Notes on the geography of South-East Asian *Begonia* and species diversity in montane forests

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Abstract

Hoover, W. Scott[1], Karegeannes, Carrie[2], Wiriadinata, Harry[3], Hunter, James M.[4] ([1]New England Tropical Conservatory; [2]American Begonia Society; [3]Herbarium Bogoriense; [4]New England Tropical Conservatory) 2004. Notes on the geography of South-East Asian Begonia *and species diversity in montane forests.* Telopea *10(3): 749–764.* Field reconnaissance of *Begonia* in lower montane forests of Sumatra and Sulawesi, Indonesia was undertaken in 1995 and 1998, with formal research expeditions being conducted in lower montane forests of West Java in 2000 and 2001. Forty-seven mountains have been explored in Indonesia, by mostly single samplings along elevational gradients on each mountain. Taxonomic determinations have been made for most of the *Begonia* collected in 2000 and 2001 and species of the section *Sphenanthera* were recognised, observed and photographed in Sumatra and Sulawesi. In 1977 and 1978, wet tropical forest at the Carpentaria mining exploration site at the Frieda River, West Sepik, Papua New Guinea was explored for *Begonia*. Many different *Petermannia* species were diversified along elevational gradients. Field observations at this West Sepik site suggest populations of individual species were often restricted to one or several small, localised colonies along stream margins within the 25 km^2 site.

Introduction

The important horticultural genus *Begonia* is unusual among angiosperms from a number of standpoints:

1. It is ranked the 16th largest genus of vascular plants by Minelli (1993), who lists *Begonia* as having 900 species. According to Smith et. al. (1986) and Doorenbos et. al. (1998), the genus is estimated to include 1400 species, equalling *Solanum* and *Psychotria* in size. *Begonia* is now considered to be one of the five largest genera of vascular plants with up to 1600 species (Sands, 2001).
2. The taxonomy of the Begoniaceae has been very difficult and historically controversial, (for example, Irmscher 1915, Lawrence 1951). Sands' (1977, 1982, 1990 and 2001) taxonomic work on South-East Asian *Begonia* has been extensive and he has described many valuable horticultural species including *B. amphioxis* Sands and *B. chlorosticta* Sands.
3. Though many species of *Begonia* have singly occurring stomata (Hoover 1990a) many other species are observed to have stomatal clusters and a hypoderm (Fellerer 1892, Hoover 1986).
4. Medullary and cortical vascular bundles in the petiole and stem of many *Begonia* species represent an anatomical pattern more like monocotyledons than dicots (Esau 1965).

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5. Physiologically, *Begonia* is distinct for the presence of oxalic acid in cytoliths, another characteristic limited in the angiosperms (Pireyre 1961).

Most botanical exploration of SE Asian countries has occurred at lower elevations, leaving higher montane forests largely unexplored. *Begonia* is highly diversified in SE Asian montane forests (Bates 1978, Hoover 1990b, 1998; Hoover et. al. 2000) and, to such a degree, that the genus may be an indicator of overall floristic diversity. In these notes we identify the number of *Begonia* species per section and their geographical distribution in SE Asian countries.

Methods

Counts for number of species per country, region or island were initially evaluated from Barkley's (1972) list, and then updated from Doorenbos et al. (1998) sectional assignment (Table 1), although Sands regards the total number of species per country as low (Sands, pers. comm). More detailed figures for the Flora Malesiana region can be found in Sands (2001).

Botanical exploration of Indonesian montane forests and the Frieda River, West Sepik, Papua New Guinea area involved standard herbarium specimen acquisition and data recording. The first set of specimens were deposited within the countries of origin, a second set of duplicates were deposited with Harvard University Herbarium (HUH) with additional duplicate sets distributed to different herbariums by HUH. Due to great species variation in *Begonia*, often up to 10 duplicates were collected, thus providing many specimens for taxonomic specialists. Determinations have not been made on most of these collections, though many West Javan collections are believed to be identified correctly.

Accessing the remaining montane forests covering volcanoes in Indonesia involved determining which roads lead to the highest point on the mountain, hiking a couple of hours through agricultural land until reaching forest, which often was disturbed, especially in West Java Province. Sumatran and Sulawsian lower montane forests were generally not disturbed. Hunting trails network these forests. Local guides lead collectors to trails that were close to streams so there would be a higher probability of finding *Begonia*. Roads leading to the higher elevations generally stopped at 1000m. Collectors would usually hike another 200m until reaching forest, and spend the rest of the morning and early afternoon collecting from roughly 1200 to 2000m, depending upon the mountain. For safety reasons, collecting always stopped around 2:00pm.

Collecting at the Frieda River involved working at the Carpentaria Exploration Base Camp, located at approximately 4°35'S/142°E. Access to the remote, low elevation stream valleys was accomplished through use of the mining companies helicopter. Three weeks were spent conducting botanical exploration at the approximately 25 km^2 gold and copper exploration site. Collection sites were identified by geologist Ron Britten based on different soil conditions. Dr. Ted Henty of the Lae Forestry Department suggested that we conduct the general botanical exploration of the Frieda site because of its unusual flora, stating he had visited the site briefly and observed that floristic composition was more like that of lower montane forests even though elevation ranged generally from 400–1000m.

Results

The 18 sections of SE Asian *Begonia* include about 576 species. 94.6% of the species were placed in 6 sections, in order of size: *Petermannia* (189), *Diploclinium* (133),

Table 1. Taxonomic sections of SE Asian *Begonia*: Estimated numbers (and percentages) of species from different geographic areas.

Section	Indian region*	China with Taiwan	Malaysia (Peninsular)	Indochina region*	Myanmar (Burma)	Philippines	New Guinea* region	Borneo*	Sumatra	Java	Sulawesi (Celebes)	Worldwide Total species/ section
Alicida					3							3
Apterobegonia					1							1
Baryandra						1						1
Bracteibegonia									2			2
Coelocentrum		12										12
Diploclinium	19	39	2	11	4	36	9	6				133
	(14.3)	(29.3)	(1.5)	(8.3)	(3.0)	(27.1)	(6.8)	(4.5)				
Haagea	1											1
Heeringia			1									1
Lauchea					2							2
Monophyllon			1									1
Monoptera	2											2
Petermannia			5 (2.6)	1 (.53)		59 (31.2)	55 (29.1)	40 (21.2)	12 (6.4)	4 (2.1)	13 (6.9)	189
Platycentrum	25 (22.7)	45 (40.9)	21 (19.1)	4 (3.6)	6 (5.5)	4 (3.6)		1 (0.91)				110
Putzeysia	1											1
Reichenheimia	4 (9.3)	7 (16.3)	5 (11.6)	6 (14.0)	2 (4.7)			3 (7.0)	6 (14.0)	5 (11.6)	5 (11.6)	43
Ridleyella			2									2
Parvibegonia	5 (13.9)	2 (5.6)	10 (27.8)	9 (25)	7 (19.4)						3 (8.3)	36
Sphenanthera	7 (19.4)	6 (16.7)	2 (5.6)	4 (11.1)	2 (5.6)	2 (5.6)	1 (2.8)					36
Total number of species	64	111	49	35	29	102	65	50	30	15	26	576

*Indian region includes India, Nepal and Sri Lanka. Indochina Region includes Cambodia, Laos, Thailand and Vietnam. New Guinea region includes Papua, New Guinea, Irian Jaya and Solomon Islands. Borneo includes Kalimantan and Malaysian Sarawak and Sabah, plus Brunei.

Platycentrum (110), *Reichenheimia* (43), *Sphenanthera* (36), and *Parvibegonia* (36) (Table 1). The first three sections accounted for 74.7% and the latter three sections representing 19.9%. The 12 minor sections include 31 species. The few species not assigned to sections are excluded from tabulations.

South-East Asian sections have distinct geographical distribution patterns (Table 1). In *Petermannia*, 154 species representing 81.5% of the section are observed in the Philippines, New Guinea and Borneo. The remaining 35 species are distributed between Sulawesi, Sumatra, Peninsular Malaysia, Java and Indochina region, while no species of *Petermannia* were collected in Myanmar, China or the Indian region. *Diploclinium* is concentrated primarily in China, with 39 species (29.3%), and The Philippines, with 36 species (27.1%). Nineteen species (14.3%) are observed from the Indian region; these three geographical areas account for 70.7% of this section's distribution. The remaining species of this section are somewhat equally distributed between the Indochina region, New Guinea region, Sumatra, Borneo, Myanmar and Peninsular Malaysia. No species of *Diploclinium* have been described from Java or Sulawesi, though several unidentified species of this section may have been observed on these islands (Hoover 1995, 1998). The section *Platycentrum* is predominately of mainland distribution, having 82.7% of the section distributed between China (45 species, 40.9%), Indian region (25 species, 22.7%) and Peninsular Malaysia (21 species, 19.1%). Small numbers of species are observed in Myanmar, Indochina region, The Philippines, Sumatra, Borneo and Java, with no species in this section found in the New Guinea region or Sulawesi

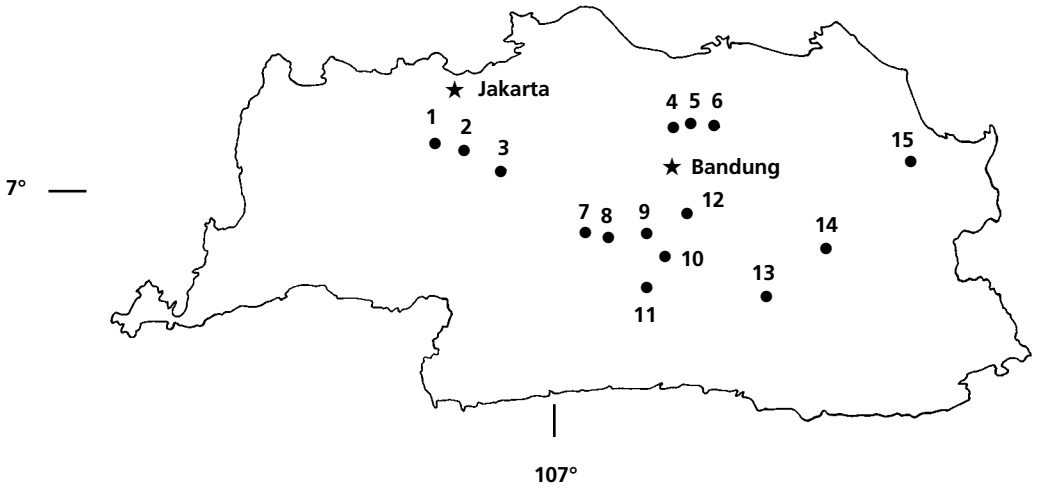
The sectional distributions of *Reichenheimia* and *Sphenanthera* indicate no single country, region or island is represented by more than 20% of their respective species. *Reichenheimia* is distributed throughout SE Asia, with no species found in the Philippines or New Guinea region. S*phenanthera* is distributed somewhat equally among the India and Indochina regions, Java, Sulawesi and China, with a few species found in Peninsular Malaysia, the Philippines, New Guinea region and Sumatra. *Parvibegonia* is primarily a mainland Asian section, with 3 species observed in Sulawesi. Our team may have recently collected one or 2 species of *Parvibegonia* on Java (pers. comm., Tebbitt), possibly being the first collections of this section from Java.

Table 2 lists the number of *Begonia* collections our team has made in SE Asia since the late 1970's. Figures 1–4 indicate the geographical locations for field work in Indonesia. Appendix 1 provides detailed information on each of the mountains we explored in Indonesia.

Table 2. Hoover and team's SE Asian *Begonia* field collections.

Country/year of expedition & duration	No. of collections	No. of estimated species
Papua New Guinea Nov. 1977–Mar. 1978	84	46
Thailand Jan.–Feb. 1990	32	14
Peninsular Malaysia March 1990	31	10
Sumatra, Java, Bali, Indonesia Jan.–Mar. 1995	36	17
Sumatra, Sulawesi, Java, Indonesia Feb.–Apr. 1998	53	20
Java, Indonesia Feb.–Mar. 2000	138	13
West Java Province, Indonesia Apr.–May 2001	85	9
Total	459	N.A.

Several field observations appear relevant to the geography of *Begonia* in these countries. It appears the most common and geographically widespread species in Indonesia are found at the lower to middle elevations, exemplified by the following: *Begonia isoptera* Dry, *B. multangula* Blume, *B. longifolia* Blume, and possibly *B. muricata* Blume. The taxonomy of these common species may be difficult due to local variation. As species characteristics are not stable, taxonomic confusion exists as noted by many botanists observing *Begonia* in the field. As elevation increases, endemism seems to be more prevalent and individual species morphological characteristics appear more stable and more clearly defined. Individual mountains at the upper elevational limits for *Begonia* (about 1800–2000m) may harbour endemic species particular to an individual mountain or a group of adjacent mountains. Sections *Sphenanthera* and *Petermannia* appear to include the most endemic species in Java and Sumatra. Species that may be new appear to be local endemics whose populations are restricted in size as well. Local endemics are found in small populations along stream margins or less frequently along ridges and forest areas between streams. The more common species of *Begonia* have been identified with reasonable certainty, but less common species remain unidentified. A number of species photographed in Sumatra and Sulawesi on the reconnaissance expeditions did not appear to be represented by any collection in the Bogor or Harvard University Herbariums. This does not mean they may not be represented in European Herbariums.



Map Legend

1. Mt. Salak
2. Mt. Pangrango
3. Mt. Gede
4. Mt. Burangrang
5. Mt. Tangkubanperahu
6. Mt. Bukittunggu
7. Mt. Patuha
8. Mt. Waringin
9. Mt. Tilu
10. Mt. Windu
11. Mt. Kancana
12. Mt. Malabar
13. Mt. Cikuray
14. Mt. Telagabodas
15. Mt. Ciremay

Fig. 1. *Begonia* exploration site in West Java. Indonesia.

At the Frieda River, West Sepik, Papua New Guinea, *Begonia* was highly diversified with seemingly local *Petermannia* endemics, ranging between 400 –1000m. The 25 km2 Carpentaria exploration site received an average of 550 inches of rainfall per year, data accumulated over the duration of the site's existence, which was first explored by geologists in 1968. The three weeks of fieldwork allowed Hoover to explore an estimated 60% of the larger streams at the site, thus offering a reasonably good opportunity for examining the distribution of *Begonia*. An estimated 20 species of *Begonia* were collected at the Frieda River area, with only one species of *Platycentrum* being common, and that was at the uppermost elevations between 800 to 1200m. Furthermore, the species occurred as a vine or an epiphyte growing to several meters along tree trunks, characteristics that were not exhibited in the other begonias at Frieda. Only one or two of the Frieda River species were observed elsewhere in Papua. *Platycentrum* species are not generally distributed in New Guinea (see Table 1). Except

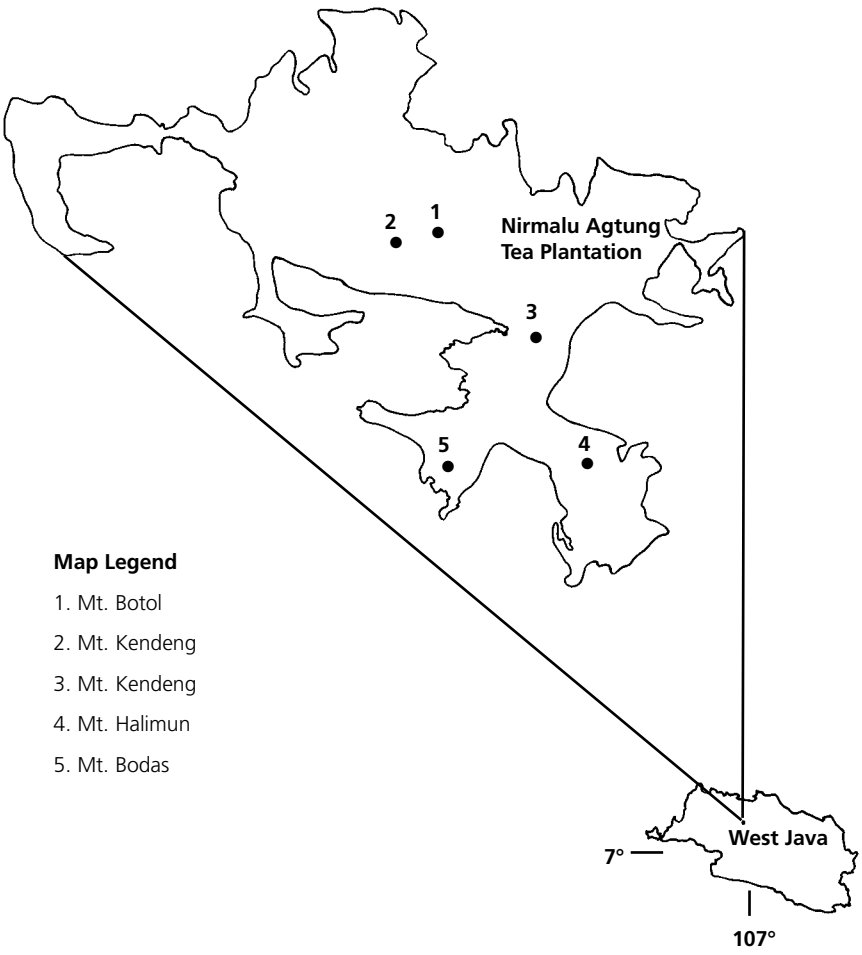


Fig. 2. *Begoina* expolration sites in Halimun National Park, West Java, Indonesia.

for the common *Platycentrum*, the distinct impression resulting from observations on Frieda River *Begonia* was that individual species appeared limited to a single population or to several, with each local population consisting of a few individual plants or small colonies. Over an elevational range of usually several hundred meters along streams, one could observe between four to six different species per stream. Individual streams had different *Begonia* species compositions, even when streams were adjacent or within close proximity to one another. This *Begonia* species diversity is the highest Hoover has ever observed in a small geographical area, though similar high-density species diversities among *Piper*, *Anthurium* and *Philodendron* in Carchi and Esmeraldes Provinces, Ecuador were observed. Croat (pers. comm.) has made similar observations for these genera of the Araceae in Western Colombia and Ecuador as well.

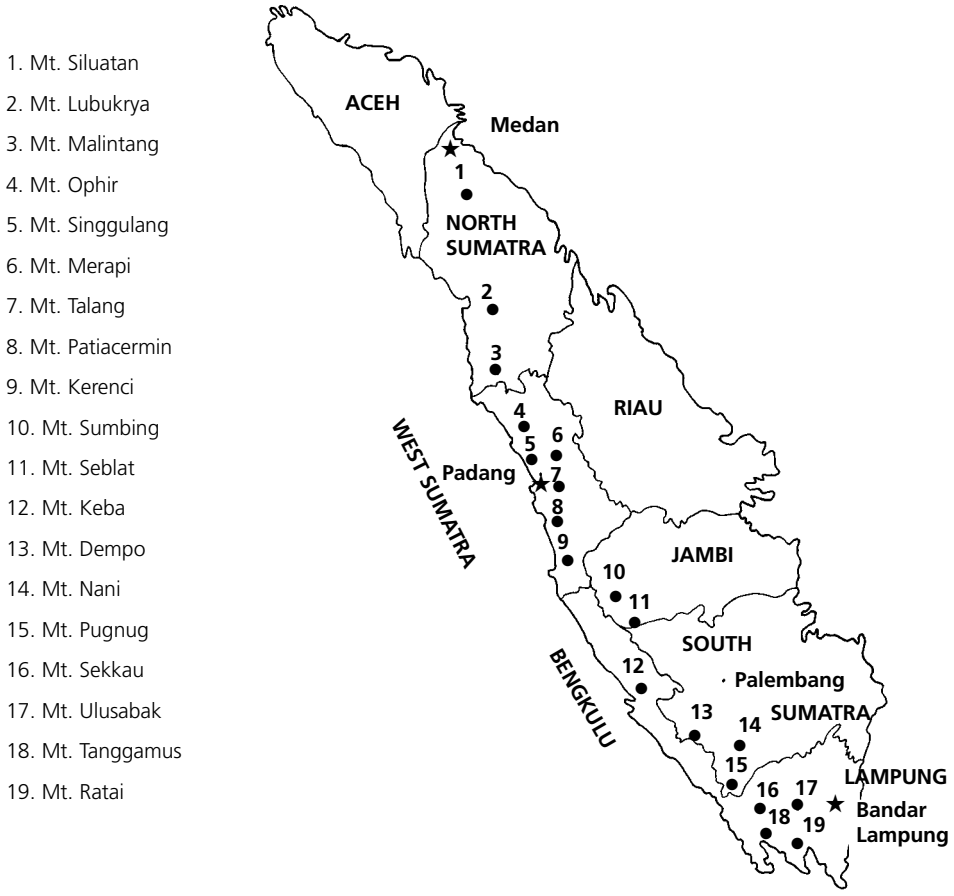


Fig. 3. Exploration sites in Sumatra, Indonesia.

Discussion

Most SE Asian begonias were collected in the past from lower elevations when forest cover was nearer its original size. The logistics required to do botanical collecting in lowland tropical forest during the 1800's to early 1900's was difficult enough, without trying to reach mountain forests large distances away along steep slopes. Deforestation has provided the unfortunate benefit in modern times of access to some montane forests, though not without considerable logistical effort. Montane forests of Java, Sumatra and Sulawesi are restricted to about 280 mountains over 1500m (unpublished data). Few of these mountains appear to have been explored scientifically.

Field observation on *Begonia* in lower montane forests of Indonesia and Papua New Guinea indicate species prefer stream margin habitats. And the steep, rocky embankments directly above streams are the habitats preferred over forest slope areas or mountain ridges. When undertaking field expeditions to collect *Begonia*, the decision was made to search out streams along elevational gradients. Stream margins are subject to regular disturbances caused by rise and fall of water level in the stream.

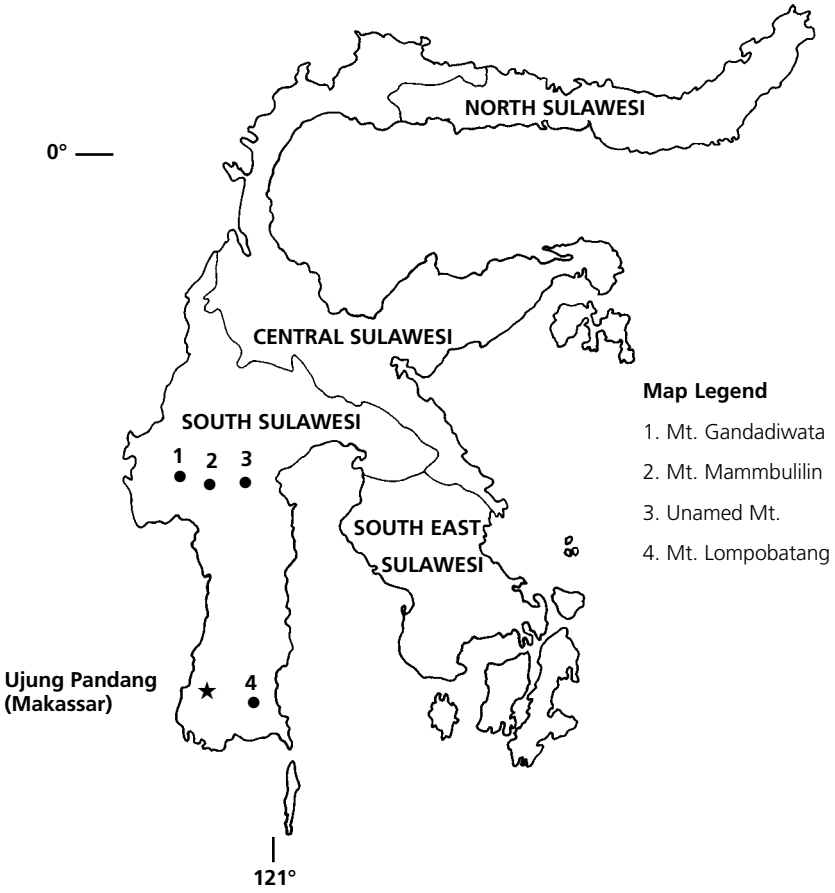


Fig. 4. *Begonia* exploration sites in Sulawesi, Indonesia.

A line of vegetation is frequently observed along stream banks, due to rainfall running off mountain slopes, filling streams and stripping the vegetation off embankments. It is also observed that light ranges from deep shade to sunny gaps along streams. These light gaps appear to be microhabitats being places where a stream levels out forming a pool or where a small flattened area is found along the mountain slope, allowing running water to spread out over a larger area, or where pools form at the base of larger waterfalls. Gaps, of course, are observed where trees fall across streams opening the canopy.

This constancy and variation of habitat disturbance, both from water and light, may be relevant to understanding high species diversity in the genus. Though not directly applicable to *Begonia* species diversity, but possibly relevant, is the "intermediate disturbance hypothesis" tested by Molino and Sabatier (2001) for tropical forest trees on Barro Colorado Island, Panama. Patch size, tree fall gaps are recognised to cause disturbance in tropical forests and are believed to harbour a greater diversity of plants than in surrounding forest. *Begonia* appears to colonise disturbed habitats in natural forest as well as along roadside embankments in lower montane forest. Could the constant disturbance of *Begonia*s environment be part of the cause for the genus being so diverse?

Having observed dozens of streams and their vegetation in lower montane tropical forests of SE Asia, the impression is that light gaps along streams are pockets of higher plant diversity than stream areas without gaps. Light gaps along streams appear to be more diverse than in forests on slopes or ridges. If indeed such an observation were confirmed through data collecting, the explanation might well be the same as for higher plant diversity caused by tree fall gaps. Unlike tree fall gaps, light gaps along streams are much older, having natural histories based on geomorphic time scales. After volcanic eruptions, streams begin to erode mountain slopes and plant colonisation begins. Some of these stream habitats may indeed be quite ancient. One often observes the same herbaceous plant groups colonising these light gaps along streams: Aroids, *Begonia*, ferns, Gesneriads (particularly *Cyrtandra*), to name a few common groups.

Field observations and herbarium specimens indicate many species of *Begonia* are local or regional endemics. Though fieldwork in the ultra-wet Frieda River was limited to the Carpentaria Site, it appeared the entire area was dominated by local endemics. In Indonesia, endemism seems to be at the regional level with individual species distributed on several mountains, often adjacent to one another. Endemic species also seem to have very narrow elevational ranges. An observation by van Steenis (1969) adds perspective to issues regarding tropical plant species endemism. "This leads me to conclude that endemic, and even, local-endemic, species in the Malesian tropics must be defined as 'species that have not yet been found elsewhere', expressing thereby that exact floristic knowledge of distribution is hard, if even possible, to attain in tropical forest." *Begonia* will continue to offer many surprises.

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Appendix 1. Indonesian mountains explored or exploration attempted by Hoover, Hunter and Wiriadinata.

Island Name of mountain Province	Lat./long. & elevation (m)	Date climbed or attempt made	Approximate elevation reached (m)/% of mtn ht	No. of *Begonia* species observed [A] or collected[B]	Notes and impressions
SUMATRA					
Mt. Lubukraya N. Sumatra	1°28'N/ 101°10'E 1886	3/19/95	1500/80%	3[A]	Quite dry. Upper 2/3s of mtn forested
Mt. Singgalang W. Sumatra	0°20'S/ 100°2'E 2877	3/17/95 1/3–2/13/98	2200/77%	7[A]	2 new species likely collected. Upper half of mtn forested
Mt. Merapi W. Sumatra	0°42'S/ 100° 18'E 2891	3/24/95 2/11–2/18/98	2200/73%	6[A]	3 new species likely collected. Upper half of mountain forested, mild volcanic activity causing deforestation on upper 10% of mtn
Mt. Talang W. Sumatra	1°13'S/ 101° E 2599	3/26/95	2200/85%	2[A]	1 new species likely Upper 2/3s of mtn forested
Mt. Patiacermin W. Sumatra	1°28'S/ 101° 12'E 2690	1/27/98	1300/47%	4[A]	3 new species likely collected. Upper half of mtn forested Remote
Mt. KerInchi Jambi	1°45'S/ 101° 20'E 3800	3/14/95 1/26/98	2350/63%	7[A]	4 new species likely collected. Large tea plantation covering lower half of mtn, national park on upper half
Mt. Keba Bengkulu	3°28'S/ 102° 30'E 1983	3/12/95 1/23/98	1500/76%	3[A]	1998 trip a new road to top of mtn. Mild volcanic activity causing deforestation on upper 25% of mtn
Mt. Dempo Sumatra	4°25'S/ 103°10'E 3159	3/10/95% 1/19–21/98S	2000/76%	4[A]	1 new species likely collected. Large tea plantation covering lower half of mtn

Island Name of mountain Province	Lat./long. & elevation (m)	Date climbed or attempt made	Approximate elevation reached (m)/% of mtn ht	No. of *Begonia* species observed [A] or collected[B]	Notes and impressions
Mt. Sekkau Lampung	5°55'S/ 104°18'E 1718	1/18/98	1500/88%	1 [A]	Considerable deforestation at upper elevations from coffee plantations
Mt. Tanggamus Lampung	5°30'S/ 104°37'E 2102	1/16/98	1300/61%	-	Quite dry
Mt. Ratai Lampung	0°10'S/ 105°15'E 1681	3/4/95	1600/60%	2[A]	Rice fields to 75% of mtn
JAVA					
Mt. Botol W. Java	6°42'S/ 106°28'E 1785	3/3–20/00	1785/100%	3[B]	Tea plantation to mid elevations and expanding into nat. park
Mt. Kendeng W. Java	6°43'S/ 106°27'E 1867	3/3–20/00	1867/100%	2[A]	Entire mtn forested. One possible new species collected
Mt. Kendeng W. Java	6°46'S/ 106°31'E 1764	3/3–20/00	1764/100%	3[B]	Entire mtn forested
Mt. Halimun-South W. Java	6°50'S/ 106°31'E 1744	4/15/01	1046/60%	4[B]	Very steep mountain
Mt. Bodas W. Java	6°52'S/ 106°28'E 966	4/17/01	862/89%	4[A]	Forest still intact
Mt. Salak W. Java	6°28'S/ 106°35'E 2211	2/22–24/00	1775/81%	5[B]	1 new species likely collected Upper 1/3 of mtn forested

Island Name of mountain Province	**Lat./long. & elevation (m)**	**Date climbed or attempt made**	**Approximate elevation reached (m)/% of mtn ht**	**No. of *Begonia* species observed [A] or collected[B]**	**Notes and impressions**
Mt. Pangrango W. Java	6°45'S/ 106°52'E 3018	4/11/01	1569/52%	3[A]	Rich forest, undisturbed at upper elevations
Mt. TalagWarna W. Java	(Pangrango complex)	4/11/01	1569/52%	4[B]	Very disturbed throughout mtn complex
Mt. Gede W. Java	6°25'S/ 106°50'E 2958	4/3/95	1400/47%	4[B]	Top 25% of mtn still forested
Mt. Burangrang W. Java	6°48'S/ 107°33'E 2064	3/10/01 3/26/01	1723/84%	3[A]	Quite dry
Mt. Tangkubanperahu W. Java	6°49'S/ 107°34'E 207	3/27/01	1877/90%	2[A]	Quite dry
Mt. Bukittunggu W. Java	6°49'S/ 107°44'E 2205	3/28/01	1754/80%	1[A]	Quite dry
Mt. Patuha W. Java	7°15'S/ 107°17'E 2434	2/11–16/00 3/14/01	2277/94%	3[B]	1 new species likely collected. Tea plantation covers 2/3 of mtn
Mt. Puncak W. Java	(Mt. Patuha complex)	2/16/00 3/14/01	2000/80%	1[B]	1 new species likely collected. Only very top ~50m forested; encroached by tea plantation
Mt. Ranca Upas W. Java	(Mt. Patuha complex)	3/6/00 3/15/00	1700	5[B]	2 possible new species
Mt. Triangularis W. Java	(Mt. Patuha complex)	3/6/00 3/15/00	1900	2[B]	Part of volcanic crater rim

Island Name of mountain Province	Lat./long. & elevation (m)	Date climbed or attempt made	Approximate elevation reached (m)/% of mtn ht	No. of *Begonia* species observed [A] or collected[B]	Notes and impressions
Mt. Cadaspang W. Java	(Mt. Patuha complex)	3/6/00 3/15/00	1900	2[B]	Part of volcanic crater rim
Mt. Kawahputih W. Java	(Mt. Patuha complex)	3/6/00 3/15/00	1800	2[B]	Part of volcanic crater rim
Mt. Kolotok W. Java	(Mt. Patuha complex)	3/6/00 3/15/00	1800	1[B]	Part of volcanic crater rim
Mt. Tikulur W. Java	(Mt. Patuha complex)	3/6/00 3/15/00	1900	2[B]	Part of volcanic crater rim
Mt. Waringin W. Java	7°10'S/ 107°25'E 2140	4/9/01	1846/86%	3[B]	New logging near upper slopes
Mt. Tilu W. Java	7°12'S/ 107°31'E 2040	4/8/01	1508/74%	3[B]	Very rich forest; undisturbed
Mt. Windu W. Java	7°14'S/ 107°42'E 2054	4/7/01	1539/75%	3[B]	New agriculture on upper slopes
Mt. Abig W. Java	(Mt. Kancana complex)	4/7/01	1939/89%	2[B]	Encroaching tea plantation
Mt. Kancana W. Java	7°18'S/ 107°35'E 2182	4/8/01	1939/89%	2[B]	Encroaching tea plantation
Mt. Malabar W. Java	7°07'S/ 107°38'E 2321	4/9/01	\1908/82%	4[B]	Well preserved, montane forest intact
Mt. Merapi Central Java	7°28'S/ 110°22'E 2911	4/5/95 3/20/00	1000 1200	3[B]	2 tuberous species collected

Island **Name of mountain** **Province**	**Lat./long. &** **elevation (m)**	**Date climbed** **or attempt** **made**	**Approximate** **elevation reached** **(m)/% of mtn ht**	**No. of *Begonia*** **species observed [A]** **or collected[B]**	**Notes** **and impressions**
Mt. Lawu Central Java	7°25'S/ 111°10'E 3265	4/7/95	1900	2[B]	1 new tuberous species collected
Mt. Cikuray W. Java	7°19'S/ 107°52'E 2821	3/22/01	1939/69%	3[A]	Rich forest, wet
Mt. Telagabodas W. Java	7°09'S/ 108°03'E 2201	3/21/01	1692/77%	2[A]	Very disturbed forest
Mt. Pasripis W. Java	(Telagabodas complex)	3/20/01	1754/80%		Very disturbed forest
Mt. Ciremay W. Java	6°58'S/ 108°26'E 3078	3/24/01	11415/46%	2[A]	Forest intact from 1200m to top of mountain
SULAWESI					
Mt. Gandadiwata S.E. Sulawesi	3°15'N/ 119°30'E 2382	3/4/98	1388/58%	2[A]	Forest intact, undisturbed
Mt. Mammbulilin S.E. Sulawesi	2°55'N/ 119°275'E 2865	3/5/98	1839/64%	2[A]	Forest intact, undisturbed

Island Name of mountain Province	Lat./long. & elevation (m)	Date climbed or attempt made	Approximate elevation reached (m)/% of mtn ht	No. of *Begonia* species observed [A] or collected[B]	Notes and impressions
Unnamed mt. S.E. Sulawesi	2°59′N/ 121°52′E 1916	3/12/98	1420/74%	2[A]	New road being constructed on lower slope of mtn from Mamasa to Ramtapo
Mt. Lompobatang S.E. Sulawesi	5°45′N/ 119°58′E 2871	3/1/98	1613/56%	1[A]	Upper half of mtn forested
LOMBOK					
Mt. Rijani	8°28′S/ 116°39′E 3726	4/23/01	1169/31%	5[A]	Dry forest: well preserved