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Rediscovery Sumatran endemic flora: towards the establishment of data of biodiversity loss

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Abstract. The research of Sumatran endemic flora species for the establishment of a database of biodiversity loss has been conducted on March 2018 around Lake Toba areas. The exploration method was applied to collect the flora endemic and identified with specimen reference collection in Herbarium Bogoriense (BO) and related references. 28 species from six families were rediscovered as Sumatran endemic flora. Orchidaceae (15 species) and Ericaceae (5 species) were the most commonly families found. Meanwhile, Taman Eden 100 and Jangga Dolok were the most common location for the rediscovery of Sumatran endemic flora.

1. Introduction

Indonesia is the third rank of the most magnificent tropical forests in the world after Brazil and the Democratic Republic of Congo (formerly Zaire) [2]. Sumatra is one of the major islands in Indonesia, which still has forest cover, particularly along Bukit Barisan. In 2013, Purba *et al.* [1] reported that forests cover are in Sumatra reached 11.4 million hectares. On the other hand, Purba *et al.* [1] estimated that total deforestation in Sumatra between 2009 and 2013 is 1,530,156 hectares or 382,539 hectares per year. They [1] also reported that Sumatra is as the second rank of deforestation rate after Borneo.

The endemism level of Indonesian flora is between 40-50% of the total floral species of on each island [4]. Widjaja *et al.* [4] also estimates that endemism level of Sumatran flora is only 23% or 1,891 species from the total 8,391 species of flora in Sumatra. While, MacKinnon *et al.* [3] mentioned that Sumatra, an island which similar size as Borneo has only 12% endemism at species level. However, the deforestation rates are quite high and are threatening the biodiversity. Especially the endemic species, which is needed the specific forest condition.

Northern part of Sumatra (North Sumatra and Aceh) are reported to have some endemic species such as on Orchidaceae [6], [7], Bambusoideae (Poaceae) [8], *Nepenthes* (Nepenthaceae) [9], [29], [32], *Impatiens* (Balsaminaceae) [10], [26], *Diplycosia* [5], *Gaultheria* [34] and *Rhododendron* (Ericaceae) [11], [12], [13], [14] and also *Begonia* (Begoniaceae) [15], [16]. Recently, Research Center for Biology – LIPI was conducted survey around Lake Toba, North Sumatra to update the data of endemic flora as well as Sumatran flora. The results presented will be used by government in implementing policies to protect endemic species as well as forest areas.



2. Materials and Methods

2.1. Study sites

This research was conducted on March 15-29, 2018 in Lake Toba areas, North Sumatra. The endemic species was collected in Toba Samosir, Simalungun, Dairi, and Samosir regencies.

The research of endemic species was conducted at Taman Eden 100 (02°35'32.8"N; 099°02'21.7"E, 1272–1607 m alt) in Lumban Julu District, Jangga Dolok (02°33'40.9"N; 099°05'29.7"E, 1120–1149 m alt), PT Inalum forest (Meranti Utara) (02°30'06.9"N; 099°12'54.1"E, 1127 m alt) in Pintu Pohan Meranti District, and Ambar Halim Village (02°31'00.4"N; 099°14'47.4"E, 1110 m alt) in Toba Samosir regency. While in Samosir regency, the research was conducted at Samosir Island around Simanindo (02°39'44.3"N; 098°41'12.4"E, 948 m alt), Pangururan (02°31'85.1"N; 098°44'05.8"E, 953 m alt), and Harian (Tele) (02°30'43.1"N; 098°38'62.5"E, 950 m alt). In Simalungun regency, the research was conducted at Sibaganding forest (02°43'35.0"N; 098°53'50.6"E, 1231–1322 m alt) at Girsang Sipangan Bolon District, along the road Simarjarunjung of Purba District (02°50'09.8"N; 098°45'32.6"E, 1479 m dpl) and forest of Mt. Singgalang, Nanggaraja Village, Silimakuta District (Saribu Dolok) (02°57'30.4"N; 098°36'06.6"E, 1438 m alt). Furthermore, in Dairi, the research was conducted around Pintu Angin forest (also known Hutan Panjang), along Merek-Sidikalang street/Sidikalang (02°47'00.5"N; 098°29'20.9"E, 1579–1807 m alt) and forest around PLTA Lae Renun, Silalahi Village, Silahisabungan District (02°47'16.8"N; 098°30'31.0"E, 1580–1689 m alt) (Figure 1).

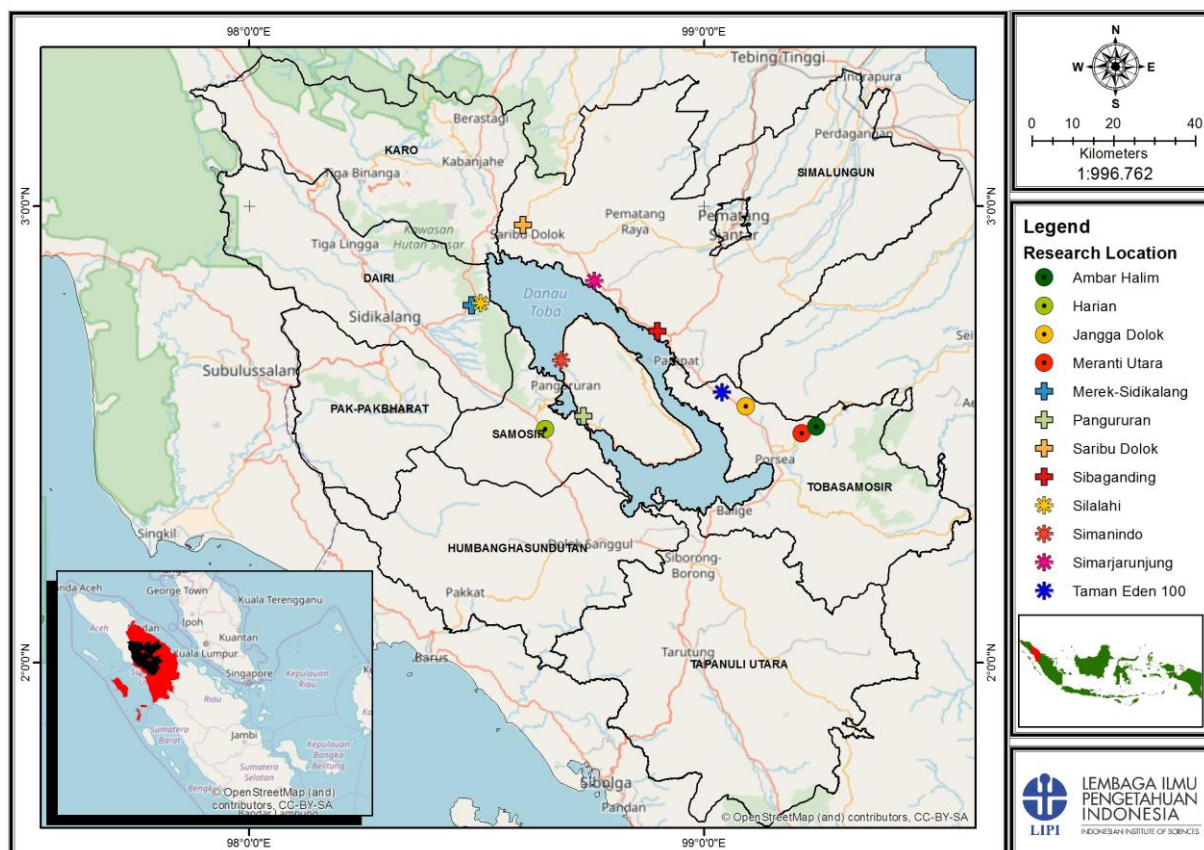


Figure 1. Research location around Lake Toba (Source: ArcMap from Arc GIS 10.5)

2.2. Methods

This research was conducted by exploration method [18]. Fertile flora (with flower, fruit or spore) was collected for herbarium specimens. Sterile flora (without flower, fruit or spore) was still collected for voucher specimens. The supporting data were recorded during collecting the specimens such as the location, habitat, distribution, altitude, latitude, longitude, and the date of collected. Those specimens sent to the Herbarium Bogoriense (BO) for further processing following method of Djarwaningsih et al. [19], [20] i.e the plant material was labelled, inserted in a newspaper and put into a plastic bag. The material was moistened with 70% alcohol. The material was dried in the oven, setting-up on the paper and stored at BO. The specimens were identified with reference collection at BO and related literature [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17], [21], [22], [23], [26], [29], [32] and [34].

3. Results and Discussions

Twenty six family, 54 genera and 120 species are reported around Lake Toba, North Sumatra. However, only 28 Sumatran endemic floras species from six genera were rediscovered (Table 1). Orchidaceae and Ericaceae are the most commonly found. Meanwhile, Taman Eden 100 and Jangga Dolok are the most common location for the rediscovery of endemic flora (Figure 2 and 3).

Table 1. List of Sumatran endemic flora from exploration around Lake Toba areas, North Sumatra

No	Family/Species	Location of Rediscovery
Balsaminaceae		
1	<i>Impatiens sidikalangensis</i> Grey-Wilson	Merek-Sidikalang
2	<i>Impatiens tapanuliensis</i> Grey-Wilson	Jangga Dolok
Begoniaceae		
3	<i>Begonia pseudoscottii</i> Girm.	Sidikalang
4	<i>Begonia scottii</i> Tebbitt	Jangga Dolok
Ericaceae		
5	<i>Diplycosia glauciflora</i> Sleumer	Harian (Tele)
6	<i>Gaultheria leucocarpa</i> Blume var. <i>hirta</i> Val. ex J.J.Sm.	Harian (Tele)
7	<i>Rhododendron jasminiflorum</i> Hook. ssp. <i>heusseri</i> (J.J.Sm.) Argent	Pangururan, Samosir Is.
8	<i>Rhododendron sessilifolium</i> J.J.Sm.	Taman Eden 100
9	<i>Rhododendron vinicolor</i> Sleumer	Taman Eden 100
Gesneriaceae		
10	<i>Liebigia adenonema</i> (Hilliard) Mich.Moller & A.Weber	Jangga Dolok
11	<i>Liebigia tobaensis</i> (Hilliard) Mich.Moller & A.Weber	Meranti Utara
Nepenthaceae		
12	<i>Nepenthes spectabilis</i> Danser	Merek-Sidikalang
13	<i>Nepenthes tobaica</i> Danser	Taman Eden 100
Orchidaceae		
14	<i>Agrostophyllum sumatranum</i> Schltr. & J.J.Sm. var. <i>sumatranum</i>	Jangga Dolok
15	<i>Bulbophyllum adelphidium</i> J.J.Verm.	Taman Eden 100
16	<i>Bulbophyllum longivagans</i> Carr	Taman Eden 100
17	<i>Coelogyne brachygyne</i> J.J.Sm.	Jangga Dolok
18	<i>Coelogyne salmonicolor</i> Rchb.f.	Taman Eden 100

No	Family/Species	Location of Rediscovery
19	<i>Corybas stenotribonos</i> J.B.Comber & J.Dransf.	Taman Eden 100
20	<i>Dendrobium brevibulbum</i> J.J.Sm.	Jangga Dolok
21	<i>Eria merapiensis</i> Schltr.	Sidikalang
22	<i>Goodyera gemmata</i> J.J.Sm.	Ambar Halim
23	<i>Micropera costulata</i> (J.J.Sm.) Garay	Ambar Halim
24	<i>Oxystophyllum hagerupii</i> (J.J.Sm.) M.A.Clem.	Taman Eden 100
25	<i>Paphiopedilum tonsum</i> (Rchb.f.) Stein	Taman Eden 100
26	<i>Schoenorchis sumatrana</i> J.J.Sm.	Jangga Dolok
27	<i>Trichoglottis adnata</i> J.J.Sm.	Taman Eden 100
28	<i>Trichoglottis simplex</i> J.J.Sm.	Taman Eden 100

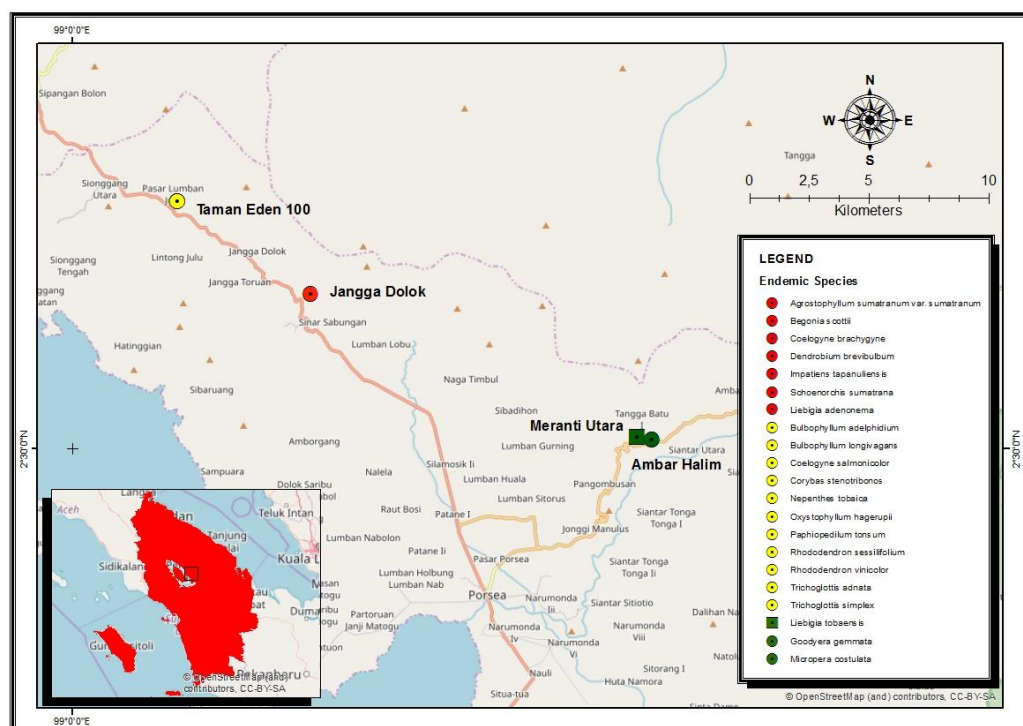


Figure 2. Map of rediscovery location of Sumatran endemic flora in Taman Eden 100, Jangga Dolok, Ambar Halim, and Meranti Utara (Source: ArcMap from Arc GIS 10.5)

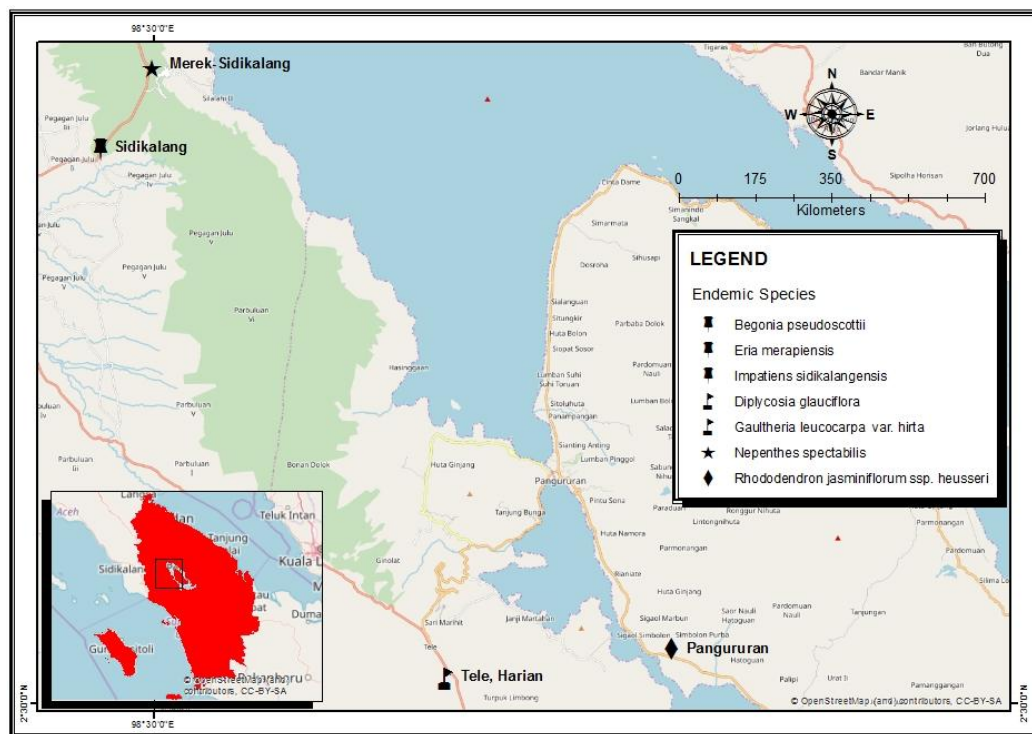


Figure 3. Map of rediscovery location of Sumatran endemic flora in Merek-Sidikalang/Sidikalang, Harian (Tele), and Pangururan (Samosir Island) (Source: ArcMap from Arc GIS 10.5)

Grey-Wilson [26] described *Impatiens sidikalangensis* for the first time in 1989. Grey-Wilson [26] also mentioned that this species found in Lae Pandom and between Merek – Sidikalang, North Sumatra. Recently, we also found this species in Sidikalang (Figure 4b). Meanwhile, *I. tapanuliensis* was first described by Grey-Wilson in 1989 based on type specimen of *Rahmat Si Boeea* 10419 (L) from Tapanuli (along the road from Porsea to Prapat), North Sumatra [26]. Grey-Wilson [26] also mentioned that these species occurred in Aceh, Sidikalang, Maranti, Lae Pandom and Manukmanuk Mts (based on the additional specimens that examined). In this research, this species was found in Jangga Dolok near the location of type specimen found (Figure 4a).

Begonia pseudoscottii was first published in 2015 by Hughes *et al.* based on a type specimen of *van Steenis* 6207 (BO) that was collected from Aceh [16]. Based on their additional specimens [16], this *Begonia* found specifically in Gunung Batu Lopang, North Sumatra and Gunung Kemiri, Aceh. Currently, this species also found in Sidikalang during exploration in North Sumatra. Meanwhile, *B. scottii* was first described by Tebbit in 2005 based on a type specimen of *De Wilde & De Wilde-Duyffes* 14309 (L) that was collected from Gunung Ketambe, Sumatra [23]. Recently, this species was also found in Jangga Dolok (Figure 4c). In 2018, Efandi [28] reported that *B. pseudoscottii* was originally collected from Mount Marapi, West Sumatra and *B. scottii*, which was originally collected from Mt. Tanggamus and Mt. Pesagi, Lampung have been introduced to Java at the Cibodas Botanical Garden for the ex-situ conservations.

Diplycosia glauciflora was reported only occur in Aceh (G. Lembuh and River Lau Alas) and North Sumatra (Sibolangit) [5], while *Gaultheria leucocarpa* var. *hirta* was reported only found in 1904 at Tapanuli, near Koeta Lekole, North Sumatra [34]. Recently, both of species were found in Tele, which an area around Harian village, Samosir Regency, North Sumatra (Figure 4e). In the other hands, *Rhododendron jasminiflorum* ssp. *heusseri* was reported to occur in Aceh (Mt. Kemiri) and North Sumatra (Sibolangit, near Pematang Siantar, around Lake Toba and Samosir) [13], [14]. In 2018, this species also collected in Pangururan, Samosir Island. The new record of *R. vinicolor* and *R.*

sessilifolium were found in Taman Eden 100 (Figure 4f, 1g respectively). Previously, *R. sessilifolium* distributed only at Tapanuli, North Sumatra and *R. vinicolor* found in Aceh (Mt. Lembuh region) and North Sumatra (Tapanuli, near Sidikalang, Mt. Bandahara and Karo near Brastagi) [13], [14].

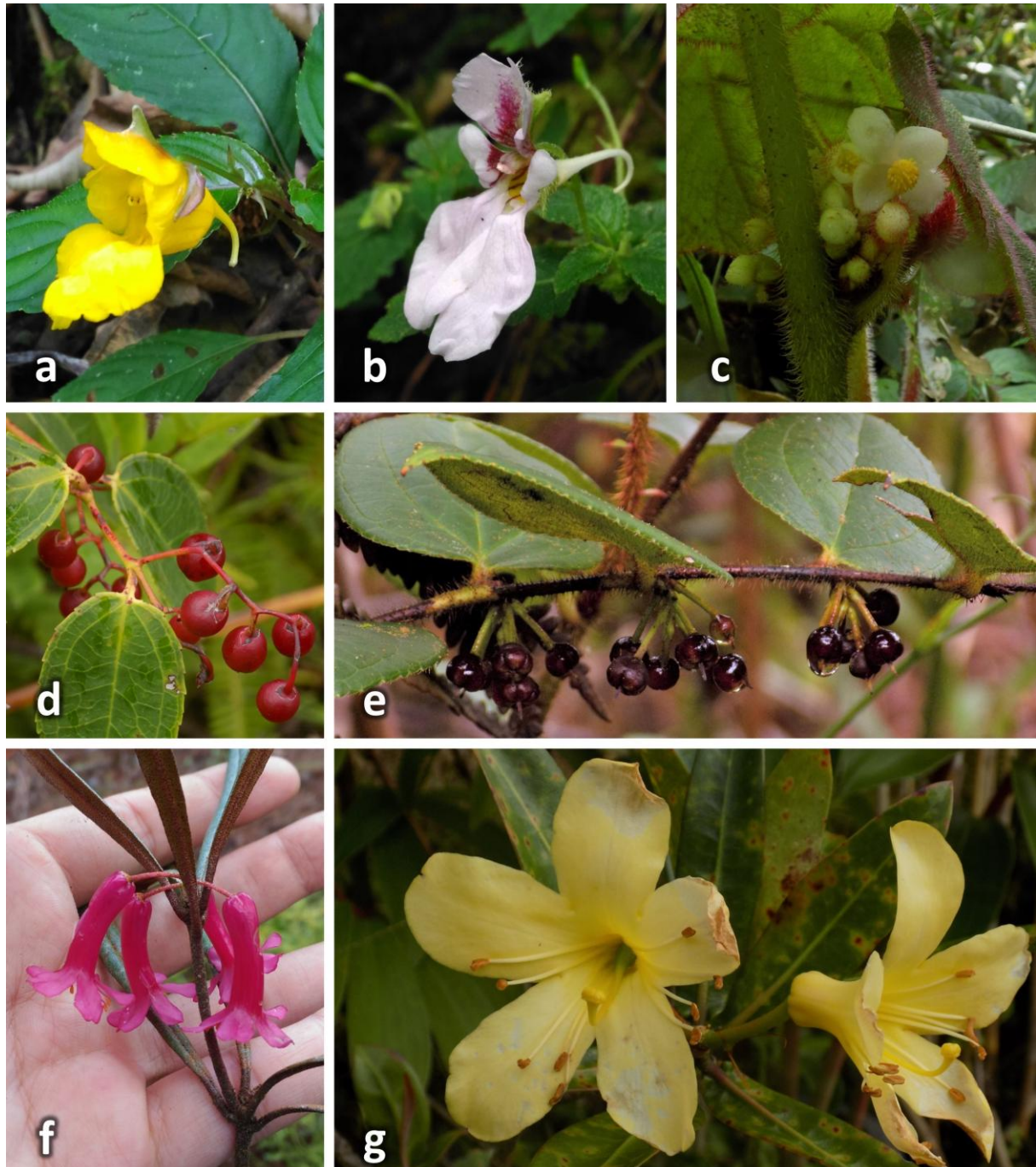


Figure 4. *Impatiens tapanuliensis* (a), *I. sidikalangensis* (b), *Begonia scottii* (c), *Gaultheria leucocarpa* (d), *Diplicosisia glauciflora* (e), *Rhododendron vinicolor* (f), *R. sessilifolium* (g). Photos: I Putu Gede P. Damayanto (a, b, f) & Yasper Michael Mambrasar (c, d, e, g).

Hilliard [27] was reported that *Liebigia adenonema* was found in Aceh (along the road of Bireuen to Takingeun) [27], North Sumatra [35] such as in Dolok Si Manoe-manoe, near headwaters of Aek

Mandosi, Dolok Sopo Raso (a mountain in a bend of the headwater of Aek Mandosi), Tapanuli (Porsea to Tutupan) and Tobing [27]. Meanwhile, *L. tobaensis* was reported only found in Aceh (Gunung Leuser Nature Reserves near Lau Ketambe) [27] and North Sumatra [35] such as in Tuktuk (Samosir Island), Kabanjahe, Parapat, Pematang Siantar and Simalungun [27]. However, we found *L. adenonema* in Jangga Dolok (Figure 5a) and *L. tobaensis* in north Meranti which of areas are never been mentioned before (Figure 5b).



Figure 5. *Liebigia adenonema* (a), *L. tobaensis* (b), *Nepenthes tobaica* (c), *Agrostophyllum sumatranum* var. *sumatranum* (d), *Eria merapiensis* (e), *Schoenorchis sumatrana* (f). Photos: Jasper Michael Mambrasar.

Nepenthes spectabilis was first described by Danser in 1928 [29]. This species reported occurred from Aceh to the Lake Toba area and endemic to northern Sumatra [25]. This species also reported found in Nature Park Ecotourism of Sicikeh-cikeh, Dairi, North Sumatra [33]. Based on Clarke *et al.* [25], *N. spectabilis* has been collected from sub-alpine shrubberies at 1,450-2,000 m altitude. According to IUCN Red List category, *N. spectabilis* is classified as VU (Vulnerable) due to this species considered to be at high risk of extinction in the wild [25]. Therefore the rediscovery of this species in the areas along the road of Merek-Sidikalang, Dairi, North Sumatra give a new information that this species still can be found in the wild. Meanwhile, *N. tobaica* was first described by Danser in 1928 based on specimens that collected from around Lake Toba [29]. This species also reported found along the roadside at east and west of Parapat, North Sumatra [30], [31]. Now, this species also found in the areas of Taman Eden 100 (Figure 5c). *N. tobaica* are reported growing in clay and volcanic soils in open shrub [32].

15 species from 12 genera of orchid found during this exploration. Mostly distributed at Taman Eden 100, Jangga Dolok, Hambar Halim and Sidikalang. Unfortunately, we only found one Sumatran endemic orchid species, *Eria merapiensis*, which, was previously reported occurs in North Sumatra (without location details) and West Sumatra (several mountains in Bukit Barisan Mountain range) (Figure 5e) [6]. Previously *Goodyera gemmata* was reported occurs in West Sumatra (Batang Palupuh and Bukit Batu Banting) and *Micropera costulata* was occurred in West Sumatra (Batang Palupu) [6] were also found in Ambar Halim during our research exploration of North Sumatra. Moreover, we recorded that *M. costulata* distributed at an altitude 1110 m. Unfortunately there is no published distribution news.

Comber [6] reported that *Agrostophyllum sumatranum* var. *sumatranum* was endemic to West Sumatra (near Padang and Siberut Island), while *Coelogyne brachygyne* was endemic to West Sumatra (Mt. Talamau near Mt. Ophir) and North Sumatra (Merek to Sidikalang road). *Dendrobium brevibulbum* (an accepted name by [37]) was reported endemic to Aceh (Mt. Leuser), North Sumatra (roadside near the Merek to Sidikalang) [6] and West Sumatra (Mt. Kerinci) [6], [24], while *Schoenorchis sumatrana* was endemic to Bengkulu (Rimbo Pengadang in the Bukit Barisan) and North Sumatra (Lau Kuwar) [6]. Recently, these four species also were found in Jangga Dolok, North Sumatra (Figure 5d, 5f).

The other orchids such as *Bulbophyllum adelphidium* was reported endemic to Aceh (Mt. Leuser) and North Sumatra (Merek), while *B. longivagans* was found in North Sumatra (near the Merek to Sidikalang road) [6]. *Coelogyne salmonicolor* was commonly found in many areas of West Sumatra, Jambi, Bengkulu and Lampung, while *Corybas stenotribonos* was endemic to North Sumatra (near the Merek-Sidikalang road) [6]. *Oxystophyllum hagerupii* (an accepted name by [36]) only found near Lake Toba, while *Paphiopedilum tonsum* was occurred at many places in West and North Sumatra (Lau Kawar) [6]. *Trichoglottis adnata* was distributed at many places in Sumatra (without noted specific location) but in North Sumatra, found at beside Merek to Sidikalang road [6]. *T. simplex* found in West Sumatra (Mt. Merapi) and North Sumatra (near Merek and close to the Merek to Sidikalang road) [6]. During our research exploration in North Sumatra, those eight species were found in Taman Eden 100, North Sumatra.

4. Conclusion

There are 28 species from six genera (Balsaminaceae, Begoniaceae, Ericaceae, Gesneriaceae, Nepenthaceae, Orchidaceae) of Sumatran endemic flora have been rediscovery around Lake Toba areas, North Sumatra. Orchidaceae and Ericaceae are the most commonly found. Meanwhile, Taman Eden 100 and Jangga Dolok are the most common location for the rediscovery of Sumatran endemic flora.

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