

IX. ON THE SPECIAL BOTANICAL CHARACTER OF THE LEUSER PARK AND VICINITY, WITH EMPHASIS ON THE HIGH MOUNTAIN BLANG VEGETATION OF NORTHERN SUMATRA

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SUMMARY

'Blang' is the Gayo name for the extensive, open, grassy, lowland savanna land of their area in Aceh, N Sumatra. By analogy, the open areas with heath-like vegetation high in the mountains are called 'mountain blang'.

There are two somewhat intergrading types: a wet and a dry one. They are believed to have been caused by regularly burning since immemorial times by hunters, but our explanation is that they have (at least largely) developed for edaphic reasons, i.e. are due to prevailing climatic conditions on very poor, leached-out and almost impermeable kaolinitic soils. Their extension was possibly enlarged by occasional frost and burning, which may account for the sometimes, but not at all always, sharp demarcation with the surrounding stunted forest. The wet-type blang probably is maintained by the absence of woody species which cannot stand the permanent water-soaked conditions of the peat soil under the boggy vegetation.

It is advanced here that the mountain blangs, although in total they may cover only a few square kilometres, merit the status of a high-ranking vegetation formation of their own, next to the subalpine ericoid forest, rather than being included in the latter as accepted for the whole of Sumatra. This is supported by: 1. its floristic composition, including a number of 'northern' as well as 'eastern' elements and a remarkable number of very local endemic species on the old, largely non-volcanic N Sumatran mountains, compared to those over base rock of volcanic origin as found on the high mountains of the rest of the Barisan Range, possibly in connection with isolation by the relatively recent volcanic Toba eruptions; 2. the singular physiognomy of the high mountain blang vegetation, located on a number of high mountains in restricted areas in N Sumatra; 3. the edaphic, non-anthropogeneous origin, both of the dry and the wet types of the blang.

INTRODUCTION

While compiling a brief survey of the vegetation of the Gunung Leuser National Park for 'Leuser, a Sumatran sanctuary' (De Wilde & Duyfjes, 1996) and treating the biodiversity of this natural reserve, our attention was drawn again to the remarkable subalpine heath-like vegetations unique to several high mountains of northern Sumatra, the so-called high mountain blang (Fig. 1). Similar vegetation types are known from other high tropical areas in- and outside Malesia (see for instance the many pictures of New Guinea vegetation types in Van Royen, 1979, and their composition in Hope, 1976, Chapter 8), but how these relate to the Sumatra type is not studied here.

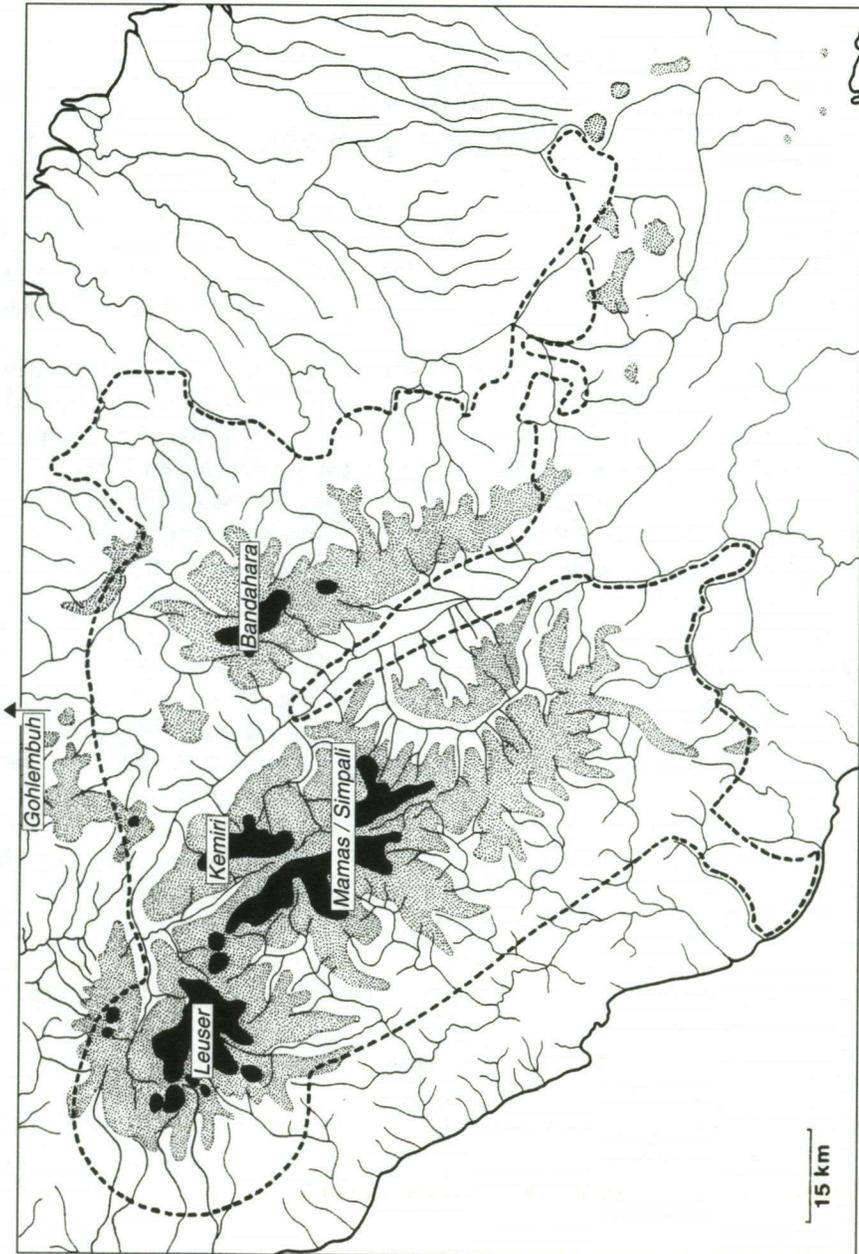


Fig. 1. Approximate areas of the Leuser Park above 2500 m altitude where high mountain blangs occur (black), with names of the most important mountain summits. Adapted from N.J. van Strien, Management Plan Leuser Park, 1978.

The Leuser Park mainly consists of a complicated rugged mountain complex covered by forest, which can be described by using the generally accepted forest formations according to altitudinal climatic zonation. This is also one of the leading criteria for defining the vegetations accepted for the vegetation map of Sumatra. On the map for northern Sumatra (Laumonier et al., 1987) the vegetation of the top zone of the high mountains above 2700 m were qualified as "low forest and thicket of the ericaceous zone", leaving out the blangs as a separate vegetation type.

The blang vegetation was discovered by Van Steenis during the Leuser expedition of 1937 (Van Steenis, 1938) and was further sampled by us in more recent times during extensive expeditions in the summit areas of several high mountains within the Leuser Park (De Wilde & Duyfjes, 1994).

THE BOTANICAL EXPLORATION TOURS BY C.G.G.J. VAN STEENIS IN THE GAYO LANDS, ACEH, 1937

The scientific interest in the flora of northern Sumatra, especially that of the non-volcanic mountains of Aceh, was initiated by Van Steenis prompted by his study on the origin of the mountain flora of Malesia (Van Steenis, 1934–1936). This suggested that the flora of the high mountains of Aceh might have played a major role. Accordingly, in 1937 Van Steenis explored Mt Leuser as well as some other high mountains in the vicinity, all above 3000 m altitude. In 1934 during a preliminary orientation tour in the area he visited the surroundings of Lake Takengon and climbed some higher mountains nearby. These, although not reaching 3000 m altitude, yielded some most exciting species with a distinct northerly affinity, e.g. *Pyrola sumatrana* (Pyro.), *Swertia bimaculata* (Gent.), and *Schoepfia fragrans* (Olac.), suggesting even more spectacular records to be discovered on the other still higher summits in the area.

Van Steenis (1938) extensively related his explorations in a paper with many beautiful, clear and illustrative photographs of the vegetation and species, which unfortunately has not become generally known. He was much perturbed when Merrill (1940) preemptively, so he felt, published several of 'his' new species and awaiting identifications of his own collections by true specialists he never came to a full and detailed report of the scientific results of the 1937 expedition.

In this brief analysis of the flora and vegetation we have, on his own urgings, included his observations which modified his ideas of 1936 on the cause of the pathways along which mountain plants moved into Malesia.

ON THE CAUSE AND CHARACTER OF THE HIGH MOUNTAIN BLANG

There has been some dispute regarding the reason for the presence of the high mountain blang, that is, the rather extensive low heather-like vegetation on flat or slightly sloping plains in the summit areas of the larger mountain complexes in the Gayo Lands. Van Steenis was the first botanist to see and study it during his 1937 expedition, although the blangs will have been known long before by local people, and later by the military and the geographers. According to his report (Van Steenis, 1938) blangs were caused by the regular or incidental burning by local hunters during dry spells. Indeed, in 1937, an extensive, recently completely burnt forested slope and ridge of some 15 kilometres

length at the East side of Mt Leuser, was seen. Also, because soil samples taken from underneath the blang appeared to be similar to those taken from adjoining scrub forest, Van Steenis argued that in the blang areas the humus-rich layer of top soil had been burnt and washed away by rains after the burning of the original scrub forest, so that conditions for regrowth of taller vegetation had become unfavourable. This is the now generally accepted explanation of most of similar extensive low vegetation areas of high elevation in New Guinea and elsewhere.

Hoogerwerf (1939), in his preliminary zoological report on the same expedition of 1937, doubted Van Steenis' assumptions and explanation, reasoning that the washing away of the topsoil layer of the usually almost horizontal blang terrains was unlikely, and he rather believed that the blang originated on areas with naturally poor soils. This latter explanation was corroborated by the extensive research by the pedologist Van Beek (1982), who found that the soil of the blang is extremely infertile and that its special vegetation should be attributed to edaphic properties, particularly to the lack of plant nutrients. These soils, largely over quartzitic base rock, appeared to be very old. They lay generally more than 2.5 m thick, and consist of deeply, intensely, weathered-out almost impermeable kaolinitic clay, sometimes mixed with some quartzitic sands, largely formed already before the geological upheaval of the mountains. The thick peaty soil layer under the wet blang started developing over these poor, impermeable, soils more recently, apparently some 8000 years ago, after the last Pleistocene ice covering.

Whitten et al. (1984) comprehensively reported on a visit to the Mt Kemiri summit area and commented on the observed slow rate of decay of plant materials and flora regeneration. They attributed the blang ("a complex of grassy, heathy, and boggy areas"), at least for the wet parts, to soil factors, alluding to the more recent notion, held by Van Steenis (personal communication to Whitten and the authors), that in the Malesian region no (sub)alpine tree species occur which can stand permanent inundation. Whitten et al. (1984, opposite p. 396) gave a beautiful colour photograph of peaty blang. Other photographs of the N Sumatran mountain blang habitat were published by Van Steenis (1938), Hoogerwerf (1939, f. 89), Kern (1976) in his treatment of *Cyperaceae* for Malesia, Van Beek (1982), and De Wilde & Duyfjes (1994, 1996).

From the foregoing we can conclude that the cause and character of the high mountain blang areas, including the wet and the dry facies, in the Gayo Lands, N Sumatra, is complex, and largely set by the following circumstances:

1. The presence in the Gayo Lands (unique for Sumatra) of old partially glaciated flattish land forms in the cold top zones of the old non-volcanic high mountain complexes, with soils mainly over quartzitic rock and shales.
2. The equally unique presence at high altitudes of old, thick strata over these flat lands of impermeable kaolinitic putty-like soil of very low fertility, on which low heath-like vegetation, partly forming thick water-soaked layers of peat soil could develop; the peat may be ombrogenous and/or topogenous on account of seepage from higher slopes.
3. The absence in Malesia of (sub)alpine tree species which can stand the permanent inundation conditions in these peaty lands; the adjoining and interspersed well-drained sites, like sloping places, hummocks and hillocks are grown with subalpine ericoid low forest or scrub.

4. The regular or incidental burning in places of the low forest and ericoid scrub vegetation, on these poor soils, with the washing off of the top soil layer with minerals, leaving either a thin fine whitish quartzitic sand layer, or bare rock, has caused, under the cold high mountain conditions, the dry variants of blang, and, anyway, will have enlarged the total area of dry-land blang vegetation; the sometimes sharp demarcations of blang and scrub also point to this.
5. A distinct, physiognomically characteristic type of low heath-like vegetation, with characteristic floristic composition, including special life-forms such as 'Polster' plants (cushion- or ring-shaped growth forms), 'Spalier' shrublets (wind forms), and a comparatively high number of distinct endemic plant species, unique for this particular area, often with relationship to congeners of remote northern or eastern distribution (see also next chapter).

All this pleads for the distinction of a separate vegetation type for the northern Sumatran high mountain blang vegetation, to be recognized beside subalpine ericaceous low forest and scrub.

THE SPECIAL CHARACTER OF THE FLORA OF NORTHERN SUMATRA

In general characteristics the vegetation and floristic composition of Sumatra agrees with that of the rest of W Malesia. Especially the lowland and the (lower) montane flora of phanerogams and ferns links up with that of Peninsular Malaysia. According to Van Steenis (1987) Sumatra as a whole is comparatively poor in endemics: there are only 13 endemic genera of phanerogams and in comparison to the other large Malesian islands there are few endemic species. The flora is generally homogeneous as well, but the northern part, roughly the area around and north of Lake Toba, appears to be distinct from the rest of the island. The same was also found for the fauna by McKinnon (see Whitten et al., 1984: 58–60, and in Laumonier et al., 1987). This distinction is evident in the floristic composition of all vegetation formations, but is most pronounced in the montane and subalpine low forest and scrub vegetation and especially in the high mountain blang flora.

Perhaps a large part of the explanation lies in the gigantic Toba eruptions, only about 75,000 years ago, which smothered existing plant growth, blocked dispersal, and, later on, offered new and different soils with opportunities for plant settlement and subsequent speciation. The distinctiveness of the high mountain blang flora, restricted to the Gayo Lands, seems to be related to the largely old and non-volcanic origin of these mountains, in contrast to the volcanic character of the rest of the Barisan Range. Because these Gayo mountains are much older, it is enigmatic why a comparatively large number of species remained restricted to this area in Sumatra. They have not spread outside this area in the high main chain of Sumatra, unlike many other high mountain plants with a wide distribution along the pathway of the Himalaya dispersal track.

Also the relatively dry, seasonal climatic condition in the remote north of Aceh (outside the Leuser area) may account for part of the distinctiveness of northern Sumatra.

Regarding the origin of the allochthonous mountain flora in Malesia Van Steenis (1934–1936, 1938) postulated the existence of three tracks over past and present mountains, through which these microtherm plants arrived in the region. For Sumatra two

tracks are relevant: viz. 1. the Himalaya track, reaching via Java as far East as the Lesser Sunda Islands, and 2. the eastern Kinabalu track, from Australasia, via New Guinea and Kinabalu extending as far West as to the Gayo mountains in the northern tip of Sumatra. The main evidence of this latter track within Sumatra is the unique occurrence of species of genera of typical eastern distribution, including Kinabalu, such as *Patersonia* (Irid.), *Oreobolus* (Cype.), *Danthonia* (*Monostachya*) (Gram.), and *Centrolepis* (Cent.). It is supposed that the Kinabalu track is much older (Cretaceous), as compared to the Himalaya-Java track (Tertiary), which stresses the more the strange isolated character of the mountain flora of Aceh. [One problem here is that the first known *Gramineae* date from the Middle Eocene in S America and W Australia, so that *Danthonia*, a fairly derived genus, would seem to be too 'young'. The problem with at least the first track is that the present mountains are mid-Miocene (15 Ma) or younger. It presupposes the presence of former mountain ranges now more or less completely eroded away. The first record of grasses in Australia is from the middle Eocene (c. 43 Ma) and the family is virtually absent until the middle Miocene (14 Ma). At that time a graminicolous fauna also appeared. Grass-dominated woodlands and savannas seem to date from the Pliocene, 4.5 Ma ago (Jacobs et al., 1999). Ed.]

A well-known example of an Himalaya element reaching far into Malesia along this track is *Primula prolifera* (Prim.). Species indicative of this track are the Sumatra endemics *Senecio dewildei* (Leuser) and *S. sumatranus* (Aceh to G. Dempo) (Comp.). A remarkable distribution is shown by *Petrosavia* (*Protolirion*) *sakurarii* (Petr.), described from Japan, later found also in S China, Taiwan (H. Ohashi, TUS, pers. comm.), Myanmar, and N Sumatra (Gayo Lands, West Coast). Examples of mainly continental SE Asian larger genera with one (or few) species radiating into Malesia and occurring on various high mountains, also, but not exclusively, on Leuser, and not confined to the Himalaya-Barisan track, are, among several, *Ainsliaea latifolia* subsp. *henryi* (*A. pteropoda*, *A. reflexa*; Comp.) or *Aletris foliolosa* (Lili.).

As said above, the analysis of the by now extensive plant collections from northern Sumatra, has demonstrated that the whole of the Leuser area (Leuser mountains with adjacent areas) is floristically distinct, and represents a separate plant-geographical unit within the region. Primarily this concerns the high mountain flora, but it also holds for the montane and colline altitudes. This is expressed by a comparatively high number of species with their distribution in Sumatra restricted to that area, including many true endemics.

FLORISTIC ANALYSIS

To illustrate the particular exclusive character of the floristic wealth of the Leuser area, the distribution of as many as possible species known from the area was checked. Here-with should be remembered that a large part of the collections still await treatment by specialists, and also that we may be ignorant of new findings, so that the evidence is still defective. There is also the problem of nomenclatural instability.

With the term Leuser area, s.l., is understood the whole region of the Gayo and Alas Lands comprising the largely non-volcanic complex of the northern Barisan Range, situated in, and in the close vicinity of, the Leuser Park, including the mountainous area to

the North, hence including Mt Goh Lembuh (outside the Park) up to the north to the Takengon area with the mountains Bur-ni-Telong and Bur-ni-Geredong (the latter two being volcanic), and also including the area towards Sibolangit, SE of the Park.

With the term floristic wealth we mean the number of species (and genera) which have been found in Sumatra till now (almost) only in the Leuser area.

The plant species, phanerogams and ferns, which demonstrate the floristic wealth of the Leuser area, can be classified into the following five categories; most species have been found solely in the Leuser Park, others can also be found elsewhere:

1. South-East Asian species, i.e. species with their main distribution in continental SE Asia, and also found in the Leuser area. See Veldkamp & Moerman (1979: 466).
2. Easterly species which have in the Leuser area their most westerly locality. See e.g. the note by Schouten & Veldkamp (1985: 325).
3. Local endemic taxa, which are, as judged from other species within the genus, either of Sumatran, or SE Asian, or easterly, or uncertain affinity.
4. Species which occur in Sumatra exclusively in the Leuser area and in Peninsular Malaysia; species mostly of genera with their main distribution in SE Asia.
5. Species with a wide distribution; in Sumatra for some reason only or almost exclusively found in northern Sumatra, i.e. in the Leuser area.

Most species are colline or montane, or subalpine; those marked with an asterisk * are possibly typical for the high mountain blang or low open scrub vegetation, those marked with (A) are local endemic species of SE Asian affinity.

LISTS OF SPECIES FOR FLORISTIC ANALYSIS

1. South-East Asian species, in Malesia (almost) exclusively found in the Leuser area

This category closely links up with local endemic species marked with (A) of category 3 (see below):

**Anemone rivularis* — Ranu. — Sri Lanka, Himalayas

**Aniselytron treutleri* (*Deyeuxia pseudopoa*) — Gram. — Sikkim to S China, Japan, Taiwan, Kinabalu

Broussonetia kurzii — Mora. — Myanmar, Thailand

Carex teinogyna — Cype. — SE Asia, Japan, Korea; one collection from E Kalimantan

Cheilothea (*Monotropastrum*) *humile* — Eric. — SE Asia

Chikusichloa mutica — Gram. — S China, Hainan

Cyclea atjehensis — Meni. — N Thailand

Geranium nepalense — Gera. — (In Sumatra once near Laut Pupanji) SE Asia

**Haloragis philippinensis* — Halo. — SE Asia, Luzon, not on Kinabalu [map in Van der Meijden & Caspers, Fl. Males. I, 7 (1971) 243]

Hypericum uralum — Hype. — SE Asia, in Sumatra S to Mt Kerinci

Microtopis wallichiana — Cela. — Sri Lanka, Kinabalu

Mimulus tenellus — Scro. — Himalayas

Panicum khasianum (*P. oblongispiculum*) — Gram. — Himalayas

Pentaphragax euryoides — Pent. — SE Asia, also Peninsular Malaysia (Pahang, Selangor)

- Photinia davidiana* — Rosa. — N Vietnam to S China, Kinabalu
Rhus succedanea — Anac. — India to Japan, also West Coast Sumatra (Mt Sago)
Schoepfia fragrans — Olac. — Nepal to SW China
Swertia bimaculata — Gent. — disjunct in E Himalaya, Japan
Terminalia myriocarpa — Comb. — India to Yunnan [map in Exell, Fl. Males. I, 4 (1954) 555]
Teucrium wightii — Labi. — India to Guangdong
 **Viola biflora* — Viol. — Circumboreal
Zanthoxylum acanthopodium — Ruta. — SE Asia, also Peninsular Malaysia

Remarks

- There is some connection with the mountain flora of Kinabalu (*Microtropis*, *Photinia*).
- Some species are montane (*Broussonetia*, *Carex*, *Cheilothecca*, *Cyclea*, *Terminalia*, *Zanthoxylum*), others are subalpine.
- Some species have a very disjunct distribution, e.g. *Mimulus*, *Swertia*, *Viola*.
- For the genera *Cheilothecca*, *Chikusichloa*, *Mimulus*, and *Schoepfia* the Leuser area is the only locality within Malesia.

2. Easterly species, with the Leuser area as the westernmost locality

- Blechnum fluviatile* — Ferns — New Zealand, through Malesia, Philippines, Kinabalu
 **Centrolepis fascicularis* — Cent. — Disjunct between Leuser and New Guinea, Australia (N.S. Wales, Queensland) [map in Ding Hou, Fl. Males. I, 5 (1957) 424]
 **Danthonia oreoboloides* — Gram. — Kinabalu, Sulawesi, Luzon, New Guinea (not in Java, Lesser Sunda Islands, Moluccas)
Haloragis chinensis — Halo. — C, E Malesia to China [map in Van der Meijden & Caspers, Fl. Males. I, 7 (1971) 243, incl. Kinabalu]
Korthalsella geminata — Visc. — Peninsular Malaysia (Kedah, Malacca, Pahang), E Borneo (not from Kinabalu), Flores
 **Oreobolus kuekenthalii* — Cype. — Peninsular Malaysia (Pahang, Perak), Sarawak; the Leuser is the westernmost locality of the genus [maps in Kern, Fl. Males. I, 7 (1974) 682, 685]
 **Patersonia lowii* — Irid. — Borneo (Kinabalu, Murud), Mindoro, New Guinea [map in Geerinck, Fl. Males. I, 8 (1977) 80]; the Leuser is the westernmost locality of the genus
Podocarpus atjehensis — Podoc. — also New Guinea (Wissel Lakes) [map in De Laubenfels, Fl. Males. I, 10 (1988) 408]
 **Potentilla borneensis* — Rosa. — Kinabalu¹
 **Schoenus maschalinus* — Cype. — Philippines, New Guinea, Australia, New Zealand
Stackhousia intermedia — Stac. — disjunct with E Malesia, Micronesia, Australia [map in Brouwer, Fl. Males. I, 4 (1948) 35]
Trigonobalanus verticillatus — Faga. — Peninsular Malaysia (Pahang), C Sulawesi, Sarawak [map in Forman, Fl. Males. I, 7 (1972) 403]

1) The N Sumatran specimens have been described by Soják [Preslia 64 (1992) 221] as *Potentilla sumatrana*, a local endemic species not related to *P. borneensis*, but rather to species in the Himalayas].

Remarks

- A rather mixed group as regards the main distribution of the genera: some are clearly of eastern affinity (*Centrolepis*, *Danthonia*, *Oreobolus*, *Patersonia*), others appear to have a boreal origin (*Potentilla*, *Trigonobalanus*, the latter with 2 species in SE Asia, 1 in Colombia, and fossils from the Eocene in Europe).
- Except for *Korthalsella* (partly) and *Trigonobalanus*, all species occur in the subalpine zone, and most are from the mountain blang.
- Most species are also known from the Kinabalu.
- Most species have very disjunct areas, with gaps at least to the Kinabalu (e.g. *Centrolepis*, *Schoenus*, and others).
- Some of the genera are not truly of eastern origin, for instance *Korthalsella*, *Potentilla*, *Trigonobalanus*; see also the first remark.
- *Haloragis chinensis* and *Stackhousia intermedia* have a wide distribution in East Malesia, but have a small western outlayer in the Sumatran Karo-Batak area, reaching the Leuser area. These species obviously prefer open, regularly burnt grassy plains, but it is singular that the distribution in Sumatra has remained so limited in extent.

3. Local endemic taxa

A: species with SE Asian affinity; *: subalpine species

Note: Recently described taxa may have been omitted as new ones are still regularly discovered among the Leuser collections and we are not always notified of their description.

(A) *Anneslea steenisii* — Thea.

**Anthoxanthum horsfieldii* var. *sumatranum* — Gram. — the species ranges from S India to Japan with 6 other varieties in Malesia [Schouten & Veldkamp (1985)]

Baccaurea aff. *racemosa* — Euph. — *De Wilde 12096, 12192*, etc.

Bulbophyllum adelphidium — Orch.

Calamus mogaee — Arec.

Canarium karoense — Burs.

Crepidium dewildeanum — Orch.

Crepidium flammeum — Orch.

Crepidium vermeulenianum — Orch.

**Cymbidium hartinahianum* — Orch.

Cynometra spec. nov. — Legu.

Daphniphyllum woodsonianum — Daph.

Deyeuxia atjehensis — Gram.

Didymocarpus vandaalenii — Gesn.

Diplycosia atjehensis — Eric.

Diplycosia brachyantha — Eric.

Diplycosia cinnabarina — Eric.

Diplycosia glauciflora — Eric.

Diplycosia pubivertex — Eric.

Diplycosia tetramera — Eric.

Disepalum platypetalum — Anno.

- Drypetes dewildei* — Euph.
Elaeocarpus dewildei — Elae.
Elaeocarpus mamasii — Elae.
 **Emilia sonchifolia* var. *lanceolata* Tjitrosoedirdjo, ined. — Comp.
 **Epigeneium pulchellum* — Orch.
 **Eriocaulon pachystroma* — Erio.
Eurya steenisii — Thea.
 **Festuca sumatrana* — Gram.
Galium spec. nov. — Rubi.
 **Garnotia spadicea* — Gram.
Gaultheria acroleia — Eric.
Gaultheria atjehensis — Eric.
Gaultheria barbatula — Eric.
Gaultheria kemiriensis — Eric.
Gaultheria losirensis — Eric.
Gaultheria pernettyoides — Eric.
 **Gentiana pachyphylla* — Gent.
 **Gentiana ulmeri* — Gent.
Gigantochloa several new sp. — Gram.
Gomphostemma dolichobotrys — Labi.
Gordonia (aff. *vulcanica*) — Thea.
Gymnanthes remota — Euph.
 **Helictotrichon sumatrense* — Gram.
Horsfieldia atjehense — Myri.
 **Hypericum beccarii* subsp. *steenisii* — Hype.
Ilex ketambensis — Aquil.
Impatiens acehensis — Bals.
Impatiens calendulina — Bals.
Impatiens dewildeana — Bals.
Impatiens rubriflora — Bals.
Knema losirensis — Myri.
 * (A) *Kobresia kobresioidea* — Cype.
Lindera delicata — Laur.
Lithocarpus atjehensis — Faga.
Lithocarpus orbicularia — Faga.
 **Lobelia sumatrana* — Camp.
Loerzingia thyrsoiflora — Euph.
Luerksenia (Tectaria) kehdingiana — Ferns — also Mentawai Isl. & Great Nicobar
Mallotus sphaerocarpus — Euph.
Monophyllaea caulescens — Gesn.
Monophyllaea wildeana — Gesn.
Neocinnamomum atjehense — Laur.
 **Nepenthes densiflora* — Nepe.
Nepenthes tobaica — Nepe.
Paraboea leuserensis — Gesn.
Paraboea scabriflora — Gesn.

- * (A) *Parnassia procul* H. Turner & Veldk., ined. — Parn. — Closest seems *P. crassifolia* from Sichuan, Yunnan
Pentastemona sumatrana — Pent.
 **Pholidota longilabra* — Orch.
 **Pholidota rupestris* — Orch.
 * (A) *Pleiocraterium gentianifolium* — Rubi.
Premna spec. nov. — Verb.
 * (A) *Prenanthes sagittata* Tjitrosoedirdjo, ined. — Comp.
 **Prenanthes stenolimba* — Comp.
 * (A) *Prenanthes sumatrana* Tjitrosoedirdjo, ined. — Comp.
Pyrola sumatrana — Pyr.
Quercus steenisii — Faga.
Rafflesia micropylora — Raff.
Rhododendron adinophyllum — Eric.
Rhododendron atjehense — Eric.
Rhododendron frey-wijsslingii — Eric.
Rhododendron sumatranum — Eric.
Rhododendron vanderbiltianum — Eric.
Rhododendron rarilepidotum — Eric.; closely related to *R. robinsonii* from Peninsular Malaysia
Rhododendron vinicolor — Eric.
Sarcotheca laxa var. *brigittae* — Oxal.
 **Schefflera* spec. nov. — Aral.
 **Senecio dewildei* Tjitrosoedirdjo, ined. — Comp.
Siraitia silomaradjae — Cucu.
Sophora wightii subsp. *sumatrensis* — Legu.
 **Swertia javanica* subsp. *steenisii* — Gent. — other subsp. on Mt Kerinci, and in Java, Sulawesi, Timor
 **Swertia piloglandulosa* subsp. *piloglandulosa* & subsp. *biovulata* — Gent.
Symplocos atjehensis — Symp.
Symplocos columbuli — Symp.
Thottea macrantha — Aris.
Thottea reniloba — Aris.
Trichosanthes emarginata — Cucu.
Trichosanthes leuserensis — Cucu.
Trichosanthes rotundifolia — Cucu.
Trigonotus hirsuta — Bora.
 * (A) *Utricularia steenisii* — Lent.; close to *U. salwinensis* from the Sino-Himalayas
Vaccinium gracilipes — Eric.
Vitex vansteenisii — Verb.
Xanthophyllum brigittae — Polyga.
 **Xyris flabellata* — Xyri.

Remarks

- There are comparatively many *Ericaceae*, *Gramineae*, *Fagaceae*, and *Gesneriaceae* among this category, partly because these families recently have been taxonomically

treated; however, *Cyperaceae* also have been treated recently, revealing few endemic elements. In this latter family *Kobresia kobresioides* is a very interesting discovery. The following genera are represented in Malesia only by one endemic species in the Leuser area: *Kobresia*, *Luerssenia* (*Tectaria*), *Parnassia*, *Pleiocraterium*, *Pyrola*, *Pentastemona* (with a second species in W Sumatra), *Loerzingia* and *Luerssenia* are endemic genera.

- Rather many species are submontane or montane.
- A total of some 107 endemic taxa is rather high for the comparatively small area involved.

4. Species which occur in Sumatra only in the Leuser area and in Peninsular Malaysia (based on e.g. Turner, 1997)

- Acrotrema costatum* — Dill. — widespread in Peninsular Malaysia, also in Lower Myanmar, Peninsular Thailand, the genus disjunct also in Sri Lanka, S India [map in Hoogland, Fl. Males. I, 4 (1951) 151, the question mark for the Leuser now confirmed]
- Biophytum adiantoides* — Oxal. — N half of Peninsular Malaysia, north to C Thailand [map in Veldkamp, Fl. Males. I, 7 (1971) 165]
- Burkillanthus malayanus* — Ruta. — also in W Sumatra, Peninsular Malaysia (Malacca, Pahang, Selangor), rare in Sarawak
- Elaeocarpus mastersii* — Elae. — throughout Peninsular Malaysia, Borneo (northern and W Kutai)
- Eleutherococcus malayanus* (*Acanthopanax malayanus*) — Aral. — Peninsular Malaysia (Kelantan, Pahang)
- Euonymus wrayi* — Cela. — Peninsular Malaysia (Kedah, Pahang, Perak, Selangor, Trengganu)
- Ficus araneosa* — Mora. — Peninsular Malaysia (Perak, Selangor)
- Knema andamanica* var. *nicobarica* — Myri. — Peninsular Malaysia (Penang), Andaman Is., S Thailand
- Lithocarpus suffruticosus* — Faga. — West Coast, Peninsular Malaysia (Perak, Pahang, Selangor, Trengganu)
- Osmanthus scortechinii* — Olea. — Peninsular Malaysia (Johore, Pahang, Perak, Selangor, Trengganu)
- Panicum hayatae* — Gram. — Sumatra (Toba area), Peninsular Malaysia (Pahang), N Vietnam
- Thismia clavigera* (*Geomitra clavigera*) — Burm. — Peninsular Malaysia (Langkawi, ?Perak), Sarawak
- Thottea sumatrana* — Aris. — Peninsular Malaysia (Kedah, Perlis), Peninsular Myanmar and Peninsular Thailand

Remarks

- The list contains species all from the montane or lower zones.
- According to Dransfield [Fl. Males. Bull. 27 (1974) 2163] in the (lower colline) Bohorok area many Peninsular Malaysia palm species occur, e.g. of *Areca* and *Pinanga*, which are apparently absent from the rest of Sumatra.

5. Species with a wide distribution, but in Sumatra for some reason only found in the northern part, i.e. in the Leuser area

Those marked with an asterisk * are possibly typical for the high mountain blang or low open scrub vegetation.

There are many examples in this category; only a few illustrative examples are listed, e.g.:

- Anthoxanthum horsfieldii* — Gram. — See List 3.
- Brachypodium sylvaticum* var. *pseudo-distachyon* (*Brachypodium luzoniense*) — Gram. — Kashmir, Sikkim, India, Sri Lanka to Taiwan; Malesia: Java, Bali, Lombok, Timor, S Sulawesi, Philippines (Luzon), Moluccas (Ceram), Papua New Guinea
- Cardiopteris quinqueloba* — Card. — E India to Yunnan, Malesia: Peninsular Malaysia (Kedah, Perlis, Perak), SE Borneo, Java, Lombok, Sumbawa, Sumba, Alor, Sulawesi, Tenimbar Isl. [map in Sleumer, Fl. Males. I, 7 (1971) 95]
- Carex echinata* — Cype. — N America, Eurasia to Australia and New Zealand; in Malesia N Sumatra and New Guinea.
- Cynoglossum javanicum* — Bora. — Java, ?Bali, ?Lombok
- Dacrycarpus cumingii* — Podoc. — Sarawak, Philippines (Mindanao) [map in De Laubenfels, Fl. Males. I, 10 (1988) 381]
- Dacrycarpus imbricatus* var. *curvulus* — Podoc. — W, C Java [map in De Laubenfels, Fl. Males. I, 10 (1988) 379]
- Drosera indica* — Dros. — Tropical Africa, Sri Lanka to Japan, Australia, scattered in Malesia, not yet in the Moluccas [map in Van Steenis, Fl. Males. I, 4 (1953) 379]
- **Drosera spathulata* — Dros. — S China to Japan, New Zealand, Malesia: Peninsular Malaysia (Kedah), Kinabalu, Philippines (Luzon, Mindoro), Papua New Guinea (Western Prov.) [map in Van Steenis, Fl. Males. I, 4 (1953) 379]
- **Haloragis micrantha* — Halo. — E India to Korea, New Zealand, Malesia: not in Peninsular Malaysia, scattered, e.g. Kinabalu [see map in Van der Meijden & Caspers, Fl. Males. 7 (1971) 244, also 828]
- Juncus effusus* — Junc. — Temperate zones, not in Australia, Malesia: Java, Kinabalu, Philippines (Luzon, Mindanao), New Guinea
- Lepidosperma chinense* — Cype. — SE China, Malesia: Peninsular Malaysia (widespread), Kinabalu, New Guinea (Vogelkop) [map in Kern, Fl. Males. I, 7 (1974) 669]
- Sporobolus harmandii* — Gram. — Myanmar, Thailand, Laos, S Vietnam, in Sumatra in Aceh, Tapanuli, East Coast, absent in Peninsular Malaysia
- Ulmus lanceifolia* — Ulma. — N India to N Vietnam, Malesia: Flores, Sulawesi [map in Soepadmo, Fl. Males. I, 8 (1977) 41]

PLANT GEOGRAPHICAL CONSIDERATIONS IN CONNECTION WITH THE LISTS, AND CONCLUSIONS

Notwithstanding the fact that the lists presented above are doubtlessly fairly incomplete, they largely confirm the following generalizations on the Leuser flora already formulated by Van Steenis (1938):

1. The Leuser area contains a rich and fascinating flora, and there is a remarkably large number of endemics.
2. It is an ancient junction of plant-geographical pathways, with its flora a mixture of Asian and eastern elements; the former are in the majority, but the eastern element is surprisingly conspicuous.
3. There is a clear relation with the flora of the Kinabalu (which is also a non-volcanic mountain massive) with a similar mixture of local, western, eastern, and northern taxa.
4. The unique flora of the Leuser area is most clearly expressed in the subalpine zone, especially the blang areas, less clearly in the montane and lowland flora.

The high mountains in the Leuser area are geologically of old age, and non-volcanic, unlike the high mountains of W, C, and S Sumatra and some volcanoes in the far north of Aceh. By this the high mountains in the Leuser area have played a part, during a very long period, in the receiving and further dispersal of microtherm flora elements. Obviously, there have been connections with other ancient centres of species-development in Malesia, i.e. Peninsular Malaysia and Borneo, as well as with the flora of the non-volcanic mountain complexes of the SE Asian mainland. The Leuser mountain complex became through isolation a relict-area for a number of eastern species, while a large number of endemic species came into existence.

The great enigma remains the fact that – if we assume on the basis of the rich species assortment that the mountain flora of Leuser is of old age – this flora has kept for such a large proportion its own, independent local species assortment. Why could this mountain flora not have dispersed over the Barisan Range to the other high volcanoes situated up to some 600–800 km further south? Among these species, a number will be of Upper Miocene or at least Pliocene age, so that several millions of years would have been available for dispersal.

As a matter of fact, there are mountain plant species, most of Asian affinity, which have spread both in the Leuser area and in the remainder of the Barisan Range of western Sumatra (Mt Kerinci, Mt Merapi, Mt Singalang, Mt Malintang, Mt Talang, etc.) e.g.: *Ainsliaea latifolia* subsp. *henryi* (Comp.), *Aletris foliolosa* (Lili.), *Anemone sumatrana* (Ranu.), *Gentiana sumatrana* (incl. *G. singgalangensis*; Gent.), *Pinus merkusii* (Pina.), *Primula prolifera* (Prim.), *Swertia javanica* (Gent.), and many others, and also some Sumatra-endemic species, e.g. *Senecio sumatranus* (Comp.). Therefore it is quite noteworthy that more than 100 endemic species, plus another 10 easterly and 20 SE Asian species, i.e. together at least 135 species, have remained restricted in their distribution to the Leuser area.

As a possible explanation one could think of insufficient botanical exploration in the vast areas of the Sumatra West Coast mountains, but these have been relatively well-collected. Also, the different nature of the base rock or soils might be the cause, viz. volcanic for the West Coast mountains of the Barisan, versus non-volcanic for the Leuser mountains. The influence by the base rock, however, should not be over-estimated: numerous mountain plant species of Asian origin grow in the Khasia–Himalaya region on non-volcanic substrates, but have been found on all volcanoes of Sumatra and Java, while in the Leuser area itself species like *Mimulus tenellus* (Scro.), *Panicum khasianum*

(Gram.), *Pyrola sumatrana* (Pyro.), *Swertia bimaculata* (Gent.), and others, were found for the first time in the area on extinct volcanoes like Bur-ni-Geredong near Takengon in N Aceh.

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