



Sphagnum bogs of Kelantan, Peninsular Malaysia

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Key words

elephants
Padang Ragut
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Abstract Sphagnum bog, a unique plant community for Peninsular Malaysia was encountered on Padang Ragut, Kelantan. Its topographical features and flora are described, and compared with padang and upper montane floras. It is postulated that the community is derived from upper montane forest and is the result of zoogenic factors, namely elephant activity.

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INTRODUCTION

An expedition to the botanically unknown Gunung Tera (N 5° 20' 52.0", E 101° 54' 14.9") area in Kelantan, Peninsular Malaysia (Fig. 1) was carried out from 5–15 February 2007. The area comprises a series of mountain peaks (1284–1556 m) on lithodemic leucogranite (Mohd Rozi 2005). The slopes ascending the summits and ridges are steep, often with sheer rock cliffs. These highlands also form the watershed area for rivers flowing to all directions. The vegetation types of the area include lowland mixed dipterocarp forest, hill dipterocarp forest and lower and upper montane forest. Apart from the chain of summits, maps show an open area on a highland plateau at 1371 m south-east of Gunung Tera, which the locals call Padang Ragut. Areas indicated in this way are usually covered in padang vegetation, which is not common in Peninsular Malaysia. A detailed inventory of Padang Ragut was therefore undertaken.

Padang vegetation

'Padang', a Malay word meaning an open grassy area, was used by Ridley (1915) to refer to vegetation on the open undulating plateau on Gunung Tahan, which is traversed by small streams intersecting dry patches vegetated by small-crowned, dwarfed trees and waterlogged, coarse-grained white sand dominated by sedges. Two areas of padang vegetation in Peninsular Malaysia have been described: the Padang on Gunung Tahan, Pahang, between 1400–2000 m (Ridley 1915), and Padang Temambong, Endau-Rompin State Park, Johor, at c. 700 m (Wong et al. 1987).

Ridley described two plant communities on Gunung Tahan, namely the 'dry rock flora' and 'wet woodland flora'. The dry rock flora is dominated by sedges, interspersed with a dwarf tree community of *Baeckea frutescens* L. and *Leptospermum javanicum* Blume (*Myrtaceae*) with both epiphytic and lithophytic orchids. *Nepenthes* L. (*Nepenthaceae*) are also abundant. Fringing the streams, the wet woodland flora has a richer flora of dense trees and resembles heath forest in the preponderance of microphyllous trees and epiphytic plants (Whitmore 1990). *Utricularia* L. spp. (*Lentibulariaceae*), *Lycopodiella caroliniana* (L.) Pic.Serm. (*Lycopodiaceae*) and *Xyris grandis* Ridl. (*Xyridaceae*) grow on the silver sand or on submerged rocks in streams bordered by mosses and hepatics.

Padang Temambong is sited on a gently sloping plateau with a raised rim (Davison 1988). It is a waterlogged area with trickles of water flowing into bigger streams. The waterlogged, sandy areas are dominated by sedges, grasses, *Lycopodiella caroliniana* and *Xyris* L. sp. and the drier areas with groups of straggly trees with shrubs and ferns (Wong et al. 1987). Epiphytes, ant plants and insectivorous plants are abundant. Gnarled *Leptospermum javanicum* trees and the fern *Dipteris conjugata* Reinw. (*Dipteridaceae*) grow along the water courses. Vegetation in the open area intergrades on the margin with small-crowned, low-statured, pole-sized (8–10 cm dbh) trees, which in turn are surrounded by a sea of tall hill dipterocarp forest.

Padang Ragut

This extensive plateau (measuring 0.27 km² on the map) at 1371 m is gently sloping and is a poorly drained, waterlogged depression with a few pools of open water. The deep semiliquid peat is blanketed by a 10–15 cm thick layer of sphagnum. Aquatic plants grow in the open water pools, which are fringed by sedges and a few grasses. There is no woodland like that on Gunung Tahan and Padang Temambong. In fact there is hardly any solid ground except for the hummocks at the base of a few scattered trees. The transition between the plant community on the waterlogged peat and the surrounding taller upper montane forest on the free-draining peat is sharp – sphagnum abruptly disappears and is replaced by a ground layer of the *Leucobryum* Hampe (*Leucobryaceae*) covering the dry peat. During our botanical foray, all vascular plant species were inventoried and fertile specimens collected (Chew et al. 2009).

Vegetation

Sphagnum L. (*Sphagnaceae*) covered most of the waterlogged area. Three species are recorded from Gunung Stong, a peak to the south-east of Padang Ragut, namely *Sphagnum junghuhnianum* Dozy & Molk., *S. perichaetiale* Hampe and *S. cuspidatum* C.Müll. (Damanhuri et al. 2005). Sedges that grew throughout the area were *Machaerina maingayi* (C.B.Clarke ex Ridl.) T.Koyama and *Actinoschoenus thouarsii* (Kunth) Benth. (*Cyperaceae*), both were especially abundant on the fringe of pools. The dominant grass was *Ischaemum timorense* Kunth (*Poaceae*). The herb with fleshy strap-like leaves, *Xyris grandis*, was also common.

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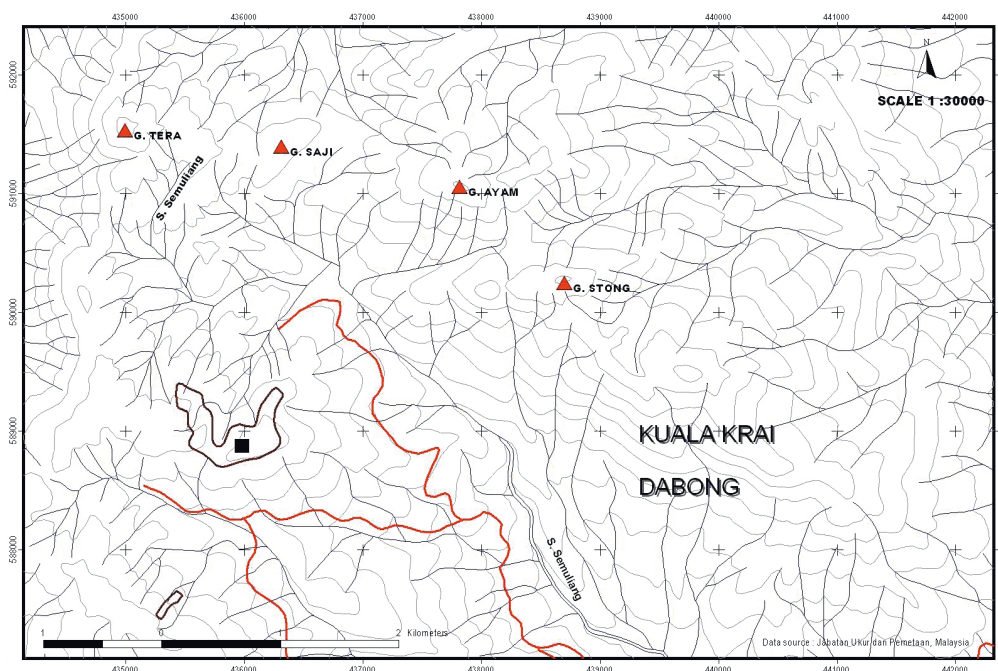


Fig. 1 Map of the Gunung Tera area, showing the chain of summits (▲) and a highland plateau (■).

The pools provided a habitat for aquatic plants such as the sedge, *Schoenoplectus mucronatus* (L.) Palla (Cyperaceae), with its base submerged in the liquid peat. Elephant footprints created a microhabitat for *Utricularia* species: *U. minutissima* Vahl grew on the vertical sides above the water level while *U. uliginosa* Vahl grew partly submerging in the puddle water.

Tree species were notably poor. The dominant species was *Leptospermum javanicum*, stunted, straggling and only c. 5 m tall with some *Baeckea frutescens* and a few saplings of *Dacrydium beccarii* Parl. (Podocarpaceae). The few scattered hummocks at the base of these gnarled trees supported terrestrial species, such as the ferns *Matonia pectinata* R.Br. (Matoniaceae), *Dipteris conjugata*, *Gleichenia microphylla* R.Br. and *Sticherus truncatus* (Willd.) Nakai (both Gleicheniaceae) and the herbs *Isachne globosa* (Thunb.) Kuntze, *Lophatherum gracile* Brongn. (both Poaceae) and *Burmanna disticha* L. (Burmanniaceae).

Unlike padang flora elsewhere, the epiphytic flora was extremely poor on Padang Ragut. Only a single individual each of the epiphytic ant plants, *Hydnophytum formicarium* Jack (Rubiaceae) and *Lecanopteris pumila* Blume (Polypodiaceae), were found. Epiphytic orchids were almost absent, just two species, *Dendrobium uniflorum* Griff. and *D. bifarium* Lindl. (Orchidaceae), were seen.

Differences between the Padang Ragut, Gunung Tahan and Padang Temambong floras

Unlike the padang floras elsewhere, Padang Ragut has a depauperate flora and appears to be the remnant of upper montane forest that has been modified by elephant activity. Elephant activity was evidenced by the network of elephant trails up the mountain side to the plateau and signs of feeding on small palms, gingers, *Xyris grandis*, and the *Machaerina* sedge. On the plateau itself there were many water-filled footprints and the open-water pools appear to be elephant wallows, all indicators of a high level of elephant activity. According to a local Malay guide, 'padang ragut' means a browsing area for elephants. This suggests that the sphagnum bog on Padang Ragut is the result of elephant activity that had modified upper montane forest. To test this hypothesis, a summit without any signs of elephant activity was chosen for comparison.

Gunung Kob, a mountain top free from elephant activity

The flora of Gunung Kob (1266 m), a nearby peak to north east of Padang Ragut, was inventoried. It is only accessible by an extremely steep and narrow ridge leading to the small peak. It is therefore not accessible to elephants and no signs of their presence was observed. The substrate was covered in a thick layer of dry peat. Its summit was covered by typical upper montane forest, which generally occurs above 1500 m (Whitmore 1990). The tree canopy was complete and the common trees found included *Baeckea frutescens*, *Leptospermum javanicum*, *Tristaniopsis merguensis* (Griff.) Peter G. Wilson & J.T. Waterh. (Myrtaceae), *Pentaphylax euryoides* Gardner & Champ. (Pentaphylacaceae), *Dacrydium beccarii*, *Podocarpus neriifolius* D. Don (Podocarpaceae) and *Styphelia malayana* (Jack) Spreng. (Ericaceae). These gnarled trees (c. 5 m) grew on a thick peat layer and at the tree base was an abundance of bryophytes, mostly leafy liverworts but including some *Sphagnum*. *Nepenthes gracillima* Ridl. hung from the gnarled branches. *Gahnia baniensis* Benl and *Machaerina maingayi* (Cyperaceae) were the only two sedges found. Epiphytes were common and among those in flower were *Chelonistele sulphurea* (Blume) Pfitzer, *Bulbophyllum* cf. *coniferum* Ridl. and *Dendrobium uniflorum* (Orchidaceae). *Dipteris conjugata*, *Gleichenia microphylla* and *Matonia pectinata* were the common ferns observed.

DISCUSSION

All the trees found on Padang Ragut were also found on Gunung Kob, as were several other species such as *Machaerina maingayi*, *Dendrobium uniflorum* and *Sphagnum*.

The major difference was the poor diversity of species on Padang Ragut, probably due to the semi-liquid peat and trampling by elephants. However, the paucity of epiphytes is more difficult to explain but perhaps may be due to the exclusion of ants by the waterlogged soil.

On the other hand, species that grew on Padang Ragut but were absent on Gunung Kob were all species associated with waterlogged soil, such as *Schoenoplectus mucronatus*, *Utricularia* species and *Xyris grandis*. Elephant trampling also

keeps the peat churned up, preventing the establishment of trees. In addition, water absorbance by sphagnum raises the water table leading to anaerobic conditions in the rhizosphere that many trees are intolerant of.

CONCLUSION

The Padang Ragut flora is derived from upper montane forest and, by a combination of topography (slightly depressed plateau) and the zoogenic factor (regular trampling and churning by elephants), has turned the peat semi-liquid interspersed with pools of open water. This has provided the ideal habitat for lush growth of *Sphagnum* so that now a sphagnum bog blankets the area. This plant community is unique and has not been observed elsewhere in Peninsular Malaysia and indeed it has nothing in common with padang vegetation. A second sphagnum bog was encountered on the saddle between Gunung Ayam and Gunung Tera, where similar signs of a high level of elephant activity were also observed.

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