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Bukit Nanas the Biodiversity Gem of Kuala Lumpur

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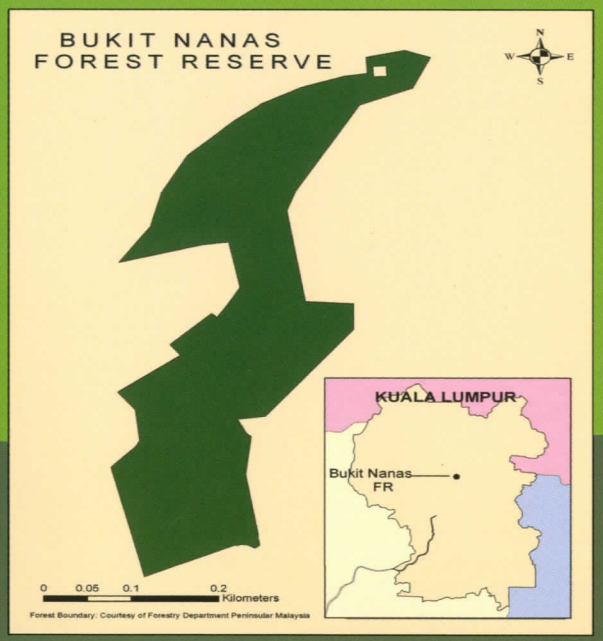

Map of Bukit Nanas Forest Reserve

How many capital cities have a rain forest in their midst? The Bukit Nanas Forest Reserve (3°09' N, 101°42' E), although an isolated forest island in the centre of bustling Kuala Lumpur, is a significant green lung. Considering its small size, it is a surprise to still find a variety of plant species, including big trees and endemic species within it (Putz, 1978). Due to its easy accessibility, it is botanically well researched. The first Bukit Nanas herbarium specimen dates from 1901, and by 1940, 299 species had been collected by Forest Department staff. The survey by the Forestry Department of Peninsular Malaysia (JPSM) in 2007 reported 259 species. We were interested to find out what flora still remained after about a decade. Also, does the forest still have value as a place for education and research?

Over the period of one year, we visited every month, collecting specimens as a permanent record, resulting in 324 forest species, an increase of 65 species over the 2007 survey (Norzielawati *et al.*, in prep). Our first surprise was the number of very large trees over a metre in diameter. The record was the fig, *Ficus vasculosa* with a dbh (diameter at breast height) of 124 cm, closely followed by jelutong (*Dyera costulata*) with a dbh of 120 cm, and *Neesia malayana* with a dbh of 110 cm. The second surprise was the number of dipterocarps (16 species) that formed the emergent layer together with trees of *D. costulata, Gluta curtisii, G. wallichii, G. malayana, Mesua ferrea, N. malayana* and *Palaquium obovatum*. Despite its chequered history, BNFR has retained the typical three-layered tree structure of a lowland dipterocarp forest. According to JPSM, Bukit Nanas FR was never logged, and this could account for the presence of the many dipterocarps and the enormous, old trees in this forest (JPSM, 2007).

The second layer, the main stratum at about 24–36 m high, is dominated by a variety of medium-sized trees typical of lowland forest, such as *Calophyllum inophyllum, Canarium littorale, Dacryodes costata, Pouteria malaccensis, Santiria apiculata, Sindora coriacea* and the large palms, *Arenga westerhoutii* and *Oncosperma horridum*.

The understorey and ground layers are occupied by smaller, shade-tolerant trees, saplings of the upper two layers, shrubs and herbs where *Aglaonema simplex, Chassalia chartacea, Phaeanthus opthalmicus, Tacca integrifolia*, and *Thottea tricornis* are common.

Endemic, rare and threatened species

The forest structure is not only still intact but includes species typical of lowland rain forest. It is also home to species of conservation importance and species endemic to Peninsular Malaysia. Although we found 16 endemic species (Table 1), it is worrying that this is a reduction from the 35 endemics recorded earlier. Encroachment and reduction in the size of the forest area are probably major causes of this reduction. However, we were delighted to rediscover *Tarrena rudis* which was first recorded from BNFR 87 years ago. It is endemic to Selangor.

The history of Bukit Nanas

- The site of pitched battles between Raja Mahadi and Raja Abdullah in the 19th century.
- Had a fort where prickly pineapples were planted all around to deter barefoot attackers, hence named Bukit Nanas (bukit = hill; nanas = pineapple).
- In 1900, 17.5 ha were gazetted as the Weld Hill Forest Reserve, the oldest forest reserve in the country.
- Name changed to Bukit Nanas Forest Reserve (BNFR) in 1930, later gazetted as a Wildlife Reserve and Bird Sanctuary in 1934.
- In 1950, the central pristine section of about 5 ha was gazetted as a Virgin Jungle Reserve (VJR) for research purposes.
- In 1996, the KL Tower was built.
- BNFR has been reduced to 9.37 ha because of development.
- In 2009, this last remnant of pristine forest was officially renamed KL Forest Eco Park but it is still locally known as Bukit Nanas.

Habit and fruits of *Tarrena rudis*, a species endemic only to Selangor.

We also found several species that are categorized as Near Threatened (NT), such as *Anisoptera costata, Magnolia montana, Memecylon campanulatum* and *Shorea sumatrana*. Of conservation concern is the single giant tree of *S. sumatrana* (dbh 108 cm) (IUCN, 2016). We fear that continuous development around the BNFR and degradation of the forest area due to infrastructure development, like paths, canopy walk, cable car, etc., will result in a reduction in the number of endemic species and loss of the Near Threatened species.

Table 1. List of species endemic to Peninsular Malaysia found in Bukit Nanas Forest Reserve.

No.	Species	Family
1	*Anodendron wrayi*	Apocynaceae
2	*Artocarpus hispidus*	Moraceae
3	*Barringtonia fusiformis*	Lecythidaceae
4	*Dichapetalum griffithii*	Dichapetalaceae
5	*Diospyros argentea*	Ebenaceae
6	*Gluta curtisii*	Anacardiaceae
7	*Kostermansia malayana*	Malvaceae
8	*Oxyceros fragrantissimus*	Rubiaceae
9	*Oxyspora bullata*	Melastomataceae
10	*Palaquium maingayi*	Sapotaceae
11	*Pellacalyx saccardianus*	Rhizophoraceae
12	*Ryparosa fasciculata*	Achariaceae
13	*Scaphocalyx spathacea*	Achariaceae
14	*Schismatoglottis scortechinii*	Araceae
15	*Syzygium inophyllum*	Myrtaceae
16	*Tarenna rudis*	Rubiaceae

Threats to the Forest Reserve

With progressive development around the area, BNFR is isolated in a sea of urbanisation. The reduction in size from its original 17.5 ha to the present 9.37 ha means that the core area has become smaller in proportion to the extent of the margin, resulting in the remaining forest being vulnerable to edge effects where conditions of high light, high temperatures and low humidity encourage invasion by secondary and naturalised weed species, thus preventing the growth and regeneration of the primary rain forest species (Latiff, 2010).

Towards conservation

So what does the future hold for BNFR? Currently, the tall emergent trees and complete canopy structure provide stable, cooler, humid conditions suitable for the growth and regeneration of forest trees and shade tolerant shrubs and herbs, but for how long? What will happen when the tall trees die? Are there sufficient seedlings and saplings regenerating in the understorey to replace them? Or will the gaps be too large and secondary forest species invade instead? Will the sensitive species be lost gradually as the climate in the city becomes hotter and less humid? As we have observed, species loss is particularly conspicuous among the endemic species.

Proactive conservation action within BNFR is clearly required to protect the habitat from continuously degrading. JPSM has made an effort by growing some forest species in the open areas resulting from the construction and development within BNFR. However, care needs to be taken to maintain the original forest species composition and to prevent invasion by both native and exotic weed species brought in from elsewhere. Disturbance from the construction of visitor facilities needs to be minimised. Judging from the number of visitors who walk the trails and paths, BNFR is valued as a recreational area and tourist destination. It also has great potential as a centre for research and education. With its intact and diverse structure, it should not be forgotten that it is also home to an equally diverse fauna, particularly of birds and insects (JPSM, 2007). It is indeed a precious biodiversity gem in the heart of Kuala Lumpur.

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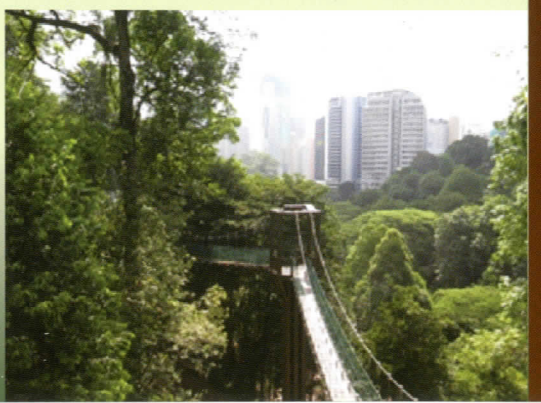

Canopy walkway - one of the attractions for tourists.

NATURE'S LIGHTS ON TREES

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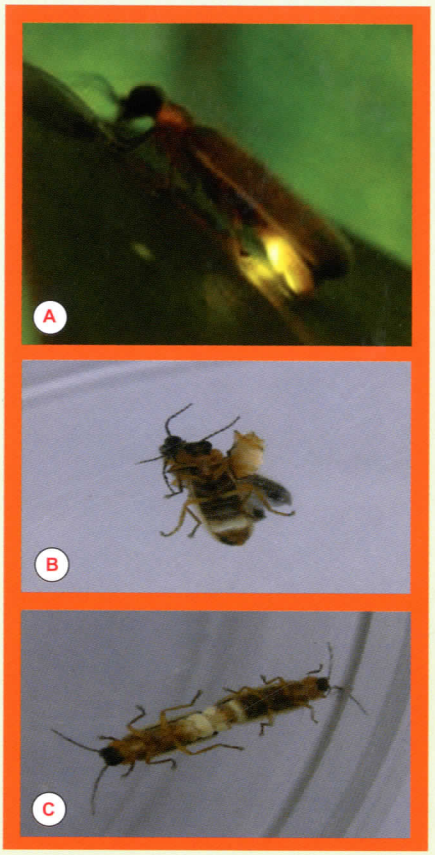
At dusk the riparian vegetation along certain sections of some estuarine rivers in Malaysia magically lights up. Mystical synchronous flashing lights emitted by fireflies are found along certain rivers and this was documented more than a century ago during excursions made by F.W. Burbidge to the Scudai River, Jahore (sic.) in 1880, Nelson Annandale's expedition to the Malay Peninsula in 1899-1900, as well as in a historical note by Robert W.C. Shelford in his book "A Naturalist in Borneo" published in 1916 (Gudger, 1919).

These synchronous flashing lights are produced by fireflies from the genus *Pteroptyx* Olivier, which can be found in South and Southeast Asia to Papua New Guinea (Ballantyne & McLean, 1970). Not all *Pteroptyx* species are synchronous flashers but at least two species, *P. tener* and *P. malaccae*, are able to flash in synchrony (Buck & Buck, 1968; Case, 1980). The firefly is actually a beetle and in the case of *P. tener*, measures only 4.0-6.2 mm in length (Ballantyne & McLean, 1970).

Aggregating fireflies play a role in generating income for the state. Nature enthusiasts and curious visitors are willing to pay to go on boat rides along rivers where the fireflies are found to witness their spectacular displays. The silence of the night is only broken by the sounds of oars dipping into the water and the murmurs of excitement of those who witness these tiny lamps. The trees look like they are decorated with fairy lights – minus the electricity bills.

Fireflies flash for one purpose only: to find their mates. Male fireflies produce species-typical signals to conspecific females (Forrest & Eubanks, 1995). For the synchronous *P. tener*, only males flash rhythmically in groups; flashing at 3.7 times per second (Case, 1980) while the females produce response flashes (Buck, 1988). During laboratory observations in the dark room, it was found that the male will begin the courting process by aiming its lantern towards the female, with hopes of reciprocation. If it receives a response, the male will climb onto the female's back; both heads in the same direction, and flex his lantern towards the female's eyes; an action perceived to be able to "blind" the female with only its flashes. This action could end up positively or disastrously – the positive being the pair ending in copulation, whereby the pair would rotate to an end-to-end position, remaining like



A. A male *Pteroptyx tener* emitting light.
B. A male *P. tener* mounting a female while flexing its light organ towards her eyes.
C. Fireflies in copulation where both male and female are at an end-to-end position.

that for almost four hours! If the pair does not end up copulating, the male will have to repeat the courting process again, with another hopefully responsive female. My observation in the laboratory concurred with the results of the courtship behaviour study conducted by Case (1980). Reading literature and witnessing the courtship behaviour oneself is a different experience all together. Indeed the marvels of nature!

The time to catch the nightly light displays will be as soon as it turns dark and it is best on moonless nights when the complete darkness enables our eyes to focus solely on the fireflies' lights. As the night progresses, the fireflies' lights start to dim – possibly because those which have found their soul-mates would have ceased their flashes. Preliminary studies on their flashing rhythms documented that the flashes peaked early in the night and started decreasing around 10.30 p.m., with very low flash rhythms recorded in the early hours of the morning (Khoo & Kirton, 2012).

With the understanding that fireflies communicate through light, it is believed that artificial light in the vicinity of their habitat could hinder them from getting their flash signals across to their potential partners. A change in their flashing behaviour could have a negative consequence on the firefly population. Thus, studies were conducted to observe the short- and long-term effects of artificial light on the aggregating synchronous fireflies along the Selangor River (Khoo *et al.*, in prep.). Results from the short-term studies showed that the fireflies reduced their flashing when exposed to artificial light for 30 minutes, in comparison to the un-illuminated control site. After 90 minutes without artificial illumination, the percentage of fireflies flashing increased; initially beyond that of the control site. When the artificial light was switched off for an additional three minutes after the 30-minute exposure to allow intervals for recovery, the fireflies were observed to increase their number of flashes sharply during the intervals. However, a different scenario was observed when the display trees were exposed to continuous light for three nights. The drop in the number of flashing fireflies was drastic, and recovery was very low; even a week after the illumination episode. These findings suggest that short-term exposure to artificial light had an immediate but reversible effect on their flashing behaviour, but long-term exposure caused the fireflies to move away from the affected display trees. These findings serve as an eye-opener for local authorities to ensure minimal lighting in the areas adjacent to the firefly habitat if they want to maintain or increase existing firefly populations.

Visitors who have witnessed these light displays might have thought that the firefly lifecycle revolved around the trees on which they aggregate. Contrary to that, the early stages of the firefly lifecycle occur in the floodplains behind the display trees. *Pteroptyx tener* has a life span of 4 to 7 months (egg to adult), with almost 60% of its lifetime spent as a predatory larva in the inundated area (Nada & Kirton, 2004). All known firefly larvae produce a faint glow, but some adult fireflies may differ greatly in the absence, presence, location, shape and use of their light organs (Branham & Wenzel, 2003; Stanger-Hall *et al.*, 2007). The predatory larvae feed on snails and slugs. However, these tiny worm-like creatures with three pairs of legs are not in the limelight compared to the adults. The larva transforms into a pupa, which will be inactive for a brief period before turning into a young adult which then flies out to the display trees to continue

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First Record of the Spotted Palmfly, *Elymnias malelas ivena*, in Central Peninsular Malaysia

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Butterflies of the genus *Elymnias*, known as Palmflies, are distributed from Sri Lanka and India through Southeast Asia to the Papuan region. In their larval stages, they are known to feed on palms and orchids. They are classed as Brushfoot butterflies (family Nymphalidae) belonging to the subfamily Satyrinae and are generally forest butterflies. A few species that feed on agricultural or ornamental palms are more common in man-made environments. Most species are rare to exceedingly rare. In fact, some of the rarest butterfly species in the country belong to this genus.

Elymnias are remarkable in that many species are mimics of certain poisonous butterflies from the subfamily Danainae and the family Pieridae. For instance, the Spotted Palmfly, *E. malelas*, is a mimic of the Striped Blue Crow, *Euploea mulciber*. Two other species of *Elymnias*, i.e. *E. casiphone* and *E. patna* share the same strategy by their close resemblance to the Striped Blue Crow. The former is a lowland forest species while the latter is generally confined to submontane and montane forest. Previously, *E. malelas* was the only one of these three closely related species that was not listed as occurring in Peninsular Malaysia (Corbet & Pendlebury, 1992; Eliot, 2006). It had always been regarded as a continental species with a southernmost known distribution in Peninsular Thailand (Inayoshi, 2017), until it was recently discovered on Langkawi Island (Aoyama, 2012).

A male specimen of *Elymnias malelas ivena* Fruhstorfer, 1911 from the reference collection of the first author. Left: upper side. Right: underside. Forewing length 43 mm.

However, on 18 March 2016, the first author photographed a male Spotted Palmfly attracted to fermented prawn paste bait, far south in the middle of the Main Range, along an old logging track in a forest reserve in Raub at 300 m above sea level. Some questions came up immediately: How could this continental species be found in the middle of the deepest recesses of a forest reserve in the middle of the peninsula, and why only now? When Aoyama reported it from Langkawi in 2012, he suggested that the species could travel rapidly south. Since the food plant of the Spotted Palmfly is the coconut palm (Pisuth, 2012), it would make sense that it would spread south since coconut palms are widely distributed in Malaysia. However, Raub is about 360 kilometers south in a straight line from Langkawi – Why has no one recorded the species in more northerly regions of Kedah, Perak and Selangor over the last six years? One possibility we considered was that it could have been spread by man's activities through the transportation of agricultural or ornamental palms. Indeed, many horticultural products in Malaysia are imported from Thailand, for example, orchids, fruit trees, ornamentals and palms, including seedlings of the aromatic pandan coconut. But this possibility does not offer a logical explanation to the puzzle at hand: the place where it was found is situated right in the midst of a vast forest reserve that has its borders in the heart of the Main Range. Coconut groves, once found abundantly fringing traditional villages in Raub, are no longer exploited and whatever remnant plants that are found today are unlikely to be recent introductions from the north.

To date, the Spotted Palmfly has never been observed in any other sites around the district of Raub. Ours is the first known record despite three years of extensive butterfly documentation in the area by the first author. Could this be a discovery of a previously unrecorded species that was already present in the heart of the Malaysian peninsula or an accidental introduction, or is it simply a successful traveller from the north? Many questions remain unanswered.

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the cycle of life. The next time you chance upon aggregating fireflies, remember that they do not only need the display trees; the habitats behind these trees are important too!

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