XV. STATE OF BIODIVERSITY STUDIES: SUMATRA AND PENINSULAR MALAYSIA COMPARED[1]

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Sumatra and Peninsular Malaysia are both part of Sundaland together with Borneo and Java. Vegetation studies by Laumonier (1990, 1997) show the Sumatra flora is most similar to that of the Peninsula (sharing 49% of species) compared with those of Borneo (45%) or Java (37%).

From the literature, opinions about the Sumatran flora seem contradictory. On the one hand, Van Steenis (1987) noted the peculiarity of the low number of endemic genera in Sumatra, 13, compared with 24 in Peninsular Malaysia (Johns, 1995). On the other hand, Sumatra boasts one of the two Malesian endemic families, the Pentastemonaceae, while the Peninsula has none.

Davis et al. (1995) estimated that the Sumatran flora comprises about 10,000 species, more than the Peninsula with 7,660 species but considered that endemism at the species level was much lower, about 12% compared with 45% in Peninsular Malaysia.

From this, one thing is very clear – the flora of Sumatra is very poorly known compared with that of Peninsular Malaysia for which there are basic floras, Ridley's Flora of the Malay Peninsula (1922–1925), the four-volume Tree Flora of Malaya by Whitmore & Ng (1972–1989), a recently updated checklist (Turner, 1997), as well as monographs for dipterocarps, ferns, orchids, grasses, rattans, etc., and checklists for specific localities and ecosystems, such as Chin's checklist of limestone plants (1977–1983). In contrast, the only flora for Sumatra is that of Miquel (1860–1861), long outdated, there is only a checklist for trees (Whitmore & Tantra, 1986), and very few monographs, for example, for *Impatiens* (Grey-Wilson, 1989), orchids (Comber, 2001) and *Nepenthes* (Clarke, 2001). There are no modern and comprehensive checklists for localities, even for national parks. Outstanding from the biodiversity point of view is Laumonier's comprehensive vegetation survey (Laumonier, 1997).
[Editor's note: based on an unpublished thesis (2000) on the Compositae of Sumatra Tjitrosoedirdjo (2001) listed 126 ('122') species of which 6 are endemic against 61 and 3, resp., in Peninsular Malaysia (Turner, 1997).]

With the little we know, how big is the flora of Sumatra likely to be? The number of species recorded from Peninsular Malaysia is 7,660 (Turner, 1997). The number of species in Sumatra is likely to be much higher based on land area (Sumatra covers 472,610 km^2 compared with Peninsular Malaysia's 131,598 km^2) and, while they share many of

1) Based on a paper presented at the 3rd International seminar on tropical rainforest plants and their utilization for development, University of Andalas, Padang, Sumatra, 23–24 October 2001.

the same plant communities, e.g. lowland mixed dipterocarp forest, peat swamp forest, fresh water swamp forest, mangroves, coastal forest, hill forest, lower and upper montane forest, and forest on limestone, Sumatra has many that are not found or are more poorly represented in Peninsular Malaysia, such as deciduous monsoon forest, heath forest, grasslands, blang, vegetation associated with volcanoes, lake margins, montane limestone, and subalpine forest. The highest mountain in the Peninsula is only about 2,000 m a.s.l. compared with 3,805 m in Sumatra.

Another way to calculate the size of the flora is by taking the number of orchids that represent about 10% of species in the Malesian flora (11% for Peninsular Malaysia). This would give 11,800 species for Sumatra, based on the 1,180 species recorded by Comber (2001), far more than the Peninsula's 7,660.

Some genera for which revisions are available (Table 1) also suggest that many groups are better represented in Sumatra. The notable exception is the Dipterocarpaceae.

The lower species number for genera like *Monophyllaea* and *Paraboea* that are most speciose on limestone is clearly an artifact of under-collecting in Sumatra where limestone has hardly been botanically explored. Under-collecting is indeed a major problem in Sumatra. Laumonier (1997) calculated that there were only 24 herbarium specimens per km^2 for Sumatra compared with 175 in the Peninsula. This would explain the great discrepancy in, for example, the number of *Henckelia* species in the Peninsula (90 species) compared with only 12 described from Sumatra.

Several taxa that are better represented in Sumatra are those where the majority of species (Ericaceae, *Impatiens*, and *Nepenthes*) are montane. Considering that the Barisan Range is far more extensive than the Main Range in the Peninsula and reaches much higher altitudes, the Sumatran montane flora is likely to be much more species rich. Collecting has centred on Gunung Leuser, the Lake Toba area and Gunung Kerinchi, leaving much of the Range unexplored (Ashton, 1989).

Table 1. Species number and endemicity in some Sumatran and Peninsular Malaysian plants.

	Sumatra		Peninsular Malaysia	
	No. spp.	% endemicity	No. spp.	% endemicity
Dipterocarpaceae	95	10	156	16
Elaeocarpus	34	38	42	47
Ericaceae	76	59	47	44
Impatiens	30	96	11	72
Monophyllaea	5	80	7	71
Nepenthes	29	76	10	50
Orchidaceae	1118	41	850	27
Paraboea	6	80	18	77
Rhaphidophora	15	26	15	13
Schismatoglottis	16	56	7	14
Compositae	126	5.5	61	5

Another point is that there are many new species already collected but still undescribed and many groups of plants that are still under-collected. For example, Sands (2001) considers there are at least 56 taxa of *Begonia* represented in herbarium but only 36 have been described. Even for trees, Laumonier (1990), who recorded 2,500 tree species during the course of his vegetation survey, estimated that these represented only between 70–80% of the total tree flora, which would bring the figure to 3,000 species and close to that for the Peninsula. Comber (2001) estimated that the number of orchids will increase by 10% as many new species await discovery.

So what can these figures tell us? The estimate of 10,000 (Davis et al., 1995) is probably within the right order of magnitude but is probably on the low side. However, the estimate for the level of endemism at 12% is far too low.

Apart from the Dipterocarpaceae, a lowland group that was able to be dispersed between Borneo, Peninsular Malaysia and Sumatra when they formed a single land mass during the Ice Ages (Johns, 1995), all the other groups in Table 1 exhibit much higher levels of endemism than 12%, which are comparable to, or even higher than, those in the Peninsula. Even for trees that tend to be more widespread than herbs, the levels are quite similar: Laumonier (1990) estimates 20% for Sumatra's 2,500 tree species; while Ng (1991) gives 26.4% for the 2,830 species in Peninsular Malaysia. For non-climbing herbs that make up about 30% of the flora, there is no difference between the levels for Peninsular Malaysia and Sumatra (between 40–97%), while for ferns Sumatra shows much higher endemism with 46 endemic species compared with only 8 in Peninsular Malaysia (Johns, 1995).

The biodiversity of Sumatra is fascinating, not only are there a wide range of plant communities but there are also 19 distinct subfloristic divisions (Laumonier, 1990, 1997) and the phytogeographical links are various: with Borneo and Peninsular Malaysia, with the Indochinese flora in the north, the Javanese mountain flora to the south, and the Riau Pocket that includes southern Sumatra, southern and eastern Peninsular Malaysia and west and north-west Borneo (Ashton, 1989; Laumonier, 1997). Because of this, no single area can protect more than a small fraction of Sumatra's flora. In an attempt to prioritize biodiversity hotspots, only six localities were identified (Davis et al., 1995). This contrast with Peninsular Malaysia for which 11 areas were identified with an additional 21 localities pinpointed for limestone and 17 for montane areas.

Table 2. Centres of plant diversity for Sumatra (Davis et al., 1995).

	size (km^2)	altitude (m)	estimated no. spp.
G. Leuser NP	9000	0–3466	2000–3000
Limestone	5000	150–1500	1500–2000
Barisan Selatan	3650	0–1964	?
Tigapuluh Mts	2000	150–800	2000–3000
Berbak Game Reserve	1750	0–16	?
Kerinchi-Seblat NP	1485	200–3805	2000–3000

The first point to note is that there are no comprehensive, up-to-date checklists for any of these localities and that for two there are no floristic data at all. These two data deficient sites, Barisan Selatan and Berbak Game Reserve, are included because lowland forest is such an endangered ecosystem in Sumatra. It is estimated that less than 1% of lowland forests is left. For the montane ecosystems, the Kerinci-Seblat NP, representing mountains of volcanic origin, and Gunung Leuser of non-volcanic origin, are both relatively well collected, the latter by the intensive and extensive botanical explorations of De Wilde & Duyfjes between 1972 and 1985. The Tigapuluh Mountains represent the Riau Pocket. For limestone no specific locality is mentioned, nor do any inventories or publications exist.

This lack of information is chronic. It hampers conservation of rare and unique species simply because it is not known where they occur or how local they are. It restricts the value that can be gained from useful indigenous plants when there are insufficient resources to identify them or know where they grow. It reduces the appreciation of the value of natural ecosystems for sustaining water supplies, preventing erosion, siltation and flooding. It hampers scientific discovery by local scientists in both in the recognition of new species, new bioactive chemicals and pharmaceuticals, and prevents publication in international-standard journals, and this in turn undermines the expertise and level of teaching in local institutes, which produce the next generation of botanists.

This all points to the urgent need for collecting herbarium specimens (Ashton, 1989; De Wilde, 1989; Laumonier, 1997) with a focus on lowland areas that are vanishing at a rapid rate and little known areas such as limestone hills and mountain peaks. Even in 1987, Whitten et al. reported that 70–80% of lowland forest and 30% of forest in mountains was lost. With such widespread deforestation, the specter of extinction becomes very real and even a conservative estimate of 2% extinction rate (Kiew, 2001) translates into about 200 extinct species. De Wilde & Duyfjes (2001) have already reported several species collected early in the last century that have not been collected since.

Ashton (1989) and De Wilde (1989) both noted that there were no local Sumatran institutes that could carry out wide ranging biodiversity surveys. In Sumatra, taxonomy and botanical exploration is based in local universities, which are hampered by a lack of staff, taxonomic literature, and authoritatively identified herbarium specimens, not to mention financial hardship since the recent currency crisis. Ashton (1989) has gone so far as to say "From the mid 1970s the rate of inventory of the regional flora has seriously declined to a point where it is now derisory". Although Indonesia was the recipient of a GEF grant for biodiversity inventory, this has hardly changed the situation in Sumatra.

Laumonier (1990) makes the additional point that there is a severe lack of local floras and manuals that can be used by students or local researchers to get a grasp of the local flora. Although Whitten et al.'s Ecology of Sumatra is important in filling a gap in local knowledge and is especially useful in providing an overview, its ecological approach does not address the barrier to carrying out local ecological research, namely how to identify the species? And without the possibility of accurate scientific names how can the local academic publish his research?

Ashton (1989) suggested that international collaboration is one way forward with local institutes acting as co-sponsors. Indeed, it was the Japanese universities collaboration with Andalas University, Padang, that added a new endemic genus, *Furtadoa* (Araceae), to the Sumatran flora (Hotta, 1981). Overseas specialists can contribute a great deal in transfer of knowledge and expertise, contributing to accurate identification of herbarium specimens, providing obscure and difficult-to-get literature, and collaborating on revisions that can be published internationally. One setback is that grants for scientific research are generally on a shoe-string so most scientists cannot come with bags of money but they can compensate by coming with bags of enthusiasm. It was personal enthusiasm, largely self-funded, that produced the two recent fine monographs on the orchids and pitcher plants of Sumatra. Sumatra is an exciting place botanically – there are certainly new species, even genera, waiting to be discovered and described, as well as little-known plant communities with high endemism, such as limestone, mountains in Aceh, the Indragiri coastal hills, and many more, awaiting botanical exploration.

How else can the vast lacunas in our knowledge and understanding of the biodiversity of Sumatra proceed at an increased rate but with international collaboration? The ratio of botanists to plant species in the tropics will never be sufficient, but international collaboration can help to fill the gap, especially if research permits can be granted with the same speed as logging and clearing of the Sumatran flora is proceeding.

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