue team can be activated.
What to do not to get lost:

- Ensure that you have registered at the base camp and provided details of your plans and expected time back.
- Always stick to the group (min 3 pax) and do not wander on your own.
- Monitor compass to have a feel for your bearing.
- Return to base in case of GPS failure.
- Watch for other members of the team and do not allow them to split from group.
- Carry extra supplies of energy food and extra water and or purifying tablets.

What to do in case you get lost:

**STOP > Sit, Think, Observe and Plan.**

- **Stay Calm and Stay Where You Are.** If nobody is in danger, then don't move. Wandering in the forest only befuddles those searching for you.
- **Take note of your position.** Try to establish contact with base camp and provide your position or last known position / area.
- **Prepare Your Own Signals.** Be aware of rescuers trying to signal and make contact with torchlights, whistles, tree drumbeats or shouts.
- **Take an Inventory of Supplies.** Water, food, dry clothes and material for shelters are all essential items.
- **Conserve Body Heat and Energy.** Do not risk getting cold or wet to allow hypothermia to creep up; wear multiple layers and stay under shelter.
- **Move Away From Hazards.** Don't risk your safety being exposed to strong winds, rain or lightning, move nearby and leave a sign - trail tag or rock marker - at your last stop.
- **At Dark, Get Rest.** Don't travel at night and light a fire if possible; switch-off on guard duty to watch for rescue signals.

How to deal with:

_Snake Bite:_

**Signs of Snake Bites**

If you have to walk in high water, you may feel a bite, but not know that you were bitten by a snake. You may think it is another kind of bite or scratch. Pay attention to the following snake bite signs.

Depending on the type of snake, the signs and symptoms may include:

- A pair of puncture marks at the wound
- Redness and swelling around the bite
- Severe pain at the site of the bite
- Nausea and vomiting
- Labored breathing (in extreme cases, breathing may stop altogether)
- Disturbed vision
- Increased salivation and sweating
- Numbness or tingling around your face and/or limbs

**What To DO if You or Someone Else is Bitten by a Snake**
• Remain calm. Two out of 3 victims are injected with very little or no venom. In the latter case, no specific treatment is required. Venomous snakes use their venom to kill their prey. If molested, they bite in defence, and usually do not inject their venom.

• Identify the snake if it is safe to do so. This is very important if the doctors are to give the right antidote. Injecting the wrong type of antivenin is not only useless, but may also endanger the victim’s life.

• Apply first aid if you cannot get the person to the hospital right away.
  - Lay or sit the person down with the bite below the level of the heart.
  - Tell him/her to stay calm and still.
  - Cover the bite with a clean, dry dressing.

• DO NOT attempt to cut or suck the wound. Apply a simple bandage and keep the bitten area lower than the level of the heart if possible. Go to the hospital, do not await the development of symptoms. If you are the victim and all alone, then walk slowly. Do not run for help.

• The correct antivenin is the only treatment of proven value. Panaga Health Centre stocks antivenin of all commonly encountered snakes in Brunei, and doctors are capable of treating snakebites and cases of adverse serum reaction and shock.

• Prompt medical treatment, reassurance and bed-rest are the keys to a full recovery.

Insect bites and stings (severe reactions):

1. Bites on mouth or throat / multiple bites – return to base.
2. Check the person’s airways and breathing. If necessary, call emergency and begin rescue breathing and CPR.
3. Reassure the person. Try to keep him or her calm.
4. Remove nearby rings and constricting items because the affected area may swell.

General steps for most bites and stings:

1. Remove the stinger if still present by scraping the back of a credit card or other straight-edged object across the stinger. Do not use tweezers -- these may squeeze the venom sac and increase the amount of venom released.
2. Wash the site thoroughly with soap and water.
3. Place ice (wrapped in a washcloth) on the site of the sting for 10 minutes and then off for 10 minutes. Repeat this process.
4. If necessary, take an antihistamine, or apply creams that reduce itching.
5. Over the next several days, watch for signs of infection (such as increasing redness, swelling, or pain).
### Risk assessment matrix

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Guide word / Hazard</th>
<th>Threats / consequences</th>
<th>Controls</th>
<th>Recovery</th>
<th>Team Review</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Evacuation</td>
<td>False emergency / not knowing how to use it</td>
<td>Establish best means of evacuation depending on condition of casualty Identify nearest ambulance (Telau bomba?)</td>
<td>Organise rescue party but without adding any risks Ultimately Contact Bomba / Army</td>
<td>Nearest medical clinic is at Mukim Labi 3233210 next nearest is at Bukit Sawat 3323673 <a href="http://www.information.gov.bn/bunridary_content/hospital_clinic/hospital_clinic_list.html">http://www.information.gov.bn/bunridary_content/hospital_clinic/hospital_clinic_list.html</a></td>
<td>1. Borrow radios? - check TSW 2. Provide mobile phone number @ the base to all participants 3. All participants to carry and provide their mobile phone number. 4. Establish protocol for GPS coordinates 5. Briefing: Ask personnel if they can obtain coordinates from the GPS - right format 6. Brief all on protocol for GPS coordinates. 7. List of emergency contacts at base camp 8. Base camp has a phone? Number? 9. Prepare emergency contacts list - david 10. Emergency contacts list to be available at the base camp 11. Carry toilet paper to mark trail</td>
</tr>
<tr>
<td>3.</td>
<td>Overall management of teams</td>
<td>False emergency / not knowing how to use it</td>
<td>Journey plan for long expedition and possible evacuation points</td>
<td>“ Planned itinerary” sheets</td>
<td>Nearest medical clinic is at Mukim Labi 3233210 next nearest is at Bukit Sawat 3323673 <a href="http://www.information.gov.bn/bunridary_content/hospital_clinic/hospital_clinic_list.html">http://www.information.gov.bn/bunridary_content/hospital_clinic/hospital_clinic_list.html</a></td>
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<td>1.</td>
<td>Personnel getting distracted and lost</td>
<td>False emergency / not knowing how to use it</td>
<td>Use paper to mark itinerary</td>
<td>“ Planned itinerary” sheets</td>
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<td>1. Prepare guidelines if lost 2. Brief all on Guidelines if lost 3. Brief - recommended to carry extra energy food / water / purifying tablets 4. Add compass + purifying tablets to list of equipment</td>
</tr>
<tr>
<td>2.</td>
<td>Environmental Hazards</td>
<td>False emergency / not knowing how to use it</td>
<td>No issue?</td>
<td></td>
<td></td>
<td>1. Prepare guidelines if lost 2. Brief all on Guidelines if lost 3. Brief - recommended to carry extra energy food / water / purifying tablets 4. Add compass + purifying tablets to list of equipment</td>
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**Notes:**
- Ref: Reference number
- Guide word / Hazard: Description of the hazard
- Threats / consequences: Details of the potential threats or consequences
- Controls: Measures to control the hazard
- Recovery: Steps to take in case of failure of the control measures
- Team Review: Actions for the team to take in case of an emergency
- Actions: Further actions to be taken by the team or other stakeholders
<table>
<thead>
<tr>
<th>Poisonous plants and animals;</th>
<th>1. Health hazard / skin/ eye reactions</th>
<th>Possible due to nature of work</th>
</tr>
</thead>
<tbody>
<tr>
<td>lightning strikes;</td>
<td>2. Electrocuton</td>
<td>It is a possibility on ridge / primary forest</td>
</tr>
<tr>
<td>bee and wasp stings; snake, spider, centipede</td>
<td>3. Anaphylactic shock; blocked airways (bites in mouth or throat); Death</td>
<td>Low risk but possible</td>
</tr>
<tr>
<td>and leech bites; rattan thorns; overexposure to wind, rain or sun;</td>
<td>4. Eye injury; Infection</td>
<td>No issue</td>
</tr>
<tr>
<td>improper jungle clothes;</td>
<td>5. Equipment Hazards</td>
<td>May be an issue for long trails with dense vegetation</td>
</tr>
<tr>
<td>faulty torchlights; ill-fitting backpacks; missing equipment parts; GPS; Compass</td>
<td>6. poor footwear; too heavy gear;</td>
<td>Common that old footwear’s sole detaches</td>
</tr>
<tr>
<td>missing food and water supplies</td>
<td>7. Lacking food and water supplies</td>
<td>14. Briefing notes - List recommended energy food to bring</td>
</tr>
<tr>
<td>Human jungle experience;</td>
<td>8. Any participants with no jungle</td>
<td>15. Advise to take extra energy food just in case.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16. Add question to indemnity form</td>
</tr>
</tbody>
</table>