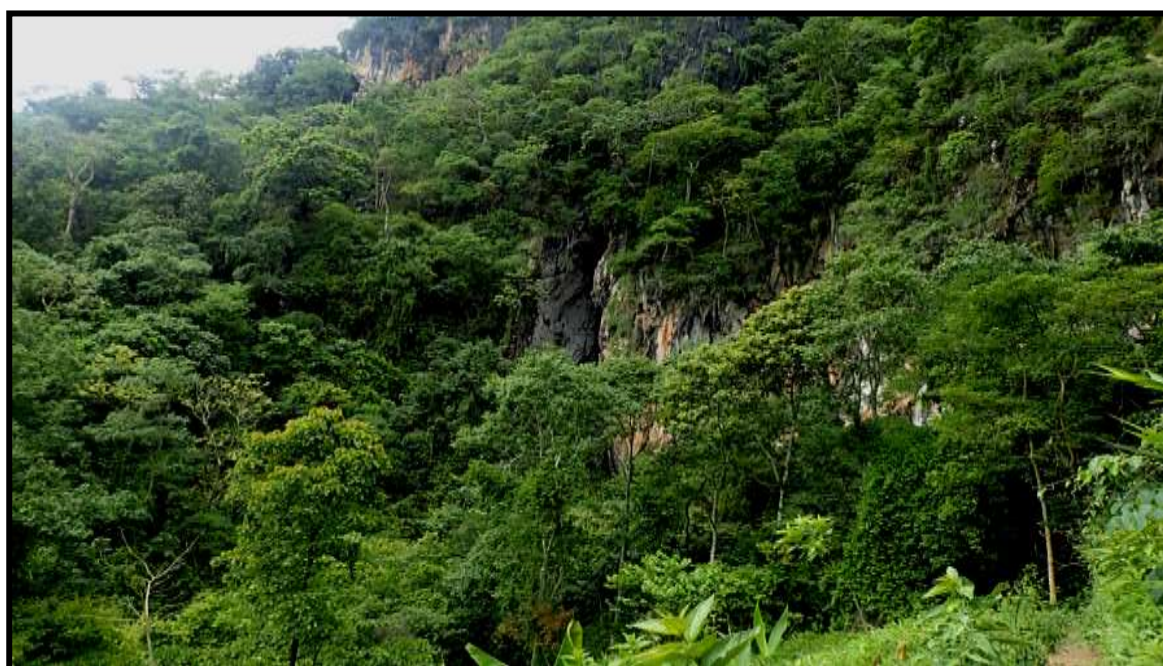


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**Botanical Survey of the Limestone Areas and Its Surrounding Regions in
Southern Shan State**



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CONTENTS

List of Tables	ii
List of Figures	ii
Abstract	iii
စာတမ်းအကျဉ်း	iv
1. Introduction	1
2. Literature review	1
3. Objectives	2
4. Materials and Methods	2
4.1. Study Sites	2
4.2. Plant Materials, Specimens Preparation and Identification	3
5. Results and Discussion	4
5.1. Vegetation of the study areas	5
5.2. Taxonomic notes	8
5.3 Medicinal plants and their resources	11
6. Conclusion	14
7. Acknowledgements	14
8. References	15
9. Appendix	17

List of Tables

Table 1	Following is the list of the principal localities from where plant collections are made, with their respective geo-referencing and vegetation class.	1
Table 2	Habit of the various species in the study areas	2
Table 3	Families of Flowering Plants with only a single Genus and a single Species in the Flora of the Southern Shan State	3
Table 4	Newly recorded species in the study areas	4
Table 5	Commercialization of medicinal plants in the study areas	5

List of Figures

Figure 1	The Location Map of Study Areas	3
Figure 2	Oak Forest at the Birds Sanctuary in Taunggyi	6
Figure 3	Yae Ayekan Reserved Forest in Kalaw	6
Figure 4	Shauk Pin Reserved Forest in Pindaya	7
Figure 5	<i>Luisia verrucosa</i> Kurzweil, Nob.Tanaka & Ormerod. A. Habit. B. Front view of flower.C. Diagonal front view of a flower	9
Figure 6	New or Noteworthy Species in Study Areas	10
Figure 7	<i>Globba</i> sp. Nov. found in Savanas at the Birds Sanctuary in Taunggyi	10

Botanical Survey of the Limestone Areas and Its Surrounding Regions in Southern Shan State

1. Introduction

Plant wealth of a country is the index of its prosperity and the only way to assess it is by the thorough of botanical surveys of its various parts, which is both assiduous and time consuming job, but the results of such studies are of great scientific and commercial value. Botanical, Geological, Zoological and Geographical surveys of a country are essential, as they reveal the richness of its plants, mineral and animal resources which form the raw materials for the development of the various industries in the country (Dewan 1960).

Nowadays, excessive mining of minerals and the establishment of cement factories in the limestone areas of Myanmar have destroyed the ecosystem of these areas and the surrounding areas, and plant and animal species are at risk of extinction. Therefore, this research aims to collect study and document the plant species growing in the natural protected forests of the limestone areas and its surrounding regions, and to document and identify the traditional uses of plants and their resources by the local herbal healers living in these areas.

The Indo-Chinese region is known as “Indo-Burma Hotspot” for its richness of biodiversity, however, the diversity is rapidly decreasing because of the deforestation and shifting-cultivation etc. Myanmar is one of these regions. On the other hand, with its wealth of plant diversity, Myanmar is one of the most botanically fascinating countries in the world. Thus it is quite evident from the fore-going historical account of the flora of Myanmar that the Southern Shan State, especially the limestone areas in the Southern Shan State has been botanically explored.

2. Literature review

Geographical Position of the area: The part of the Shan Plateau, which has been botanically explored, lies between 20° 15' and 21° 30' N, and 96° 30' and 97° 15' E, is a vast land mass with numerous monsoon streams and streamlets flowing in all the directions. It is bounded on the west by the plains of Upper Myanmar and on the east by the mountain ranges in continuation with that of the Taunggyi Ridge. It has roughly an area of 3,680 square miles.

Geology and Climate: According to Dr. Tin Hla, The known geological formations of the Shan Plateau belong to the Precambrian, Paleozoic and Mesozoic ages. Tertiary rocks are absent, owing to the fact that Plateau was already a raised land-mass during the Tertiary times. Much of the area covered by the Paleozoic zone, the stretch of this territory from Ho-Pong to Taunggyi is largely made up of hard grey limestone and calcareous shale. A mantle of incoherent red soil with varying thickness which appears to be the subtropical weathering product of limestone covers the region (Dewan, 1960). The Southern Shan State experiences a tropical climate, with distinct wet and dry seasons, influencing the biodiversity and agricultural practices.

Climate: It varies considerably from season to season. From December to middle of March, it is cool everywhere and on the open downs; sometimes as much as 10 degrees of frost are experienced. In the month of April and in winter months the temperature varies between 7° C and 26° C. The rains begin about the end of April or the beginning of May, but they are not continuous until August which is the wettest month. Rain always comes in thundershowers and varies from about 1500 mm in the broader valleys or basin to about 2500 mm on the high mountain ridges.

Vegetation: Myanmar is one of the countries with the largest forest cover on the mainland of Southeast Asia and is a region of globally significant biodiversity. It is also home

to a rich biodiversity ecosystem. About 42 percent of the country's area is hilly and mountainous, with large limestone areas. The Shan Plateau in southern Shan State, in particular, is home to a number of limestone karsts (300-500 km long) that are home to a unique biodiversity hotspot. It is considered one of the most interesting limestone areas in Southeast Asia (Dr Wolfgang Dreybrodt, 1988). limestone hills throughout SE Asia are under severe threat as the demand for cement and other limestone products (Clements et al. 2006) frequently takes precedence over conservation of biodiversity, eco-tourism, recreation, culture (cave temples) and their iconic landscape value (Kiew 1997).

The natural limestone areas of Myanmar and their associated ecosystems can also be studied. The natural plant species found in limestone areas are unique and unique to other ecosystems. Limestone vegetation is distinct from the surrounding lowland forest, not only in its species composition, but also in its appearance (Saw 2010). Its flora is extremely diverse in comparison with the small area it occupies. The general aspect of the vegetation, especially the few species of epiphytic ferns and orchids, show that the climate of this area is not persistently damp and in this respect this area is quite different from that of owner Myanmar continuously damp region.

3. Objectives

The purpose of this research is to clarify the diversity of plants species in the limestone regions of Southern Shan State. We collect plant distribution information through field surveys prepare herbarium specimens to develop a database, train young researchers in plant taxonomy, and return results to the public. The specific objectives:

- To systematically study and identify recorded species, new species, and new records by enumerating the naturally occurring plant species in the limestone areas and its surrounding regions.
- To identify and document plant species (e.g. medicinal plants) and their resources used traditionally by herbal healers.
- To contribute to the Flora of Myanmar Database and Flora of Myanmar book publishing activities

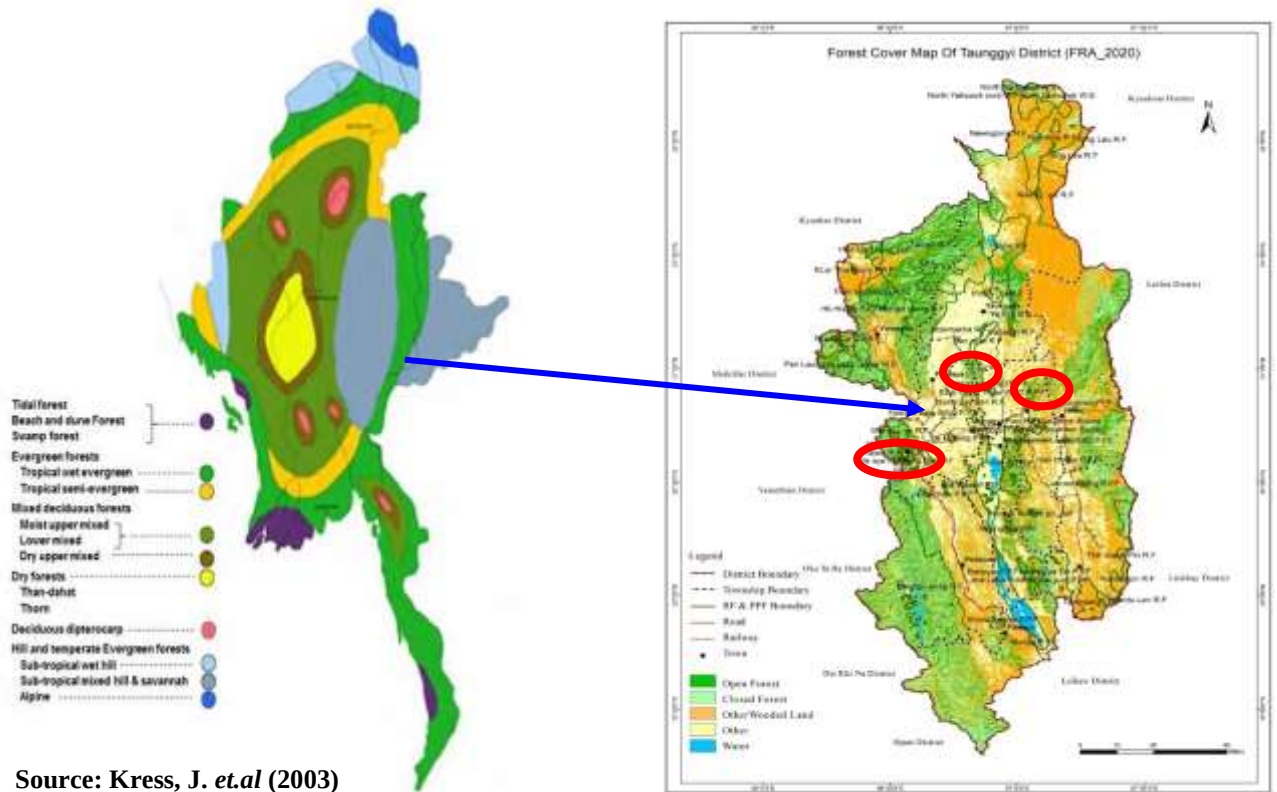
4. Materials and Methods

4.1. Study Sites

In Myanmar, we were carried out botanical survey in the topography includes parts of the Shan Plateau and is characterized by a combination of hilly landscapes and higher mountains to the north and south, making it part of the larger Shan Hills region, Kalaw, Aungban, Pindaya and Taunggyi belong to the Taunggyi District, Southern Shan State from 2022 to 2024 (Table 1 & Fig. 1).

Table 1. Following is the list of the principal localities from where plant collections are made, with their respective geo-referencing and vegetation class.

No.	Localities	Altitudes	Geographic Coordinate	Vegetation Class
1.	Aungban	1300 m	20°25'7"N 96°27'20.5"E	Semi-evergreen forest & Moist deciduous forest
2.	Kalaw	1350 m	20°36'16.7"N 96°32'10.7"E	Mix evergreen forest & Pine Forest
3.	Pindaya	1182 m	20°47'50.25"N, 96°42'00.01"E	Semi-evergreen forest
4.	Taunggyi	1687 m	20°45'12"N 97° 4'16"E	Mix evergreen forest & Oak forest



Source: Kress, J. *et.al* (2003)

Figure 1. The Location Map of Study Areas

4.2. Plant Materials, Specimens Preparation and Identification

We collected a total of 2000 voucher specimens of vascular plant species. Detailed collection localities were taken by using GPS (Global Positioning System). Species records in Myanmar are consulted based on a checklist of Myanmar (Kress et al. 2003) as well as the taxonomic literature on particular groups and regional flora including the Flora of Thailand (Smitinand et al. 1970–present), Flora of China, Flora of India, . Voucher specimens were deposited at the herbaria of Forest Research Institute (RAF) and National Museum of Nature and Science, Tsukuba (TNS).

Examination of the specimens collected by our field surveys and the existing herbarium specimens as well as their digital images of virtual herbarium at A, BM, E, F, K, MBK, NY, P, RAF, TNS, US and HITBC were conducted. Careful morphological investigations of dried herbarium specimens, spirit-preserved specimens, and living material cultivated in the nursery of the Forest Research Institute were conducted for their rigorous identification as well as the consultation of relevant literatures. Photographs used in the figures in this study were prepared in the field. Herbarium acronyms follow Thiers (2016–).

Ethnobotanical investigations of medicinal plants were conduct in the study areas during the field works. We collected data through the interviews with local herbal healers and traders.

5. Results and Discussions

The present plant collection is not so far from complete representation of the flora of that part of the Southern Shan State which we have explored botanically. The flora of the vegetation on the limestone consisted of 97 families of flowering plants, including 254 genera and 575 species.

The following table gives the composition of the vegetation according to the habit of the various species.

Table 2. Habit of the various species in the study areas

	Trees	Shrubs	Climbers & Twiners	Herbs	Grasses	Total
Number	149	156	44	198	28	575

The following table showed that seventy four of the families of flowering plants are represented by a single Genus and a single species each (Appendix).

Table 3. Families of Flowering Plants with only a single Genus and a single Species in the Flora of the Southern Shan State:

1.	Acanthaceae	27.	Cucurbitaceae	52.	Pentaphragmaceae
2.	Actinidiaceae	28.	Cyperaceae	53.	Phytolaccaceae
3.	Alismataceae	29.	Droseraceae	54.	Pinaceae
4.	Amaranthaceae	30.	Elaeocarpaceae	55.	Piperaceae
5.	Amaryllidaceae	31.	Euphorbiaceae	56.	Poaceae
6.	Anacardiaceae	32.	Fabaceae	57.	Polygonaceae
7.	Annonaceae	33.	Gentianaceae	58.	Primulaceae
8.	Apiaceae	34.	Gesneriaceae	59.	Proteaceae
9.	Apocynaceae	35.	Hernandiaceae	60.	Ranunculaceae
10.	Araceae	35.	Hydrangeaceae	61.	Rhamnaceae
11.	Araliaceae	36.	Hydrocharitaceae	62.	Rosaceae
12.	Asparagaceae	37.	Hypericaceae	63.	Rubiaceae
13.	Asphodelaceae	38.	Hypoxidaceae	64.	Rutaceae
14.	Asteraceae	39.	Lamiaceae	65.	Santalaceae
15.	Balanophoraceae	40.	Leeaceae	66.	Sapindaceae
16.	Bignoniaceae	41.	Linderniaceae	67.	Solanaceae
17.	Brassicaceae	42.	Loranthaceae	68.	Thymelaeaceae
18.	Campanulaceae	43.	Lythraceae	69.	Ulmaceae
19.	Cannaceae	44.	Malvaceae	70.	Urticaceae
20.	Caprifoliaceae	45.	Mazaceae	71.	Utriculariaceae

21.	Caryophyllaceae	46.	Menyanthaceae	72.	Verbenaceae
22.	Celastraceae	47.	Moraceae	73.	Viburnaceae
23.	Chloranthaceae	48.	Nyctaginaceae	74.	Vitaceae
24.	Commelinaceae	49.	Oleaceae		
25.	Convolvulaceae	50.	Onagraceae		
26.	Cornaceae	51.	Orchidaceae		

5.1 Vegetation of the study area

The vegetation in general is quite luxuriant and rich in the number of species genera and families and that of the limestone area is more remarkable for its beauty, variety and luxuriance. The vegetation is greatly influence d by the amount and periodicity of rainfall. Seasonality, rainfall, elevation, and disturbance all directly influence vegetation while bedrock, especially limestone, can be a factor in floristic.

The study areas are situated on various elevations between 920 m and 1500 m above sea level. The flora of this area is of the tropical in nature and includes four types of forest namely evergreen forests, moist upper mixed deciduous forests, dry upper mixed deciduous forests and subtropical pine forests.

The beautiful *Schima wallichii* with white Camelia –like flowers, *Anneslea fragrans* with cluster of pink flowers, *Betula alnoides* are common trees, especially on the western border of the Plateau. *Rosa gigantea* is conspicuous, climbing over the tall trees, from the top of which the long pendent branches covered with large white flowers hang down in profusion.

Species of *Clematis* are found covering small shrubs throughout the area. A very large liana – *Mucuna macrocarpa* grows along the western slope of the Taunggyi Ridge, just half way between the foot and top of the ridge. It goes round several trees like a monstrous python then across overs to the other side of the bridle path and behaves in the same way. Another species worth mentioning is *Entada scandens*, which branches profusely and climbs, sometimes covering the crowns of more than one dozen trees and from a distance it looks like a huge crown with numerous tall and thick pillar-like supports. A big honey-suckle- *Linocera hilderbrandiana* is a rare climber, the flowers of which along with those of *Michelia champaca* (Sagawa) are offered at the Golden Cave Pagoda near Pindaya. Family Loranthaceae is represented by fifteen species of partial parasites, distributed among three genera, *Dendrophthoe* (2) and *Loranthus* (1). Four insectivorous plants-*Utricularia flexuosa*, *Utricularia caerulea*, *Drosera peltata* and *Drosera burmanni* occur in this area. The Menispermaceae, Dioscoreaceae, Fabaceae, Apocynaceae, Cucurbitaceae and Convolvulaceae together contribute fifty three species of climbers and twiners belong to the families Rannunculaceae, Capparidaceae, Vitaceae, Combretaceae, Araliaceae, Oleaceae, Loganiaceae, Lamiaceae, Cucurbitaceae, Passifloraceae, Sapindaceae, Acanthaceae, Rubiaceae along with the Liliaceae . *Ganaphalium luteo-album*, *Rannunculus pensylvanicus*, *Asclepias curassavica* along with species of *Polygonum*, Sedges and grasses are commonly found along the watershed areas.

Pine forest found growing in Kalaw, and Aungban and in their neighborhood with *Pinus keyisia* as predominant tree species. Hill evergreen forest are mixing with the pine forest, with several species of Oaks, Chestnut, *Schima wallichii*, *Broussonetia papyrifera*, *Layerstromia flos-reaginae*, *Quercus fenestiata*, *Eriolanea quinquelocularia*, *Prunus*

cerosoide (Cherry) and *Albizia* sp. and many more species of trees; such forest cover the Aungban and Kalaw hill numerous climber and lianas as well as a thick ground cover of grasses, small shrubs and variety of herbs are also seen.



Figure 2. Oak Forest at the Birds Sanctuary in Taunggyi

Mixed Evergreen + Deciduous, Seasonal, Hardwood Forest (MXF): In Kalaw there is a distinct forest type situated above moist deciduous forests and below evergreen forest. In shale, metamorphic sandstone, and granite zones, such as Yaeaye-kan reserved forest, Taunggyi, and this MXF can be found from c. 1000-1500 m elevation. Limestone areas frequently have MXF at lower elevations, c. 1000 m, up to the summit of Birds Sanctuary (1678 m). Other limestone areas, especially typically steep cliffs, have deciduous cover in the lowlands and evergreen facies above 1000 m. MXF is best distinguished during the hot-dry season (March-May) when lowland deciduous forest are leafless and MXF areas partially so. Many MXF species, especially those epilithic on limestone, are only found in this habitat.



Figure 3. Yae Ayekan Reserved Forest in Kalaw

Typical MXF trees on the limestone summits which are deciduous include: *Brassiopsis hainla* (B.-H. ex D. Don) Seem. and *Schefflera khasianum* C.B. Clarke (both Araliaceae), *Radermachera glandulosa* Miq. (Bignoniaceae), *Falconeria insigne* Roy. (Euphorbiaceae) *Firmiana kerrii* (Craib) Kosterm. and *Sterculia villosa* Roxb. (both Sterculiaceae), and *Debgreasia wallichiana* (Wedd.) Wedd. ssp. *wallichiana* (Urticaceae). *Anneslea fragrans* Wall. (Theaceae). *Betula alnoides* Buch.-Ham. ex D. Don (Betulaceae). Evergreen counterparts are *Eriobotrya dubia* Decne (Rosaceae), *Dicellostyles zizyphifolia* (Griff.) Phup. (Malvaceae), and *Buxus* sp. (Buxaceae). Most of these species are common on the summits of the two limestone peaks.



Figure 4. Shauk Pin Reserved Forest in Pindaya

The herbaceous summit flora is mostly different from that found in other places in the study area. Most of these species are confined to this open, very rugged, and occasionally burnt habitat. The basic vegetation is MXF and in disturbed areas it is *Dendrocalamus giganteus* (Wall.) Munro (Poaceae, Bambusoideae), the only bamboo found in this habitat, is very common. I have not found flowering material of this species. Almost all of these summit species are deciduous and include mainly epiphytes and epiliths, with a few geophytes which grow in thin, black soil. *Impatiens kingdon-wardii* Nob. Tanaka & T. Sugaw (Basalminaceae) and *Clerodendron colebrookeanum* Walp. (Lamiaceae) are common annual herbs. Deciduous dicot epiliths include *Clematis burmanica* Lace. (Ranunculaceae, a vine), *Impatiens chinensis* L. and *I. amplexicaulis* Edgew. (Basalminaceae), *Senecio scandens* B. -H. ex D. Don and *Vernonia attenuata* DC. (both Asteraceae), *Paraboea glabrisepala* Burt and *Trisepalum prazeri* Burt (both Gesneriaceae), *Argostemma verticillatum* Wall. (Rubiaceae), and *Peperomia tetraphylla* (Forst. f.) Hk. & Arn. (Piperaceae). Deciduous epilithic monocots are also common with: *Hedychium ellipticum* Ham. ex J.E. Sm. (Zingiberaceae) and many Orchidaceae, viz. *Coelogyne lactea* Rchb. f., *Eria bilobulata* Seid., *Habenaria furcifera* Lindl., and *Panisea uniflora* (Lindl.) Lindl. *Asplenium interjectum* Christ (Aspleniaceae), and *Microsorium zippelii* (Bl.) Ching (Polypodiaceae). Epiphytic herbs are numerous and include some species which are also epiliths. *Eria globulifera* Seid., *Pholidota articulata* Lindl., *Holcoglossum kimbballinum* (Rchb.f.) Garay (all Orchidaceae); *Araiostegia imbricata* Ching and *Davallodes membranulosum* (Wall. ex Hk.) Copel. (both Davalliaceae), and *Loxogramme involute* (D. Don) Presl (Polypodiaceae) are common. In addition to these vascular plants there are many algae, fungi, lichens, and bryophytes on the woody vegetation and rocks.

Primary, Evergreen, Seasonal, and Hardwood Forest (EGF): EGF is present on both bedrocks from c. 1000-1525 m—the summit of Birds Sanctuary which is the highest point in the project area. Aside from MXF zones and the epilithic limestone flora, EGF is uniform throughout the area. The structure and composition of EGF is similar on both granite and limestone bedrocks. Thousands of years of soil development and floristic stabilization have resulted in this primary, climax vegetation. Unfortunately, much of the original EGF has been destroyed or degraded. EGF is distinct because of its appearance with a continuous canopy 20-30 m high and similarly dense understory and ground flora. Biodiversity is highest in EGF and, in contrast to deciduous forests, EGF cannot recover from fire, extensive grazing, and constant human exploitation. Typical canopy trees include: *Schima wallichii* (DC.) Korth. (Theaceae), *Sarcosperma arboreum* Bth. (Sapotaceae), *Cinnamomum iners* Reinw. ex Bl. (Lauraceae), *Balakata baccata* (Roxb.) Ess. (Euphorbiaceae); and several Fagaceae, e.g. *Castanopsis armata* (Roxb.) Spach., *C. tribuloides* (Sm.) A. DC., and *Lithocarpus elegans* (Bl.) Hatus. ex Soep.. Some understorey trees are *Turpinia pomifera* (Roxb.) Wall. ex DC. (Staphyleaceae), *Semecarpus cochinchinensis* Engl. (Anacardiaceae), *Ormosia sumatrana* (Miq.) Prain (Fabaceae, Papilionoideae), *Heynea trijuga* Roxb. ex Sims (Meliaceae); *Phoebe lanceolata* (Wall. ex Nees) Nees (Lauraceae), *Baccaurea ramiflora* Lour. and *Bridelia glauca* Bl. (both Euphorbiaceae), and *Ficus annuata* Bl. (Moraceae).

Woody climbers are common with *Mucuna macrocarpa* Wall., *Dalbergia rimosa* Roxb., and *D. stipulacea* Roxb. (all Leguminosae, Papilionoideae); *Rourea minor* Gaertn.) Leenh. ssp. *minor* (Connaraceae), and *Tetrastigma laoticum* Gagnep. (Vitaceae), with its distinctive, flat stems up to c. 15 cm diameter. *Leea indica* (Burm f.) Merr. (Leeaceae), *Melicope pteleifolia* (Champ. ex Bth.) T. Hart. (Rutaceae); *Psychotria monticola* Kurz var. *monticola* and *P. ophioxyloides* Wall. (Rubiaceae), *Maesa permollis* Kurz (Myrsinaceae), *Strobilanthes rex* Cl. (Acanthaceae), and *Antidesma sootepense* Craib (Euphorbiaceae) are some common treelets and shrubs found in shaded places. The ground flora is mostly evergreen and in undisturbed places it is typically dense. Common representatives include: *Mycetia glandulosa* Craib and *Ophiorrhiza trichocarpon* Bl. var. *trichocarpon* (both Rubiaceae), *Lepidagathis incurva* Ham. ex D. Don (Acanthaceae), *Polia hasskarlii* R. Rao (Commelinaceae), *Zingiber smilesianum* Craib (Zingiberaceae); and several pteridophytes, e.g. *Brainea insignis* (Hk.) J. Sm. (Blechnaceae) and *Thelypteris parastica* (L.) Fosb. (Thelypteridaceae). Seedlings and saplings also contribute to the density and diversity of the ground flora and understory. Upper water catchment valleys, ranging in elevation from 925-1352 m, include several ground flora species which are unique or most common to this habitat. The soil is typically moist, thick, and black on all bedrocks. *Musa itinerans* Chees. (Musaceae) and *Phrynium capitatum* Willd. (Marantaceae) are especially common and are good indicators of intact forest conditions.

These areas are very important for overall forest stability and sustainability, and are very susceptible to environmental degradation. All of these water sources should have top conservation and protection priorities.

5.2 Taxonomic notes

Taunggyi District because of its mainly granite and limestone bedrocks, broad elevation range of c. 600 -c. 1850 m, diverse vegetation, and specific habitats, such as the summit of Birds Sanctuary, is a very botanically rich area. In addition to many species which are either rare or poorly known, other species of special botanical interest have been collected there. *Luisia verrucosa* Kurzweil. (Orchidaceae) was collected from Birds Sanctuary, 6 June 2023 and described as a new species in 2022 (Figure. 6). We collected holotype material of

this very rare species while collecting there. We have been able to collect 24 species which are new records for Myanmar flora-all from Taunggyi District (Table 7).



Figure 5. *Luisia verrucosa* Kurzweil, Nob.Tanaka & Ormerod. A. Habit. B. Front view of flower.C. Diagonal front view of a flower (Photos: Mu Mu Aung)

Table 4. Newly recorded species in the study areas

No.	Scientific Name	Family	Habit
1	<i>Aglaia oligophylla</i> Miq.	Meliaceae	Tree
2	<i>Boesenbergia kingii</i> Mood & L.M.Prince	Zingiberaceae	Herb
3	<i>Boesenbergia maxwellii</i> Mood, L.M.Prince & Triboun	Zingiberaceae	Herb
4	<i>Hedychium tengchongense</i> Y.B.Luo	Zingiberaceae	Herb
5	<i>Argostemma thaithongae</i> Sridith	Rubiaceae	Herb
6	<i>Lobelia clavata</i> E. Wimm.	Campanulaceae	Herb
7	<i>Impatiens kingdon-wardii</i> Nob.Tanaka & T.Sugaw	Balsaminaceae	Herb
8	<i>Zingiber flovomaculosum</i> S. Q. Tong	Zingiberaceae	Herb
9	<i>Zingiber mekongense</i> Gagnep.	Zingiberaceae	Herb
10	<i>Zingiber purpureoalbum</i> M.M. Aung & Nob. Tanaka	Zingiberaceae	Herb
11	<i>Zingiber smilesianum</i> Craib	Zingiberaceae	Herb
12	<i>Zingiber densissimum</i> S.Q.Tong & Y.M.Xia	Zingiberaceae	Herb
13.	<i>Aeschynanthus minutifolius</i> D.J.Middleton	Gesneriaceae	Epiphytic plants

14.	<i>Trailliaedoxa gracilis</i> W.W.Sm. & Forrest	Rubiaceae	Shrub
15.	<i>Amischotolype neoscandens</i> Idress	Commelinaceae	Herb
16	<i>Vincetoxicum rotundifolium</i> (Buch.-Ham. ex Wight) Kuntze	Apocynaceae	Herb
17	<i>Hydrocotyle chiangdaoensis</i> Murata	Apiaceae	Herb
18	<i>Rohdea siamensis</i> Yamashita & M. N. Tamura	Asparagaceae	Herb
19	<i>Lamium</i> sp.	Lamiaceae	Herb
20	<i>Mamtema</i> sp.	Caryophyllaceae	Herb
21	<i>Angelica</i> sp.	Apiaceae	Herb
22	<i>Curcuma</i> sp.	Zingiberaceae	Herb
23	<i>Globba</i> sp.	Zingiberaceae	Herb
24	<i>Zingiber</i> sp.	Zingiberaceae	Herb



Zingiber sp. nov.
(Sect. Chryptanthium)



Curcuma sp. nov.
(Sect. Ecomata)



Curcuma sp. nov.
(Sect. Ecomata)

Figure 6. New or Noteworthy Species in Study Areas



Figure 7. *Globba* sp. nov. found in Savanas at the Birds Sanctuary in Taunggyi

5.3 Medicinal plants and their resources

A comprehensive compilation is provided of the medicinal plants of the study areas in the southern Shan State. A total of 68 medicinal plant species were used by herbal healers in the study areas belonging to 63 genera and 41 families.

Commercialization of medicinal plants: a total of 68 medicinal plant species in study areas are commercialized (Table 4); of these *Zingiber officinale* and *Kaempferia galanga* are (Zingiberaceae) cultivated species. *Curcuma aromatica* (Zingiberaceae) *Swertia angustifolia* is both cultivated and wild. Three wild species in high market demand are *Paris polyphylla* (Melanthiaceae), *Cinnamomum tamala* (Lauraceae) and *Spatholobus suberectus* (Fabaceae). Most of the species are sold to traders or in the market of the Nhu Thanh and the Nhu Xuan districts. Traders usually sell roots of *Morinda officinalis*, roots of *Polygonum multiflorum*, roots and stems of *Smilax glabra*, roots of *Gynura japonica* and stems and barks of *Abrus precatorius* to traditional medicine shops in big cities in Vietnam. *Spatholobus suberectus* and *Amomum villosum* are exported to China. The demand of the market and the collection intensity of *Betula alnoides*, *Paris polyphylla*, *Cinnamomum tamala*, *Cissus discolor*, *Dendrobium* sp., *Aquilaria malaccensis*, *Curculigo orchoides* used as variety of herbal products are especially high. From our botanical field surveys it appeared that these species have become endangered by over-collecting of the entire plant, and will soon be extinct, at least locally, if no attempts are made to get the plant into cultivation.

Table 5. Commercialization of medicinal plants in the study areas

No.	Family	Scientific Name	Local Name	Part of Use
1	Acoraceae	<i>Acorus calamus</i> L.	Linn-nay	Rhizome
2	Amaryllidaceae	<i>Curculigo orchoides</i> Gaertn.	Taw-htan	Rhizome & Root
3	Apocynaceae	<i>Alstonia scholaris</i> (L.) R.Br.	Letpan-kha	Bark, leaves, seeds, and latex
4	Apocynaceae	<i>Dregea volubilis</i> (L.f.) Benth. ex Hook.f.	Gawy-tauk	Flower, tender shoot, leaf
5	Apocynaceae	<i>Holarrhena antidysenterica</i> (G.Don) Wall.ex A.DC.	Let-htoke	Bark, leaves, seeds, and flowers
6	Apocynaceae	<i>Leptadenia reticulata</i> (Retz.) Wight & Arn.	Gon-kha	Leaves, flowers, fruits, stem and roots
7	Apocynaceae	<i>Plumeria rubra</i> L.	Tayok-sankar	Flower
8	Apocynaceae	<i>Rauwolfia serpentina</i> Benth. ex Kurz	Bone-mayaza	Root
9	Araceae	<i>Homalomena wallisii</i> Regel	Thi-la-sandar	The whole plants
10	Aristolochiaceae	<i>Aristolochia indica</i> L.	Nga-phone-sae	Roots, leaves, bark
11	Asteraceae	<i>Carthamus tinctorius</i> L.	Supan	Flowers and Seeds
12	Betulaceae	<i>Betula alnoides</i> Buch.-Ham. ex D.Don	Pa-yoak, Cherry-pho	Bark

13	Bignoniaceae	<i>Millingtonia hortensis</i> L.f.	Akayit	Flowers, stem bark,leaves, and roots
14	Calophyllaceae	<i>Mesua ferrea</i> L.	Kantkaw	Flowers, seeds, and roots
15	Caprifoliaceae	<i>Nardostachys jatamansi</i> (D.Don)DC.	Kant-balu	Roots, rhizome, leaves, and whole plant
16	Combretaceae	<i>Terminalia bellerica</i> Roxb.	Thitseint	Bark, fruit, resin, gum, oil,and seeds
17	Combretaceae	<i>Terminalia chebula</i> Retz.	Phankha	Leaves and fruit
18	Combretaceae	<i>Terminalia citrina</i> (Gaertn.) Roxb.	Kya-su	Bark, Fruit
19	Convolvulaceae	<i>Ipomoea nil</i> (L.) Roth	Taung-kasun	Seeds, leaves, and whole plant
20	Cucurbitaceae	<i>Momorodica charantia</i> L.	Kyet-hin-kha	Tender fruit, tender shoot
21	Fabaceae	<i>Afzelia xylocarpa</i> (Kurz) Craib	Padauk-net	Bark, leaves and seeds
22	Fabaceae	<i>Caesalpinia digyna</i> Rotter	Sun-let-thae	Roots, bark, Seed pods
23	Fabaceae	<i>Glycyrrhiza glabra</i> L.	Ngwe-cho	Roots & rhizomes
24	Fabaceae	<i>Senna siamea</i> (Lam.) H.S.Irwin	Mezali	Flower bud
25	Fabaceae	<i>Trigonella foenum-graecum</i> L.	Pe-ka-toe	Seeds, leaves and oil
26	Flacourtiaceae	<i>Flacourtia cataphracta</i> Roxb. ex Willd.	Kat-pho	Bark, fruit and roots
27	Gentianaceae	<i>Gentiana kurroo</i> Royle	Se-palae	Root, rhizome, and flower
28	Gentianaceae	<i>Swertia angustifolia</i> Buch.-Ham.	Pan-sae-kha	The whole plants
29	Lamiaceae	<i>Clerodendron indicum</i> (L.) Kuntze	Nga-yant-palu	Leaves, roots, and resin
30	Lamiaceae	<i>Clerodendrum paniculatum</i> L.	Pan-yin	Leaves, roots and flowers
31	Lamiaceae	<i>Clerodendrum serratum</i> (L.) Moon	Yin-pya	Roots, leaves and seeds
32	Lamiaceae	<i>Vitex quinata</i> (Lour.)	Kyet-lae-san	Stem bark, leaves, and wood
33	Lamiaceae	<i>Vitex trifolia</i> L.	Kyaung-pan-lay	Leaves , fruitslowers, fruit, and
34	Lauraceae	<i>Cinnamomum macrocarpum</i> Hook.f.	Karaway	Bark, leaves, and root bark
35	Lauraceae	<i>Cinnamomum tamala</i> Nees & Eberm.	Thitkyabo	Leaves, bark, and fruit

36	Lauraceae	<i>Litsea glutinosac</i> (Lour.) C.B.Rob.	Ohn-ton	Leaves, bark, and seeds
37	Lythraceae	<i>Woodfordia floribunda</i> Salisb.	Pan-lae	Bark and leaves
38	Malvaceae	<i>Pterospermum acerifolium</i> (L.) Willd.	Kala-met	Flowers, bark, leaves and wood
39	Malvaceae	<i>Thespesia populnea</i> (L.) Soland. Ex Correa	Sanda-ku-ni	Leaves, bark, flowers, fruits, roots and seeds
40	Melanthiaceae	<i>Paris polyphylla</i> Sm.	Taung-loan-kyaw	Rhizome, leaves and whole plant
41	Menispermaceae	<i>Stephania rotunda</i> Lour.	Taung-kya	The whole plants
42	Menispermaceae	<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thomson	Sin-tone-ma-new	Stem and leaves
43	Moringaceae	<i>Moringa oleifera</i> Lam.	Dantda-lun	Tenderfruit, leaf
44	Myrsinaceae	<i>Embelica robusta</i> Roxb.	Aitmaawe	Dried bark and roots
45	Nymphaeaceae	<i>Nelumbo nucifera</i> Gaertn.	Kya	Seeds, young stems, stamens
46	Oleaceae	<i>Jasminum grandiflorum</i> L.	Myat-lay	Flowers & leaves
47	Oleaceae	<i>Jasminum officinale</i> L.	Sabae	Flowers, leaves & roots
48	Phyllanthaceae	<i>Phyllanthus emblica</i> L.	Ziphyu	Fruit, leaves, bark & Seeds
49	Orchidaceae	<i>Dendrobium</i> sp.	Orchids	Leaves, stems, whole plant, pseudobulb
50	Pinaceae	<i>Pinus kesiya</i> Royle ex Gordon	Htin-yu	Wood
51	Piperaceae	<i>Piper attenuatum</i> Buch.-Ham.	Sayo	Leaves, roots & whole plant
52	Plantaginaceae	<i>Plantago major</i> L.	Se-poe-ti	Leaves, juice & seeds
53	Polygonaceae	<i>Bistorta yunnanensis</i> H. Gross	Se-pu-sun	Roots , leaves & other parts
54	Pontederiaceae	<i>Eichhornia crassipes</i> Solms.	Bae-da	The whole plants
55	Primulaceae	<i>Anagallis arvensis</i> L.	Nygetma-nar	The whole plants & aerial parts
56	Rhizophoraceae	<i>Carallia brachiata</i> (Lour.) Merr.	Maniauga	Leaves, bark, fruit, and wood
57	Rubiaceae	<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Htain	Bark and roots
58	Rutaceae	<i>Aegle marmelos</i> (L.) Correa	Ushit	Leaves, roots, bark,fruits, and seeds

59	Santalaceae	<i>Dendrotrophe varians</i> (Blume) Miq.	U-patha-kar	Aerial stem
60	Santalaceae	<i>Santalum album</i> L.	Nantha-phyu	Wood, bark, leaves, and fruits
61	Sapotaceae	<i>Mimusops elengi</i> L.	Kha-yae	Bark, leaves, flowers, seeds, and fruit
62	Theaceae	<i>Anneslea fragrans</i> Wall.	Panma	Leaves, stems, and bark
63	Thymelaeaceae	<i>Aquilaria malaccensis</i> Lam.	Thitmwe	Wood, bark, and leaves
64	Vitaceae	<i>Cissus discolor</i> Blume	Tapin-taing-mya-nan	Leaves and whole plants
65	Zingiberaceae	<i>Curcuma aromatica</i> Salisb.	Nanwin-kha	Rhizome and Flower
66	Zingiberaceae	<i>Kaempferia galanga</i> L.	Kunsa-gamone	
67	Zingiberaceae	<i>Zingiber montanum</i> (J.Koenig) Link ex A.Dietr	Meiktha-lin	Rhizome & leaves
68	Zingiberaceae	<i>Zingiber officinale</i> Roscoe.	Gyin	Rhizome and stem

6. Conclusion

Many new records and new species of the plants are still to be expected from Myanmar. To develop the better conservation planning, it is necessary to conduct further intensive botanical inventories and accurately know the plant species diversity as reliable baseline information. Further continuous field works will provide the good materials towards the Flora of Myanmar. Publications: these results are presenting by a series paper such as **“Contributions towards the Flora of Myanmar”**, and other appropriate papers. **“Specimen Database for Flora of Myanmar”** is now constructing at the Forest Herbarium (RAF), Biodiversity Research Center

The Botanical Survey of the study area serves the nation by providing scientific basis for conservation and sustainable use of wild plant diversity through survey, documentation, taxonomic research and environmental awareness such as **“Contributions towards the Flora of Myanmar”**, and other appropriate papers. **“Specimen Database for Flora of Myanmar”**

These results of the research would be contributed to the updating for the flora in Myanmar. Flora Survey should be done three seasons especially winter and summer seasons to assess their species diversity and extension on the conservation of rare and endangered species. Many new records of the species are still to be expected from the study area. Further botanical survey and accurately know the species diversity as reliable baseline information. Further continuous field works will provide the good materials towards the Flora of Myanmar.

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Appendix

Families of Flowering Plants with only a single Genus and a single Species in the Flora of the Southern Shan State

No.	Family	Scientific Name
1	Acanthaceae	<i>Acanthus leucostachyus</i> Wall.ex Nees
2	Acanthaceae	<i>Justicia procumbens</i> L.
3	Acanthaceae	<i>Phlogacanthus vulgaris</i> L.
4	Actinidiaceae	<i>Saurauia napaulensis</i> DC.
5	Alismataceae	<i>Sagittaria sagittifolia</i> L.
6	Amaranthaceae	<i>Achyranthes aspera</i> L.
7	Amaryllidaceae	<i>Crinum defixum</i> Ker Gawl.
8	Anacardiaceae	<i>Semecarpus anacardium</i> L.f.
9	Anacardiaceae	<i>Spondias mangifera</i> Willd.
10	Annonaceae	<i>Desmos dumosus</i> (Roxb.) Saff.
11	Apiaceae	<i>Angelica archangelica</i> L.
12	Apiaceae	<i>Centella asiatica</i> (L). Urb.
13	Apiaceae	<i>Pimpinella diversifolia</i> DC.
14	Apiaceae	<i>Selinum tenuifolium</i> Salisb.
15	Apocynaceae	<i>Aganosma marginatum</i> (Roxb.) D.J.Middleton
16	Apocynaceae	<i>Alstonia scholaris</i> R.Br.
17	Apocynaceae	<i>Stephanotis volubilis</i> (L.f.) S.Reuss, Liede & Meve
18	Apocynaceae	<i>Streptocaulon wallichii</i> Wight
19	Apocynaceae	<i>Wrightia arborea</i> (Dennst.) Mabb.
20	Araceae	<i>Amorphophallus bulbifera</i> (Schott) Blume
21	Araceae	<i>Typhonium diversifolium</i> Wall. ex Schott
22	Araliaceae	<i>Schefflera vernulosa</i> (Wight & Arn.) Harms
23	Araliaceae	<i>Schefflera eleta</i> (Buch. -Ham. ex D.Don)
24	Araliaceae	<i>Trevesia palmata</i> (Roxb. ex Lindl.) Vis.
25	Asparagaceae	<i>Asparagus filicinus</i> Buch.-Ham. ex D. Don
26	Asphodelaceae	<i>Dianella ensifolia</i> (L.) Redoute
27	Asteraceae	<i>Ageratum conyzoides</i> L.
28	Asteraceae	<i>Cosmos caudatus</i> H.B.K.
29	Asteraceae	<i>Crassocephalum crepidioides</i> (Benth.) S.Moore
30	Asteraceae	<i>Erigeron mucronatus</i> DC.

31	Asteraceae	<i>Galinsoga parviflora</i> Cav.
32	Asteraceae	<i>Gnaphalium luteoalbum</i> L.
33	Asteraceae	<i>Ligularia hookeri</i> (C.B.Clarke) Hand.-Mazz.
34	Balanophoraceae	<i>Balanophora dioica</i> R.Br. Ex Royle
35	Bignoniaceae	<i>Jacaranda mimosifolia</i> D.Don
36	Boraginaceae	<i>Cynoglossum wallichii</i> G.Don
37	Brassicaceae	<i>Brassica campestris</i> L.
38	Campanulaceae	<i>Asyneuma</i> sp.
39	Campanulaceae	<i>Lobelia clavata</i> E. Wimm.
40	Cannaceae	<i>Canna indica</i> L.
41	Caprifoliaceae	<i>Nardostachys</i> sp.
42	Caryophyllaceae	<i>Arenaria roseiflora</i> Sprague
43	Caryophyllaceae	<i>Mantema</i> sp.
44	Caryophyllaceae	<i>Silene burmanica</i> Collett & Hemsl.
45	Celastraceae	<i>Euonymus glaber</i> Roxb.
46	Chloranthaceae	<i>Cgloranthus officinalis</i> Blume
47	Chloranthaceae	<i>Chloranthus spicatus</i> (Thunb.) Makino
48	Commelinaceae	<i>Amisotolype hookeri</i> (Hassk.) Hara
49	Commelinaceae	<i>Cyanotis barbata</i> D.Don
50	Convolvulaceae	<i>Argyreia nervosa</i> (Burm.f.) Bojer
51	Convolvulaceae	<i>Cuscuta reflexa</i> Roxb.
52	Cornaceae	<i>Alangium babatum</i> (R.Br. ex C.B.Clarke) Baill.
53	Cucurbitaceae	<i>Coccinia grandis</i> (L.) Voigt
54	Cyperaceae	<i>Fimbristylis dichotoma</i> Vahl.
55	Droseraceae	<i>Drosera peltata</i> Thunb.
56	Elaeocarpaceae	<i>Elaeocarpus grandiflorus</i> Sm.
57	Euphorbiaceae	<i>Antidesma collettii</i> Craib
58	Euphorbiaceae	<i>Macaranga denticulata</i> (Blume) Mull.Arg.
59	Fabaceae	<i>Adenantha pavoniana</i> L.
60	Fabaceae	<i>Apios comea</i> Benth. Ex Baker
61	Fabaceae	<i>Archidendron jiringa</i> (Jack.) I.C.Nielsen
62	Fabaceae	<i>Bauhinia racemosa</i> Lam.
63	Fabaceae	<i>Clitoria ternatea</i> L.
64	Fabaceae	<i>Mucuna macrocarpa</i> Wall.
65	Fabaceae	<i>Pithecellobium</i> sp.
66	Fabaceae	<i>Pueraria collettii</i> Prain
67	Fabaceae	<i>Vigna adenantha</i> (G. Mey.) Marechal
68	Gentianaceae	<i>Canscora diffusa</i> R. Br.
69	Gentianaceae	<i>Exacum teres</i> Wall.
70	Gentianaceae	<i>Swertia angustifolia</i> Buch.-Ham. ex D.Don
71	Gesneriaceae	<i>Aeschynanthus mannii</i> Kurz ex C.B.Clarke
72	Gesneriaceae	<i>Boea wallichii</i> R.Br.

73	Gesneriaceae	<i>Didymocarpus neurophylla</i> (Collett & Hemsl.) B.L. Burt
74	Gesneriaceae	<i>Petrocodon</i> sp.
75	Hernandiaceae	<i>Illigera coryzadenia</i> Meisn.
76	Hydrangeaceae	<i>Dichroa febrifuga</i> Lour.
77	Hydrangeaceae	<i>Philadelphus delavayi</i> L.Henry
78	Hydrocharitaceae	<i>Ottelia alismoides</i> (L.) Pers.
79	Hypericaceae	<i>Mesua ferrea</i> L.
80	Hypoxidaceae	<i>Hypoxis aurea</i> Lour.
81	Lamiaceae	<i>Lamium</i> sp.
82	Lamiaceae	<i>Premna nana</i> Collett & Hemsl.
83	Lamiaceae	<i>Vitex glabrata</i> R. Br.
84	Leeaceae	<i>Leea crispa</i> L.
85	Linderniaceae	<i>Torenia fournieri</i> Linder ex E.Fourn
86	Loranthaceae	<i>Loranthus falcatus</i> L.f.
87	Lythraceae	<i>Rotala rotundifolia</i> (Buch.-Ham ex Roxb.)
88	Malvaceae	<i>Hibiscus abelmoschus</i> L.
89	Malvaceae	<i>Tilia</i> sp.
90	Mazaceae	<i>Mazus rugosus</i> Lour.
91	Menyanthaceae	<i>Nymphoides</i> sp.
92	Moraceae	<i>Broussonetia papyrifera</i> (L.) L'Her. Ex Vent.
93	Moraceae	<i>Morus indica</i> L.
94	Nyctaginaceae	<i>Boerhavia repanda</i> Willd.
95	Oleaceae	<i>Jasminum scandens</i> (Retz.) Vahl
96	Onagraceae	<i>Ludwigia adscendens</i> (L.) H.Hara
97	Orchidaceae	<i>Aerides falcata</i> Lindl
98	Orchidaceae	<i>Anthogonium gracile</i> Wall.ex Lindl.
99	Orchidaceae	<i>Dendrochilus</i> sp.
100	Orchidaceae	<i>Disperis</i> sp.
101	Orchidaceae	<i>Habenaria dentata</i> (S.W.) Schltr
102	Orchidaceae	<i>Hemipilia callophylla</i> Par & Rchb.f.
103	Orchidaceae	<i>Holcoglossum kimballinum</i> (Rchb.f.) Garay
104	Orchidaceae	<i>Pecteilis</i> sp.
105	Orchidaceae	<i>Spathoglottis pubescens</i> Lindl.
106	Pentaphylacaceae	<i>Anneslea fragrans</i> Wall.
107	Pentaphylacaceae	<i>Eurya japonica</i> Thunb.
108	Phytolaccaceae	<i>Phytolacca</i> sp.
109	Piperaceae	<i>Peperomia tetraphylla</i> (Forst. f.) Hk. & Arn
110	Poaceae	<i>Agrostis burmanica</i> Bor
111	Poaceae	<i>Bambusa bambos</i> (L.) Voss
112	Poaceae	<i>Cymbopogon citratus</i> Stapf.
113	Poaceae	<i>Ophiopogon wallichianus</i> Hook. f.

114	Poaceae	<i>Pennisetum purpureum</i> Schumach.
115	Poaceae	<i>Pseudoxytenanthera albociliata</i> (Munro) T.Q. Nguyen
116	Polygonaceae	<i>Polygonum plebeium</i> R. Br.
117	Polygonaceae	<i>Rumex nigricans</i> Hook. f.
118	Primulaceae	<i>Maesa indica</i> (Roxb.) A.DC.
119	Primulaceae	<i>Maesa mollissima</i> (Blume) A.DC.
120	Primulaceae	<i>Maesa ramentacea</i> (Roxb.) A.DC.
121	Primulaceae	<i>Maesa sinensis</i> A.DC.
122	Proteaceae	<i>Helicia excelsa</i> Blume.
123	Proteaceae	<i>Helicia robusta</i> Wall.
124	Ranunculaceae	<i>Anemone rivularis</i> Galcier
125	Ranunculaceae	<i>Anemone rivularis</i> Galcier
126	Ranunculaceae	<i>Anemone rivularis</i> Galcier
127	Ranunculaceae	<i>Clematis burmanica</i> Lace
128	Ranunculaceae	<i>Delphinium altissimum</i> Wall.
129	Rhamnaceae	<i>Berchemia flavescens</i> Wall.
130	Rhamnaceae	<i>Ventilago calyculata</i> Tul.
131	Rhamnaceae	<i>Ziziphus incurva</i> Roxb.
132	Rosaceae	<i>Agrimonia eupatoria</i> L.
133	Rosaceae	<i>Docynia indica</i> (Wall.) Decne.
134	Rosaceae	<i>Eriobotrya dubia</i> Decne.
135	Rosaceae	<i>Prunus erasoides</i> D. Don
136	Rubiaceae	<i>Borreria articularis</i> (L.) F.N. Williams
137	Rubiaceae	<i>Morinda elliptica</i> Ridl.
138	Rubiaceae	<i>Oldenlandia ramosa</i> Roxb.
139	Rubiaceae	<i>Paederia pilifera</i> Hook. f.
140	Rubiaceae	<i>Pavetta tomentosa</i> Roxb.
141	Rutaceae	<i>Murraya paniculata</i> (L.) Jack
142	Santalaceae	<i>Santalum album</i> L.
143	Sapindaceae	<i>Lepisanthes tetraphylla</i> (Vahl) Radlk.
144	Solanaceae	<i>Brunfelsia undulata</i> Sw.
145	Solanaceae	<i>Cestrum nocturnum</i> L.
146	Solanaceae	<i>Physalis peruviana</i> L.
147	Thymelaeaceae	<i>Wikstroemia indica</i> C.A. Mey.
148	Ulmaceae	<i>Trema occidentalis</i> (L.) Blume
149	Urticaceae	<i>Urtica</i> sp.
150	Utriculariaceae	<i>Utricularia graminifolia</i> Vahl
151	Verbenaceae	<i>Phyla</i> sp.
152	Viburnaceae	<i>Sambucus javanica</i> Blume
153	Viburnaceae	<i>Viburnum coriaceum</i> Blume
154	Vitaceae	<i>Cissus discolor</i> Blume