



UNIVERSITI PUTRA MALAYSIA

**FLORISTIC DIVERSITY AND CONSERVATION IMPORTANCE OF BUKIT
BAUK (TRENGGANU) IN PENINSULAR MALAYSIA**

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FLORISTIC DIVERSITY AND CONSERVATION IMPORTANCE OF BUKIT
BAUK (TRENGGANU) IN PENINSULAR MALAYSIA

By

TAM SHEH MAY

Thesis Submitted in Fulfilment of the Requirements for the Degree of Master of
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Praise God, In Faith shall I be delivered,
and much love to my granny and family



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LIST OF ABBREVIATIONS

a.s.l.	above sea level
c.	approximately
cm	centimeter
d.b.h.	diameter at breast height
e.g.	example
FAO	Food and Agriculture Organization of the United Nations
FELDA	Federal Land Development Authority
Fig.	Figure
F.R.	Forest Reserve
FRIM	Forest Research Institute Malaysia
g.b.h.	girth at breast height
G.P.S.	Global Positioning System
ha	hectare
IUCN	International Union for the Conservation of Nature and Natural Resources
km	kilometer
mm	millimeter
PROSEA	Plant Resources of South East Asia
ssp.	subspecies
UNEP	United Nations Environment Programme
var.	variety



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FLORISTIC DIVERSITY AND CONSERVATION IMPORTANCE OF BUKIT
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Bukit Bauk is an isolated, coastal, small hilly range which is part of the Terengganu hills situated in the low hills at the southern end of the East Range in the east coast of Terengganu in Peninsular Malaysia. These hills have been deemed to be extremely interesting botanically because they were surmised to contain a high number of species and endemic plants. However to date, a satisfactory inventory of plant species in the east coast have yet to be taken (are under-collected) and studied botanically. This study was therefore carried out to determine the floristic diversity of Bukit Bauk and subsequently compile a floristic checklist by checking relevant literature and through fieldwork; to assess the conservation importance of Bukit Bauk; to evaluate the conservation status of important species, where sampling plots and size were site and species specific and to determine threats to the flora of Bukit Bauk. The flora of Bukit Bauk was found to comprise 638 species (7.7% of the total flora of the Malay Peninsula) belonging to 285 genera and 103 families. Of these, 14.3% were



endemic taxa (91 taxa) which constituted about 3.6% of the total number of endemic species in the Malay Peninsula. Bukit Bauk also contained 17.6% of the total number of tree species and 8.0% of endemic tree species in Peninsular Malaysia. The most speciose families on Bukit Bauk were Euphorbiaceae (59 species), Dipterocarpaceae (43 species), Rubiaceae (36 species) Palmae and Guttiferae (31 species respectively). Several specific types of vegetation could be distinguished on Bukit Bauk and its nearby lowland forest according to habitat, altitude zonation and floristic composition. The vegetation types were lowland dipterocarp forest (flatland, foothills and valley bottoms), vegetation on the seaward front, hill dipterocarp forest (steep slopes and hill ridges), vegetation on the summit, vegetation of disturbed areas and peat swamp forest. A total of 385 species (60.3%) of species found on Bukit Bauk provide one or more usage to humankind with 58.7% contributing more than one type of usage. Edible wild plants, products and medicinal plants are important to the local community in Terengganu. *Didymocarpus puncticulatus* var. *baukensis* was a new herbaceous taxon discovered from Bukit Bauk in the course of this study. Five species and one variety of a species were selected as target species for further study. Evaluation of the conservation status of these species resulted in one species and one variety being classified as “critically endangered” (*Licuala ahlidurni* and *Didymocarpus puncticulatus* var. *baukensis*), one species “endangered” (*Didymocarpus minimatus*), one species “vulnerable” (*L. terengganuensis*) and two species were “lower risk/near threatened” (*Livistona endauensis* and *Dryobalanops aromatica*). Population Structure showed populations of all target species could be

considered healthy but two species and one variety (*L. ahliiduru*, *D. puncticulatus* var. *baukensis* and *D. miniatus*) would require *ex-situ* conservation as a safety measure. The three other species remain highly vulnerable to threats of habitat disturbances and destruction. Main threats to the flora of Bukit Bauk was determined as massive land clearing for development, the building of telecommunication towers and roads, quarrying activities, lack of respect for boundary between forest reserve land and village land and logging. This study reinforced Bukit Bauk F R (a relatively small area of 7596 ha) as a species rich area with a high degree of endemic species and many useful plants should be conserved and totally protected as it is an important component in the conservation of flora in Peninsular Malaysia.



Abstrak tesis yang dikemukakan kepada senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains.

KEPELBAGAIAN FLORA DAN KEPENTIGAN PEMULIHARAAN DI BUKIT
BAUK (TERENGGANU) DI SEMENANJUNG MALAYSIA

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Bukit Bauk merupakan sebuah banjaran bukit kecil yang terletak berhampiran pantai di negeri Terengganu di Semenanjung Malaysia. Kedudukan Bukit Bauk menyebabkannya dianggap sebagai sebahagian daripada kumpulan bukit-bukau Terengganu yang terletak di selatan Banjaran Timur. Kawasan tersebut dipercayai kaya dengan species flora and mengandungi banyak species endemik Semenanjung Malaysia oleh ahli botani. Namun demikian, maklumat flora untuk kebanyakan kawasan hutan di pantai timur Semenanjung Malaysia kurang memuaskan. Maka, kajian ini bertujuan mengkaji kepelbagaian flora di Bukit Bauk and seterusnya mendapatkan suatu senarai flora untuk Bukit Bauk melalui kajian literatur dan kerja-kerja lapangan. Selain itu, kajian ini juga menentukan kepentingan pemuliharaan kawasan Bukit Bauk; menentukan status pemuliharaan spesies penting di mana persampelan adalah bergantung kepada spesies dan lokasi



populasi; dan menentukan ancaman kepada flora kawasan ini. Hasil kajian ini mendapati Bukit Bauk mempunyai sekurang-kurangnya 638 spesies tumbuhan (7.7% daripada jumlah keseluruhan flora yang terdapat di Semenanjung Malaysia) dari 285 genus dan 103 famili. Daripada jumlah ini, 14.3% (91 taxa) adalah taxa endemik kepada Semenanjung Malaysia. Angka ini adalah 3.6% daripada jumlah taxa tumbuhan endemik yang terdapat di seluruh Semenanjung Malaysia. Bukit Bauk juga mengandungi 17.6% daripada jumlah species pokok dan 8.0% species pokok endemik di Semenanjung Malaysia. Famili dengan bilangan spesies tertinggi di Bukit Bauk adalah Euphorbiaceae (59 spesies), Dipterocarpaceae (43 spesies), Rubiaceae (36 spesies), Palmae dan Guttiferae (masing-masing 31 spesies). Vegetasi di Bukit Bauk boleh dibahagikan kepada beberapa vegetasi yang lebih spesifik berdasarkan kepada habitat, altitud dan komposisi flora. Vegetasi yang terdapat di Bukit Bauk termasuk hutan tanah pamah dipterocarp (tanah pamah, kaki bukit dan kawasan lurah), hutan bukit dipterocarp (kawasan lereng bukit dan tebing curam), vegetasi kemuncak bukit, vegetasi kawasan terganggu dan hutan paya gambut. Sebanyak 385 spesies (60.3%) yang direkodkan di Bukit Bauk merupakan tumbuhan yang berguna (useful plant) yang menyumbang satu atau lebih daripada satu kegunaan kepada manusia. Daripada angka ini, 58.7% menyumbang lebih daripada satu kegunaan. Tumbuhan yang boleh dijadikan makanan dan ubat-ubatan amat penting kepada komuniti tempatan. Lima spesies dan satu varieti tumbuhan telah dipilih untuk kajian saiz dan struktur populasi. *Didymocarpus puncticulatus* var. *baukensis* merupakan taxon tumbuhan herba yang baru dijumpai di Bukit Bauk. Evaluasi status pemuliharaan mendapati satu spesies

dan satu varieti (*Licuala ahlidurii* dan *Didymocarpus puncticulatus* var. *baukensis*) diklassifikasi sebagai “critically endangered”, satu spesies (*Didymocarpus miniatus*) “endangered”, satu spesies (*L. terengganuensis*) “vulnerable” dan dua species (*Livistona endauensis* dan *Dryobalanops aromatica*) “lower risk/near threatened”. Struktur populasi menunjuk semua populasi spesies yang dikaji adalah dalam keadaan baik, tetapi dua spesies dan satu varieti (*L. ahlidurii*, *D. miniatus* dan *D. puncticulatus* var. *baukensis*) memerlukan langkah-langkah pemuliharaan *ex-situ*. Tiga species yang lain mempunyai potensi yang baik untuk terus hidup dalam keadaan semulajadi selagi habitat asal mereka tidak diganggu atau dimusnahkan. Ancaman terhadap flora Bukit Bauk adalah penerangan kawasan hutan secara besar-besaran untuk projek kemajuan tanah, pembinaan jalanraya dan menara telekomunikasi, aktiviti-aktiviti kuari, adanya pencerobohan ke dalam sempadan hutan simpanan dan aktiviti pembalakan. Hutan Simpanan Bukit Bauk menempati kawasan yang kecil (7596 ha) dan didapati mempunyai bilangan species, species endemik dan species berguna yang tinggi. Bukit Bauk boleh dikatakan kawasan yang penting untuk flora Semenanjung Malaysia dan sepatutnya dipelihara.

CHAPTER 1
INTRODUCTION
Floristic Diversity

Bukit Bauk is part of the Terengganu Hills (Ulu Kemaman), which are situated in the low hills at the southern end of the East Range on the east coast of Peninsular Malaysia. These hills have always been deemed to be extremely interesting botanically because they are surmised to possess a high number of species (species rich) and to contain a high number of endemic plants. The flora was said to be extraordinarily rich and distinctly different from that of other parts of the Malay Peninsula (Holttum 1936). Corner (1960) even suggested that this area contained the richest and maybe the oldest part of the flora in the Malay Peninsula.

In 1996, the Terengganu Hills were recognized as a biodiversity hotspot in Peninsular Malaysia by the IUCN Centres of Plant Diversity project (Kiew, 1996). Its flora was estimated to be approximately 1500 vascular plant species. Exact figures were unavailable as the area has not been subjected to any detailed botanical investigation since Corner mounted two expeditions to the Terengganu Hills in 1935 (Holttum, 1936). Presently, it is generally acknowledged that the vast tracts of forests on the east coast of Peninsular Malaysia are under-collected and poorly known botanically.



A survey of relevant literature revealed that Bukit Bauk and its surrounding forest had not been collected botanically before 1927 (Burkill, 1927). The only detailed botanical investigation on Bukit Bauk was carried out in 1955 on a small ecological plot (one acre) in Compartment 8B (Bukit Bauk Virgin Jungle Reserve) by officers of the Forest Research Institute of Malaysia (FRIM), where trees of a kapur (*Dryobalanops aromatica*) forest were enumerated and subsequently re-measured in 1957 and 1959. This one acre plot yielded a comparatively high figure of 123 tree species (gbh \geq 12 in) from 31 families (Wyatt-Smith, 1963).

Putz (1978) reported that FRIM maintained the ecological plot in the Virgin Jungle Reserve; and later set up a Big Tree Plot in 1973 in the lowland forest situated beside the main road passing adjacent to Bukit Bauk. He noted also that University Malaya and other institutions of learning regularly made use of the area as a study site. Since then, examination of herbarium records showed that small collections were made from Bukit Bauk from time to time but no complete floristic checklist nor results of ecological studies concerning Bukit Bauk was ever published. Evidently a floristically rich area such as Bukit Bauk deserves a systematic and comprehensive study to compile existing information and further amass information to verify its status as a biodiversity hotspot.

Malaysia, being a member of the United Nations Convention of Biodiversity in Rio de Janeiro (1992) has formed a Biodiversity Council, which in the process of formulating the recently declared National Biodiversity Policy (approved by Cabinet on October 22, 1997 and launched nationwide on April 16, 1998) has admitted that the

country's baseline data remain incomplete. It identified that more studies are needed in order to develop a comprehensive inventory of the nation's biodiversity (flora and fauna) and research is needed to assess the value of biodiversity, to identify potential threats to biological loss and to suggest management measures to counter such problems.

Objectives of Study

Recognizing the need and imperativeness of having adequate baseline floristic data in the country, it is the purpose and scope of this study to obtain information of the flora of Bukit Bauk, concentrating on building up a floristic inventory and to analyse and present the information for public access. As the flora of Bukit Bauk has neither been studied intensively or extensively for a long time, it is the purpose of this study to achieve the following objectives:

- i) to compile a comprehensive floristic checklist of Bukit Bauk, inclusive of all plants except bryophytes and climbers;
- ii) to verify the plant biodiversity status and assess the conservation importance of Bukit Bauk;
- iii) to select target species and evaluate their conservation status; and
- iv) to document current threats to the flora of Bukit Bauk and to recommend management treatments.

CHAPTER 2
LITERATURE REVIEW
Flora of Peninsular Malaysia

The rain forests of Peninsular Malaysia are centred on the Malay Archipelago whose distinctive flora constitutes a botanical region named West Malesia, often known as Sundaland. Peninsular Malaysia boasts a remarkable concentration of plant species and is recognized as one of the world's diversity hotspot (Aiken and Leigh, 1992). Peninsular Malaysia's geographical position makes it the southernmost land limit of the Asian mainland, thus making it a meeting place for several regional floras (Wyatt-Smith, 1963).

The lowland floristic province in Peninsular Malaysia is generally recognized to be divided into four demarcations - the flora and vegetation of the extreme northwest above the Kangar-Pattani line, which is similar to Peninsular Thailand, the Perak subprovince, the generalised inland flora on adult ultisol soils on the west coast and Main Range, which is similar to that of Sumatra and Kalimantan and, the Riau Pocket, beginning from the south east of Peninsular Malaysia and existing as a belt of up to 32 to 48 km wide extending as far north as the Kelantan-Terengganu border where the flora is strongly influenced by elements from Sarawak and the Riau province (Wyatt-Smith, 1963 and Ashton, 1990).



Existing Forest Coverage in Peninsular Malaysia

The area under forest cover in Peninsular Malaysia can only be given as estimates. Collin *et al.* (1991, cited by Davis 1996) gave the figure for forest cover as 69,780 km² (53% of a land area of 131,598 km²) based on a Forestry Department map of 1989. It was calculated that 44% is lowland and hill forest (0-1300 m a s l), 5% is montane forest, 3% swamp forest, 1% mangrove forest and 0.3% limestone outcrops. More specific figures could be obtained from Chin *et al.* (1997) where it was stated that the extent of forest coverage as of 31st December 1992 was 6,116,014 ha or 46.3% of the total land area in Peninsular Malaysia. This value consisted 31.6% primary forest coverage which included good, mediocre and poor primary forest (according to foresters' classification), followed by 4.21% of primary montane forest, 51.24% of regenerated forest (from logging activities before 1960 to 1992), 2.95% of primary peat swamp forest, 3.75% of of logged peat swamp forest, 1.68% mangrove forest, 1.48% forest plantation, 2.47% forest with shifting cultivation activities and 0.67% of disturbed forest. A more recent figure quoted by the Forestry Department of Peninsular Malaysia (1995) showed 44.73 % of forest cover for Peninsular Malaysia including permanent forest estates (production forests and protective forests) and other forested areas such as state land and wildlife reserves (Anon, 1995).

On the Richness of Species and Endemism

The tropical rainforests of Peninsular Malaysia is extremely rich, harbouring a great wealth of species. A recent figure for the flora of Peninsular Malaysia obtained

from Turner (1995) listed 8239 plant species belonging to 1656 genera and 237 families, of which 632 species (34 families) are fern and fern allies and 27 species (4 families) are gymnosperms. A checklist of tree-genera for Peninsular Malaysia compiled by Ng *et al.* (1990) showed a total of 100 tree families in 532 genera with 3395 species, out of which 2830 species are trees. The total number of endemic trees was 746 species which represented 26.4% of the total number of tree species in Peninsular Malaysia.

There are about 2600 species of herbs in Peninsular Malaysia belonging to 551 genera and 94 families. About 853 species of this total belongs to the family Orchidaceae. The remaining 1747 non-orchid species belong to 450 genera and 57% of these species belong to just 7 families. The seven big families are: Gramineae (188 species), Gesneriaceae (146 species), Cyperaceae (162 species), Zingiberaceae (150 species), Rubiaceae (121 species), Araceae (112 species) and Acanthaceae (124 species) (Kiew, 1988, Turner, 1995). The level of endemism in herbaceous species is considerably higher than for trees. An average figure for all herbs cannot be calculated as taxonomic studies are still incomplete but examples of high degrees of endemism are demonstrated by several large genera with more than 40 species such as 87% for *Sonerila* (Malastomataceae), 88% for *Argostemma* (Rubiaceae), 94% for *Didymocarpus* (Gesneriaceae), 96% for *Begonia* (Begoniaceae) and 100% for the 17 species of *Didisandra* (Gesneriaceae). All these species are confined to primary rain forest. Peninsular Malaysia has six monotypic endemic genera of herbs (Kiew, 1991), namely *Acrymia* (Labiatae), *Exorhopala* (Balanophoraceae), *Klossia* (Rubiaceae).

Orchadocarpa (Gesneriaceae) *Stenothyrus* (Acanthaceae) and *Iriculistra* (Convallariaceae)

The concept of rarity in the tropics generally encompasses two very different types. One is the extremely local species, known from a single population, which may be numerous but which has a very narrow habitat range e.g. 50% of all the 48 species of *Begonia* and 70% of all the 89 species of *Didymocarpus* are known from a single locality. The other type of rarity is species that are widely distributed but are nowhere common. Many endemic species of herbs are rare and have extremely narrow distributions and hence fall into the first category while in contrast, many tree species tend to belong to the latter category (Kiew, 1991). This is because the majority of tree species in tropical forests occur at population densities of less than two trees per hectare (Primack *et al.*, 1990). A more specific view on the concept of plant rarity was proposed by Rabinowitz *et al.* (1986) based on a study of the flora of the British Isles. They suggested seven forms of rarity in plants, based on geographical distribution (broad or narrow), local population size (large or small) and habitat specificity (variety or restricted habitats). Tropical tree species could be rare because of three main reasons, namely, its required habitat is spatially a small proportion of the total habitat available, its infrequent to ceased occurrence of conditions needed for successful regeneration and the possibility that the species might be a recent immigrant from population centres outside the study area (Hubbell and Foster, 1986).