

Chapter

Introductory Chapter: Tropical Biodiversity Research in Protected Area of Pahang National Park, Malaysia

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1. Introduction

The tropical rainforests are earth's most complex biome that harbour a greater diversity of life than any other terrestrial habitat. The tropical rainforests of Kuala Keniam in Pahang National Park, Malaysia is no exception. They are home to biodiversity, which consists of thousands of species of flora and fauna that depend upon each other and are linked directly or indirectly with ecosystems. Kuala Keniam forests are one of the biodiversity hotspots in Pahang National Park located at the mouth of and along the Keniam River. A variety of species of plants, bacteria, insects, fungi, birds, mammals, reptiles, fish, invertebrates and amphibians live together with non-living elements like water, soil and air to make a functioning ecosystem [1]. This amazing spectrum of life makes Kuala Keniam forests a living laboratory of scientific research, and is regarded as one the most exciting habitat by researchers, scientists, botanists and naturalists within Pahang National Park.

Historically, Pahang National Park was declared as a National Park by the British Administrators with the name King George V National Park under Enactment 1939, to commemorate the installation of King George V in England [2]. The Department of Wildlife and National Parks (acronym: DWNP in English and PERHILITAN in Malay) was established in 1972 by the Government of Malaysia under the Wildlife Protection Act, 1972. The department is responsible to strengthen wildlife conservation programmes through management, enforcement, enrichment and research of wildlife [3]. In addition, it maintains the integrity of protected areas and enhances knowledge, awareness and public participation towards wildlife conservation. In 2007, the Universiti Teknologi MARA (UiTM), Malaysia in collaboration with DWNP established a field research station in a protected area of Pahang National Park known as UiTM-PERHILITAN Research Station.

This introductory chapter aims to document the great richness of biodiversity in the tropical rainforests of Pahang National Park, Malaysia, and share the findings from a scientific expedition undertaken by UiTM in its effort to carry out a multi-disciplinary research programme focusing on the aspects of biodiversity in the area.

2. Establishment of UiTM-PERHILITAN research station

UiTM-PERHILITAN Research Station (hereafter referred to as Kuala Keniam forests) was established with a primary focus to provide a great natural laboratory to conduct scientific investigations of the biodiversity of tropical rainforest as well as



Figure 1.
Accommodation facilities for researchers and visitors in Kuala Keniam forests, Pahang National Park.

ecosystem processes and interactions between them within the National Park landscape and on ways of managing them. Physical facilities at Kuala Keniam forests are designed to accommodate programmes of research, education and services (**Figure 1**). Currently available facilities include a multi-purpose building, boats, chalets, bathrooms, toilets, prayer room and base camp which can accommodate 50–70 people at a particular time. The interpretive trails and forest arboretum in Kuala Keniam forests are used for teaching purposes in the fields of dendrology, forest botany, environmental sciences, park and recreation management and wildlife management. Transect lines and permanent field plots from research activities were established to provide hands-on training in forest ecology, silviculture and forest inventory.

Initial research was funded through a top-down Fundamental Research Grant Scheme (FRGS) awarded by the Ministry of Higher Education, Malaysia [4]. UiTM teamed with DWNP in a joint Memorandum of Understanding (MoU) to collaborate with three main objectives. Firstly, to carry out joint programmes of scientific research, conservation, management of biological resources. Secondly, to strengthen the capacity of the DWNP in terms of training, attachment and networking and to provide the necessary framework to develop expertise in the research, conservation and management of biological resources. Finally, to provide consultancy related to research, conservation and management of biological resources.

3. Topography, climate and vegetation of Kuala Keniam forests

The total area of Pahang National Park is 4,343km² which covers the three states, namely Pahang, Kelantan and Terengganu [2]. It is considered one of the oldest tropical rainforests in the world of more than 130 million years old. Geographically, the park lies between 80 and 2,187 m above sea level with Mount Tahan is the highest peak. The weather is characterised by permanent high temperatures ranging from 20°C at night and 35°C in the daytime with high relative humidity (above 80%) [5, 6]. Annual rainfall is approximately 2,260 mm with the highest rainfall occurring



Figure 2.
Riparian vegetations along Tahan River, Pahang National Park.

in October to November with about 312 mm of rainfalls [7]. The lowest rainfall occurs in March with only about 50 mm. Keniam River is one of the major rivers flowing into the Tembeling River with the presence of *Dipterocarpus oblongifolius* (Keruing neram) trees along with the riparian habitats (**Figure 2**).

The great richness of this tropical rain forest is illustrated by a hectare plot that contains more than 280 tree species, with the Shannon index of diversity (H') ranging from 1.9 to 2.5 [5]. The rainforest consists of tall evergreen trees that attain heights up to 50 m. It is typically very damp and rich in herbaceous, shrubs, epiphytes, lianas and tree species from the family of Dipterocarpaceae [8]. *Elasteriospermum tapos* (Perah) is dominant and frequently occurs in Kuala Keniam and its vicinity [6]. Other trees include *Intsia palembanica* (Merbau), *Koompassia malaccensis* (Tualang), *Knema patentinervia* (Penarahan), *Aporosa prainiana* (Sebasah), *Macaranga lowii* (Balik angin) and *Koompassia malaccensis* (Kempas) [5, 6]. *Dipterocarpus oblongifolius* (Keruing neram), *Pometia pinnata* (Kasai daun besar) and *Pterocambium javanicum* (Melembu) trees commonly occur along the river banks together with other riparian vegetation such *Milletia hemsleyana* (Jada), *Neonauclea subdita* (Mengkai) and *Dysoxylum angustofolium* (Maris) [1]. The understory trees and shrub community consist of the families Rubiaceae, Myrtaceae and Euphorbiaceae with *Rennelia* spp., *Syzygium* spp., *Mallotus* spp. being the common genera [5]. Common tree crown epiphytes include *Asplenium nidus* (bird nest fern) and *Platycerium coronarium* (staghorn fern).

4. Biodiversity in Malaysia

Located within the tropical belt of the world, Malaysia is richly endowed with a luxuriant and diverse natural environment that offers unlimited opportunities for exploration and discovery of biological diversity of tropical rainforests. The Convention on Biological Diversity in 1993, rated Malaysia as one of the world's 12th mega diversity countries. In terms of flora diversity, the tropical rainforests of the country houses over 15,000 flowering plants, 1,159 ferns and fern allies, 513 palms, 3,000 orchids, 432 mosses and 700 fungi. There is also a greater diversity of fauna in the country. For vertebrates, there are about 300 species of wild mammals, 700–750 species of birds, 350 species of amphibians and more than 300 species of freshwater fishes [9].

5. Species richness of Kuala Keniam forests

5.1 Flowering plants

Some of the common flowering plants of Kuala Keniam are the umbel-shaped inflorescences of *Trevesia burckii* (Tapak hantu), which are found on a spiked stem (Figure 3), the striking large orange-red flowers of *Spathodea campanulata* (African



Figure 3.

A common flowering plant of *Trevesia burckii* (Tapak hantu) in Kuala Keniam forests, Pahang National Park.

tulips) and the sweet pink flowers of *Cassia nodosa* (Bebusuk) [1]. Attractive combination of orange and pink flowerheads of a shrub, *Lantana camara* (Bunga tahi ayam), clusters of white flowers of *Ixora* spp.

5.2 Medicinal plants

Zingiber spectabile (Tepus tanah) (**Figure 4**), *Labisia pumilla* (Kacip Fatimah) and *Eurycoma longifolia* (Tongkat Ali) are a few examples of common medicinal plants thriving in Kuala Keniam forests. Many more of the lesser-known plants are no less valuable with virtues waiting to be discovered. *Psycotria malayana*, *Knema glauca* and *Horsfeldia tomentosa*, to name a few, deserve attention from interested researchers searching for bioactive molecules to be turned into yet another important medicinal agent. *Rennellia elliptica* (Segemuk) has been dubbed as the Malaysian ginseng. Decoction of the roots of this plant is drunk for general health booster and also claimed to be anti-diabetic and aphrodisiac.

5.3 Mosses

Belong to the group of Bryophytes, mosses are commonly recognised as seedless nonvascular plants, which are tiny and small, but some may be as large as 35cm tall. In Kuala Keniam forests, *Calymperes moluccense* is found mainly on the tree base, *Pelekium velatum* well spread on rotten bark and *Syrrhopodon spiculosus* is found on bark of living trees in moist and shaded lowland areas. Mosses do not have direct economic value; however, they are important in many respects. They play an important role in the water balance of ecosystems in the forests by storing large amounts of water. They also prevent erosion by fixing the uppermost layer of soil, and also providing microhabitats for small animals, germination of seeds or food for certain beetles.

5.4 Ferns and allies

At Kuala Keniam forest, ferns and their allies are widespread and can be found on forest floors, tree branches and trunks, rocks and also in the drains. Ferns can be recognised by the groups of sporangia called sori on the back of the leaves (rarely on the margin). Examples of the fern allies found at Kuala Keniam forests are *Selaginella willdenowii*, *S. wallichii* and *Schizaea dichotoma*. Some ferns are good to prevent soil erosion such as *Dicranopteris* spp. Some of them can be used for food, as a biological fertilizer, and also grown in horticulture as landscape plants, for



Figure 4.

A species of true ginger *Zingiber spectabile* (Tepus tanah) has long been used in traditional medicine.

cut foliage and as houseplants, especially *Asplenium nidus* (birds-nest fern) and *Platycerium coronarium* (staghorn fern).

5.5 Rattans and bamboo

Rattans are classified into the family of Arecaceae or Palmae and the subfamily of Calamoideae. In Kuala Keniam forests, Abdul Hamid and Suratman [10] found thirteen species of rattans with the three most dominant species are *Daemonorops didymophylla* (Rotan jernang), *Calamus caesius* (Rotan sega) and *C. luridus* (Rotan kerai). Bamboo belongs to the Gramineae family and the Bambusoideae subfamily. It is considered to be one of the most fast-growing plants on earth [11]. Certain species of bamboo can grow at the rate of 900mm per day. Asari and Suratman [12] found five bamboo species grow in Kuala Keniam forests. These are *Schizostachyum grande* (Buluh semeliang), *S. latifolium* (Buluh nipis), *S. brachycladum* (Buluh lemang), *Bambusa vulgaris* (Buluh aur) and *Gigantochloa scorchedii* (Buluh semantan).

5.6 Fungi

Fungi play important roles in a rainforest ecosystem. They are the parasites, saprophytes or symbionts. As parasites, they invade living plants, cause diseases and eventually bring deaths to the plants. As saprophytes, they grow on dead plants, break organic materials and return the nutrients back to the soil. As symbionts, they form mycorrhizae with plant roots and form lichens with algae. In addition, some fungi can be food for animals in the forest. Kuala Keniam forests have a rich diversity of fungal flora, which is dominated by various kinds and forms of mushrooms and polypore or bracket fungi. For instance, the bird's nest fungus, coral fungus, long net stinkhorn (**Figure 5**), cup fungus, jelly fungus and puffball are thriving in the area.



Figure 5.

Phallus indusiatus (long net stinkhorn) is one of many fungi species that grows in the forest floor of Kuala Keniam forests.

6. Insects of Kuala Keniam forests

Despite being relatively small in size compared to many animal groups, insects are well-adapted to their environments. In order to make sure of their survival, insects have strategies by applying camouflage and mimicry, which refer to adaptations some animals use as protection from predators. Some insects display warning colours to scare off predators. They use camouflage and mimicry as methods of



Figure 6.
Shield bug (Hemiptera) uses colours as protection from predators.

hiding from predators or ambushing prey (**Figure 6**). For example, pray mantis (Mantidae), katydids (Orthoptera: Tettigoniidae), grasshoppers (Orthoptera: Acrididae) are insects that have developed camouflaged bodies. Instead of using camouflage to blend in with their habitat, some insects use mimicry to distinguish themselves from other insects or resemble certain marks. By doing so, the insects benefit by deterring the predators.

7. Rivers of Pahang National Parks

A few kilometres upstream of Tahan River, a spectacular view greets the visitors as one can observe the convergence between two rivers that has two different colours; Tahan River, a coffee-coloured river, and Tenor River with greenish colour due to its mineral contents. The dark colour results from the tannins released from the decaying leaves and organic materials of the vegetation in the area. However, in the monsoon season, this river loses its clarity and colour due to the sedimentation from the runoff of the surrounding forest. Another tributary is the Keniam River, where it is considered as a clearwater river as the water only receives minimal loading of suspended matter. Rapids and ancient rock beds are common, hence, the water has a higher pH than other tributaries.

8. Recreational opportunities

A canopy walkway in Kuala Tahan offers a close-up view of activity from the rainforest canopy. Observation hides (bumbun) are another great way to observe wildlife, especially at night to catch opportunities to observe animals in their natural habitat. Cave explorations to Luas Cave and Kepayang Cave are available from Kuala Keniam research station.

Along the Tembeling River from Kuala Tahan to Kuala Keniam (approximately 25 km), there are seven sets of rapids, which provide an exciting ride when the river is in full flood. Main activities are river rapid shooting and rafting. There are two rivers in Kuala Keniam forests (i.e., Keniam and Perkai Rivers), where wildlife viewing is possible from the water. A distinctive plant community lines the river-banks as a home to riparian flora and fauna.

9. Wildlife, birds and fishes of Kuala Keniam

Abundant food plants, a variety of habitat types and major drainage systems provide all necessary living requirements for wildlife. *Elephas maximus* (Elephant) herds are distributed in Ulu Atok, Jenut Kumbang and Trenggan of Pahang National Park. Other mammals found in Kuala Keniam forests are *Tapirus indicus* (Malayan tapir), *Cervus unicolor* (Sambar deer), *Sus scrofa* (Wild boars), *Muntiacus muntjac* (Barking deer) and *Tragulus* spp. (Mouse deer). The forest habitat in Kuala Keniam forests contains about over 20 species of birds which include *Pycnonotus plumosus* (Olive-winged bulbul), *Arachnothera longirostra* (Little spider hunter) and *Hirundo tahitica* (Pacific swallow). In addition, there are also many fish species found in Keniam River. *Hampala maerdepidota* (Sebaru), *Mystacholeucus marginatus* (Sia), *Labioobarbus* spp. (Kawan) and *Tor tombroides* (Kelah) are the most widely distributed species.

10. Conclusions

As highlighted in the chapter, tropical rainforests of Pahang National Park are ecologically diverse and exceedingly rich, however, many species remain uncovered. Kuala Keniam forests provide a spectacular example of a living laboratory and the ultimate in biodiversity. The abundance and diversity of nature in these forests are phenomenal, making it one of the world's most complex and rich ecosystems. Therefore, there is a need to enhance efforts in research as much of the country's biodiversity has yet to be scientifically investigated. Opportunities for multidisciplinary research should be fully explored and enhanced to strengthen our scientific base and at the same time build up researchers' competencies through collaborative programmes nationally and internationally working towards shared goals.

Acknowledgements

A special appreciation is extended to Y. Bhg. Dato' Professor Dr. Rahmat Mohamad who was instrumental to the establishment of the UiTM-PERHILITAN Research Station. The author is grateful for the strategic partnership and cooperation of the Department of Wildlife and National Parks, Peninsular Malaysia. The author wishes to thank the Ministry of Higher Education Malaysia for providing research funding and the Universiti Teknologi MARA, Malaysia for providing logistic and financial support.

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