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Diversity and phytogeography of vascular epiphytes in a tropical–subtropical transition island, Taiwan

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Abstract

We present the first checklist of vascular epiphytes in Taiwan, based on herbarium specimens, literature records, and field observations. Epiphyte phytogeography was analyzed using Takhtajan's modified division in floristic regions. We ascertain the presence of 336 species of vascular epiphytes (24 families, 105 genera) in Taiwan. Pteridophytes contribute most species (171 species), followed by orchids (120 species). Epiphytes contribute 8% to Taiwanese floristic diversity and epiphyte endemism is near 21.3%. The extensive mountain system is probably the most effective driver for epiphyte diversification and endemicity in Taiwan. Phytogeographically, Taiwanese epiphytes exhibit equal affinity to the Malesian region, southern China and Indo-China and Eastern Asiatic regions. However, some species have a disjunctive distribution between Taiwan and SW China and/or E Himalaya, presumably related to low habitat similarity with adjacent China and/or the legacy of Late Quaternary climate change. Vascular epiphyte distribution patterns corroborate the phytogeographical separation of the island of Lanyu from the main island of Taiwan along Kanto's Neo-Wallace Line.

Keywords: Endemism; Epiphyte-quotient; Floristic affinity; Neo-wallace line; Paleotropics; Late Quaternary climate change

Introduction

The conspicuous vascular epiphyte community in the canopy of wet tropical forests has attracted botanists as early as 1888, especially during the second half of the last century (Benzing, 1990; Gentry and Dodson, 1987a; Johansson, 1974; Kress, 1986; Madison, 1977; Richards, 1952). These studies have shown that the epiphytic life-form is a successful adaptation of plants to conditions in the canopy, comprising ca. 29,000 species, or approximately 10% of all vascular plants, in 83 different families and 876 genera (Gentry and Dodson, 1987a). Whereas the number of epiphyte inventories is gradually increasing, inventories from the paleotropics are still rare and especially from Asia few inventories are available (Wolf and Flamenco-S, 2003). In addition, little is known about epiphytes in tropical–subtropical transition zones. Consequently, the differences in vascular epiphyte diversity and composition between temperate and tropical areas and between paleotropics and neotropics remain ambiguous and lack generally accepted explanations (Benzing, 1987; Gentry and Dodson, 1987a; Zotz, 2005).

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Taiwan (formerly known as Formosa) is a continental island, separated from Southeast China by the ca. 200 km wide Taiwan Strait, which reaches a depth of 70 m. The Tropic of Cancer crosses through the middle of the southern half of the island, and about 70% of the total area is covered by mountains. Taiwan owes its existence to a collision of the Philippines Sea plate with the Eurasian continental margin some 5 million years ago, which induced orogenesis (Ho, 1988). In contrast to many other regions at the tropic of Cancer or Capricorn, Taiwan has a humid climate thanks to the high mountains that induce cloud formation in high-humidity oceanic winds. Frequent typhoons in summer and NE monsoon in winter provide most precipitation throughout the year.

Taiwan floristic diversity is high, comprising ca. 4077 species (Hsieh, 2003). Being a mountainous island, species diversity is the result of great habitat heterogeneity. Furthermore, situated at the transition from tropics to subtropics, in Taiwan many tropical plant species reach their northern limit (Hsueh and Lee, 2000), whereas temperate species are found in the high mountains (Hosokawa, 1958). Phytogeographically, Taiwan belongs to the Eastern Asiatic region (Takhtajan, 1986). Yet the south end of Taiwan, Henchun Peninsula, and two small volcanic islands, Lanyu and Lutao, located in the south-eastern Taiwan, are pertained to Malesian region (Figs. 1 and 2). The vegetation of Lanyu is characterized by tropical rain forests, and its flora and fauna have more in common with the Philippines than with Taiwan. On this basis, Kanto (1933) proposed the Neo-Wallace Line by extending the boundary of Dickerson and Merrill's Line (Dickerson, 1928) from northern Luzon to Lanyu through the middle sea of Lanyu and Lutao (Fig. 1). Kanto's proposal was corroborated by several subsequent biogeological studies (Hosokawa, 1958; Kanehira, 1935; Yen et al., 2003).

In this study we describe the epiphyte flora of Taiwan for the first time. Specifically, we address the following research questions: (i) Is species richness, endemism, and familial makeup similar to that of other floristic regions such as tropical and temperate areas in the neotropics? (ii) What is the phytogeographical affinity of epiphytes and several sub-categories? (iii) Do epiphytes corroborate the Neo-Wallace Line?

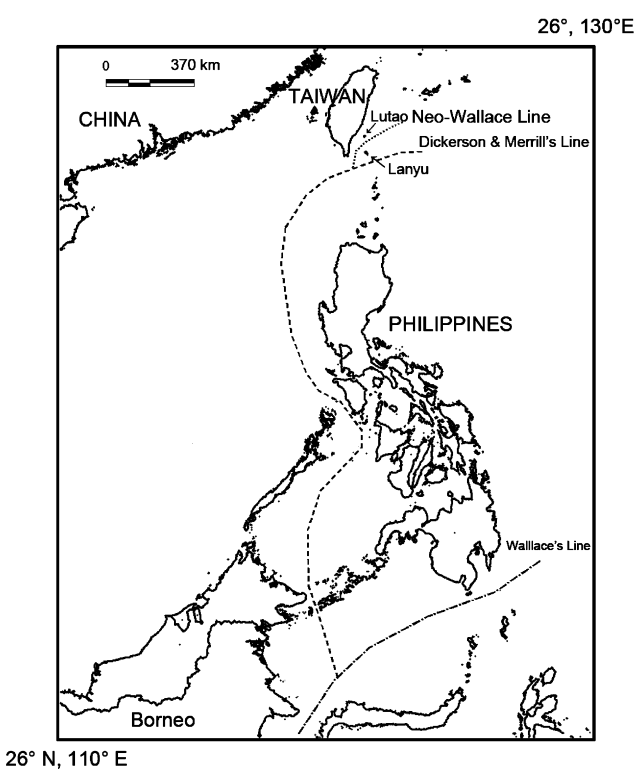

Fig. 1. Location of Taiwan, Lanyu, Lutao, and the Neo-Wallace Line (Kanto, 1933).

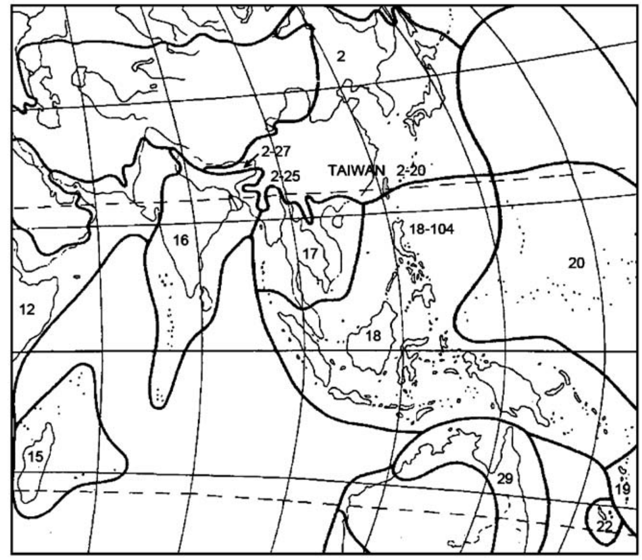

Fig. 2. Takhtajan's floristic regions. Numbers indicated: 2, Eastern Asiatic region; 2–20, Ryukyu islands; 2–25, SW China; 2–27, E Himalaya; 12, Sudano-Zambezian region; 15, Madagascan regions; 16, Indian region; 17, Indochinese region; 18, Malesian region; 18–104, Philippines; 19, Fijian region; 20, Polynesian region; 22, Neocaledonian region; 29, NE Australian region. Regions that not covered in above map but with Taiwanese epiphyte occurrence are: 3, North American Atlantic region; 4, Rocky Mountain region; 6, Mediterranean region; 8, Iran-Turanian region; 9, Madrean region; 10, Guineo-Congolian region; 21, Hawaiian region; 23, Caribbean region; 24, Guayana Highlands; 25, Amazonian region; 26, Brazilian region; 27, Andean region. The figure was modified from Takhtajan (1986).

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Materials and methods

Study site

Taiwan is situated between 21°45′N–25°56′N and 119°18′E–124°34′E with an area of 36,000 km^2 (Fig. 1). The Central Ridge of Taiwan comprises over 200 peaks higher than 3000 m a.s.l., and Yushan is the highest (3952 m) peak in this island. The annual rainfall ranges from 1000 to over 6000 mm (data from 1949 to 2004). Mean monthly temperature in the lowlands ranges from 15 to 20 °C, and is about 28 °C in summer. Based on bioclimatic analyses, Taiwan can be classified into seven climatic regions, and Lanyu is separated independently (Su, 1984, 1992). Lanyu (ca. 46 km^2, also known as Botel Tobago, Kotosho, and Orchid I.) and Lutao (ca. 16 km^2, Green I., Kwasyoto I., and Samasana I.) are small tropical islands located at 22°03′N, 121°32′E and 22°40N, 121°29E, respectively. During summer and early autumn, typhoons frequently hit Taiwan, which have less impact in western Taiwan, sheltered by the Central Ridge.

Epiphyte definition

We define epiphytes as organisms that grow on plants without extracting water or nutrients from hosts' living tissues, following Barkman (1958). In this paper, focus is on vascular plants, but many other epiphytic organisms are found in the canopy of the forest. In addition, it is not rare to find accidental epiphytes growing on other plants, which are unable to reproduce in the canopy (Moffett, 2000). We excluded accidental epiphytes from our checklist and classified vascular epiphytes in following sub-categories:

(i) *Holo-epiphytes*: epiphytes that complete their entire life cycle without contacting the forest floor (Benzing, 1990).
(ii) *Hemi-epiphytes*: epiphytes that complete part of their life cycle as terrestrial plants. Primary hemi-epiphytes begin their life cycle as epiphytes and eventually send their roots to the ground (e.g. strangler figs), whereas secondary hemi-epiphyte seedlings germinate terrestrially to become epiphytic secondarily when their rooting shoots decompose (e.g. aroids).
(iii) *Facultative epiphytes*: species in which some individuals are terrestrial.

Epiphyte checklist

Botanically, Taiwan is one of the best explored regions in the tropics. The national database houses over 200,000 botanical records (ca. 60% of herbarium collections). We gratefully made use of this wealth of information, scrutinizing for epiphytes in well-known epiphytic taxonomic groups (Benzing, 1990). In addition, we used epiphyte records in published plant inventories and floras. Nomenclature follows the 2nd edition of the Flora of Taiwan (Boufford et al., 2003). To compile this checklist, species listed in Flora of Taiwan were examined one by one, and the approximate number of epiphytes was ascertained.

Phytogeography analyses

We assessed the presence of Taiwanese vascular epiphytes in Takhtajan's floristic regions (Takhtajan, 1986). The floristic provinces, SW China, E Himalaya, Ryukyu and Philippines under Eastern Asiatic and Malesian regions of Takhtajan's system, were recognized independently (Fig. 2). Species geographical distributions were characterized based on the flora of Taiwan and collections in the global biodiversity information facility (GBIF) online database. For smaller floristic provinces, such as SW China and Ryukyu, floras of Japan and China were consulted to determine the specific occurrence locations.

Results

Species richness, family makeup, and endemism

There are 336 species of vascular epiphytes in 105 genera and 24 families in Taiwan and two subsidiary isles, Lanyu and Lutao (Appendix A). Obligate holo-epiphytes comprise 271 (81%) species, 41 (12%) species are facultative holo-epiphytes, and 7 (2%) and 17 (5%) species are primary and secondary hemi-epiphytes, respectively.

The Taiwanese epiphyte flora is dominated by Pteridophytes, i.e. ferns and fern allies, comprising 171 species (Table 1). The number of orchids is also substantial, 120 species (Fig. 3). The 10 most species-rich families contain 89% of all epiphytes and the remaining plant families with epiphytic representatives only contribute about 11% to total epiphyte richness (Fig. 3). At the genus level also, epiphytism is concentrated in few taxa. Only 5% of the genera contain more than 10 species and 54 (51%) genera are represented with one single species only in the region. More than a quarter of native Pteridophytes (Table 1) and 36% of native orchids are epiphytes. In contrast, the Epiphyte-quotient (Ep.-Q, Hosokawa, 1950), i.e. the proportion of epiphytic species in the flora, is only approximately 8% (Table 1).

Of the 336 epiphytes, 75 are endemic species. Sixty-nine species are confined to Taiwan, and one

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Table 1. Contribution of vascular epiphytes to the flora of Taiwan in various taxonomic categories (data Flora of Taiwan, Boufford et al., 2003).

	All vascular plants	Ferns and allies	Angiosperm	Dicotyledons	Monocotyledons
Families	24/235(10%)	12/37(32%)	12/190(6%)	10/151(7%)	2/39(5%)
Genera	105/1419(7%)	48/145(33%)	57/1257(5%)	16/901(2%)	41/356(12%)
Species	336/4077(8%)[a]	171/629(27%)	165/3420(5%)	40/2410(2%)	125/1010(12%)

[a]Epiphyte-quotient.

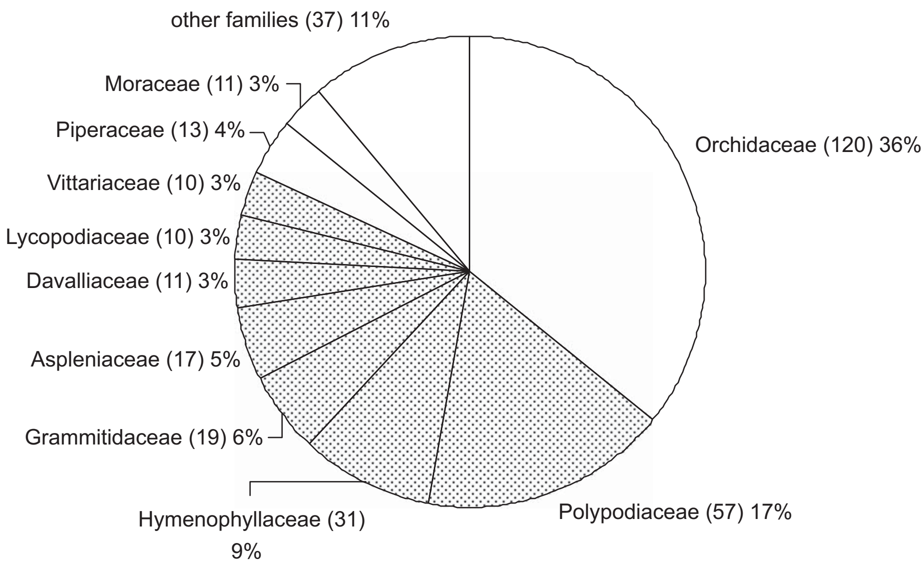

Fig. 3. Ten most species-rich epiphytic families and their contribution to total epiphyte flora in Taiwan. Numbers in parentheses are species numbers. Shading indicates Pteridophyta.

disjunctively occurs in Taiwan and Lanyu. Despite the small size of Lanyu and Lutao, five species are confined here (four species are endemic to Lanyu, and one species is shared by both). The proportion of Taiwan endemic epiphytes (21.3%, Table 2) is less than that in the entire flora (26.2%, Hsieh, 2003). Most endemic epiphytes are orchids (54.2%) despite overall higher number of epiphytic pteridophytes in Taiwan. Of all 114 epiphytic orchids, 38 species (33.3%) are endemic to Taiwan, as opposed to 19 species (11.2%) of pteridophytes (Table 2).

Epiphyte phytogeography

With respect to phytogeographical region, about 41% of epiphytes in Taiwan also occur in the Malesian region, including 10% of species shared with only the Philippines (Table 2). About 39% of species are shared with Indo-China, and about the same proportion is shared with Eastern Asiatic regions, which cover temperate E Asia, E Himalaya, SW China, and Ryukyu. The islands Lutao and Lanyu share most species (over 70%) with the Malesian region, whilst Lutao has a high proportion (40%) of species that also occur in temperate E Asia. Only Lanyu shares an exceptional high proportion (22%) of species with the Philippines (Table 2).

Overall, epiphytic ferns shared more species with other floristic regions than total epiphytic species (Table 2). Over 40% of Taiwanese epiphytic ferns also occurred in Eastern Asiatic, Malesian, and Indochinese regions. Epiphytic orchids exhibited the highest affinity (35%) to Indo-China, yet shared no species with Neotropical and Holarctic areas, except E. Asia.

Discussion

Species richness and taxonomic distribution

For a paleotropical region, the island of Taiwan is with 336 species rich in epiphytes (Table 1). There is no distinct dry season in Taiwan and abundant rainfall and warm climate promote epiphyte species richness and growth. Another reason why epiphyte richness is high may be that Taiwan served as a refuge during Late Quaternary climate change, which has been used to explain the exceptionally high diversity in Taiwan

Table 2. Floristic affinity of Taiwan epiphyte flora with phytogeographical regions, following Takhtajan (1986).

Floristic regions	Taiwan (324)	Lanyu (69)	Lutao (25)	Pteridophytes (170)	Orchids (114)
Eastern Asiatic Region	38.9 (126)	50.7 (35)	64.0 (16)	48.8 (83)	25.4 (29)
China, Japan, Korea	27.2 (88)	21.7 (15)	40.0 (10)	31.2 (53)	20.2 (23)
E. Himalaya & S.W. China	13.0 (42)	4.4 (3)	0.0 (0)	13.5 (23)	13.2 (15)
Ryukyu	13.0 (42)	29.0 (20)	24.0 (6)	18.2 (31)	6.1 (7)
Malesian Region	40.9 (132)	71.0 (49)	72.0 (18)	51.8 (88)	25.4 (29)
Malay archipelago	31.2 (101)	49.3 (34)	64.0 (16)	42.4 (72)	14.0 (16)
Philippines	9.6 (31)	21.7 (15)	8.0 (2)	9.4 (16)	11.4 (13)
Indo-China	39.2 (127)	46.4 (32)	60.0 (15)	43.5 (74)	35.1 (40)
India and Sirilanka	23.5 (76)	29.0 (20)	52.0 (13)	28.8 (49)	14.9 (17)
Melanesia and Hawaii	12.0 (39)	26.1 (18)	44.0 (11)	20.0 (34)	1.8 (2)
Africa	4.9 (16)	8.7 (6)	8.0 (2)	7.1 (12)	0.9 (1)
Australia	9.0 (29)	18.8 (13)	36.0 (9)	12.4 (21)	1.8 (2)
Neotropis	2.5 (8)	5.8 (4)	4.0 (1)	3.5 (6)	0.0 (0)
Holarctis other than E.A.	1.5 (5)	2.9 (2)	0.0 (0)	2.9 (5)	0.0 (0)
Endemicity	21.3 (69)	5.8 (4)	0.0 (0)	11.2 (19)	33.3 (38)

Given is the proportion (%) and number of Taiwanese species, in parentheses, of epiphytic Taiwanese species per region.

(4077 plant species; further discussed below). In view of this high floristic diversity, Taiwan may even be considered relatively poor in vascular epiphytes. The contribution of vascular epiphytes to total vascular flora is only 8%, whilst the EP.-Q worldwide is nearly 10%. Moreover, about 36% of orchids are epiphytic in Taiwan, which is far less than the 70% worldwide level (Atwood, 1986). Possibly frequent tropical storms have reduced epiphyte diversity in Taiwan. On average, five typhoons hit Taiwan each year (data from 1958 to 2007, Central Weather Bureau). Typhoons may have a dramatic impact on forest canopies and cause understory light levels to increase to 30% of outside levels (Lin et al., 2003). Similarly, low epiphyte diversity in Puerto Rico has been attributed to island isolation and large-scale hurricane disturbances (Migenis and Ackerman, 1993).

Epiphyte richness in neotropical areas, moreover, is generally higher. For example, Wolf and Flamenco-S (2003) report 1173 species for the state of Chiapas, Mexico (75,000 km^2, 16°N–18°N). Typical for any epiphyte flora, the diversity is concentrated in few taxa (Fig. 3, Table 1). In contrast to the Neotropics, paleotropical areas lack particularly species-rich epiphyte families (e.g. Bromeliaceae, Cactaceae, and Marcgraviaceae) and genera in the orchids (e.g. *Pleurothallis*, 1500 spp.; *Epidendrum*, 720 spp.; *Maxillaria*, 570 spp.; *Stelis*, 540 spp.) and in the aroids (*Anthurium*, 600 spp.; *Philodendron*, 350 spp. – Benzing, 1990). In Taiwan, the most abundant epiphytes are ferns, and in this respect Taiwanese epiphyte flora is typical for temperate regions. However, in comparison with other vegetation types, ecosystems, and floristic regions, the relative proportion of epiphytic ferns and orchids of Taiwan is not dramatically different, showing a transition from tropical to temperate regions (Table 3). A high proportion of ferns and fern allies is probably due to the presence of temperate mountains in Taiwan that favour epiphytic ferns over, for example, orchids (Kessler et al., 2001; Zotz, 2005). In Taiwan, no epiphytic orchids are found above approximately 2300 m a.s.l. (*Gastrochilus hoii*, pers. comm.) in contrast to epiphytic ferns with ultimate altitudes of ca. 3000 m a.s.l. (e.g. *Pyrrosia* spp., *Lepisorus* spp., *Mecodium wrightii*, pers. observ.).

Epiphyte endemism

Many islands are considered global biodiversity hotspots because of high endemicity of insular biota (Kreft et al., 2008). Taiwan is no exception, having extraordinary plant endemicity. More than 1000 vascular plant species are endemic to the island, comprising 26% of the entire flora. The strikingly high flora endemism can be explained by Taiwan's extensive mountain system. Taiwan was formed from the collision between the Philippines Sea plate and the Eurasian continental margin and gave rise to the Central Ridge of Taiwan in Mid Pliocene (3 Ma) (Ho, 1988). Active orogenesis induced a massive earthquake in central Taiwan as recent as 1999. Orogenesis results in greater microhabitat differentiation of mountainous regions, which promotes island-wide biodiversity and endemicity. Kreft et al. (2008) concluded that in continental islands, geographic isolation from the mainland may contribute less to species diversity than mountain isolation. Our data are in agreement with this conclusion. For example, several epiphytic genera of mountainous regions, *Bulbophyllum* (24 spp.), *Gastrochilus* (9 spp.), and *Oberonia* (7 spp.), show exceptionally high endemicity of nearly 50%. Furthermore, *Goodyera*, a mid-elevation (ca. 1500–2000 m a.s.l.) species, evolved

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Table 3. Epiphyte number of species (*S*) and taxonomic distribution among floristic regions and vegetation types.

Location	Vegetation type	Latitude	Rainfall (mm)	*S*	Ferns (%)	Orchids (%)	EQ (%)	Endemism (%)	Source	Regional area/ sampling effort
Paleotropics										
Taiwan	Tropical lowland to montane temperate forests	21.9N–25.3N	2467	324	52	35	8	21	This study	36,000 km^2
Cameroon	Semi-deciduous rain forest	4.25N–2.5S	ca. 1500–1900	78	25	65			Zapfack et al. (1996)	150 trees
Congo, upper Katanga	Tropical lowland to montane forests	ca. 7.5S–13.4S	780–1500	127	28	62			Schaijes and Malaisse (2001)	109,000 km^2
SW China, Mt. Ailao	Wet sub-tropical montane forests	24.53N	2450–2700	32	53	0.9			Xu and Liu (2005)	80 trees
Liberia, Nimba mountains	Tropical submontane forest	6N–8N	1500–3100	153	25	66			Johansson (1974)	463 trees
Neotropics										
Mexico, Chiapas	Tropical lowland to montane temperate forests	16N–18N	800–5000	1173	21	48	14		Wolf and Flamenco-S (2003)	75,000 km^2/ 12,276 coll.
Ecuador	Tropical lowland to montane temperate forests	1.4N–5S	100–4500	4231	ca. 5–20	ca. 30–53	ca. 25	35	Küper et al. (2004)	256,370 km^2
Ecuador, Yasuní	Tropical lowland Amazonia	0.63S	2750	313	22	30	21[a]	10	Kreft et al. (2004)	650 ha
Ecuador, Río Guajalito	Tropical montane forest	0.23S	2700	122	22	57	28		Nieder et al. (2001), Rauer and Rudolph (2001)	400 ha
Ecuador, Río Palenque	Tropical lowland wet forest	ca. 1S	2980	238	12	34	23		Gentry and Dodson (1987a)	170 ha
Costa Rica, La Selva	Tropical lowland rainforest	10.43N	4000	368	16	30	23		Gentry and Dodson (1987b)	1536 ha
Costa Rica, Santa Rosa	Seasonal forest (with 6-month dry season)	10.83N	1550	24	29	33	4		Gentry and Dodson (1987a), Janzen and Liesner (1980)	37,000 ha
Costa Rica, Monteverde	Tropical montane forest	10.3N	2500	878	22[b]	36[b]	29		Haber (2001)	10,500 ha
Panama, Barro Colorado	Tropical lowland moist forest	9.15N	2750	216	20	38	16		Croat (1978)	1560 ha
Guyana, Mabura Hill	Tropical lowland moist forest	5.33N	2700	216	18	42	13		Ek (1997)	10,000 ha
Temperate										
Chile, Fundo San Martín, Valdivia	Temperate forests	39.63S		16	63	6			Riveros and Ramírez (1978)	

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New Zealand	Temperate rain forests	34S–47S	150–5400	50	70	12	2	Oliver (1930)	268,680 km^2
Japan	Temperate forest	24N–45N	800–3600	52	63	35	ca. 1	Zotz (2005)	377,873 km^2
India, west Himalaya, Nainital	Montane temperate forest	ca. 29N	1600	17	76	24		Gupta (1968), Zotz (2005)	3422 km^2
North Korea	Temperate forest	38N–43N	560–1500	9	100	0		Kolbeck (1995)	120,540 km^2
World				28,200	9	71	ca. 10	Madison (1977)	
				23,456	11	59	ca. 10	Kress (1986)	
				29,505	9	77	ca. 10	Gentry and Dodson (1987a)	

[a] Freiberg and Freiberg (2000).
[b] Ingram et al. (1996) (composition of 256 epiphyte spp.).

three epiphytic species, including two endemics. This is the first report of epiphytism in this genus. Finally, endemicity increases with altitude in Taiwan up to nearly 60% above 3500 m a.s.l.

Yet, vascular epiphytes show lower endemism (21.3%) than terrestrial plants (Table 2). This may be due to their superior dispersal ability; 89% of vascular epiphytes in Taiwan disperse by wind. The arboreal habitat and dust-like seeds and diaspores enable long-distance dispersal. Overall, ferns show wider ranges and lower endemicity than angiosperms (Gentry and Dodson, 1987a; Kelly et al., 2004) (Table 2). In contrast with epiphytic seed plants, most large epiphytic fern genera are preponderantly pantropical (Gentry and Dodson, 1987a). Apart from dispersal ability, historical factors may also explain species geographical range (Lester et al., 2007). Kelly et al. (2004) reported that in the tropical Andes species endemism increased from primitive to advanced taxonomic groups (bryophytes < pteridophytes < angiosperms). Furthermore, taxa with narrow geographical range are often considered to have high speciation rates (Kelly et al., 2004). In this view, the high endemism (33%) in Taiwanese epiphytic orchids relates to their highly specific pollination system, which, together with the fragmented canopy habitat, promotes rapid speciation (Benzing, 1987; Gentry, 1982; Gentry and Dodson, 1987a; Gravendeel et al., 2004).

Epiphyte phytogeography

Taiwan has a relatively unique vascular epiphyte flora. The regions with closest affinity are the Malesian region, Indo-China, and Eastern Asiatic regions; ca. 40% of Taiwanese species are shared with those regions. Interestingly, about 13% of vascular epiphytes have a disjunctive distribution between Taiwan and SW China and/or E Himalayan regions (Table 2). This floristic disjunction is consistent with Hosokawa's (1958) finding that Taiwan's flora, especially of the highland, is more closely related to SW China and E Himalaya than to adjacent coastal provinces of mainland China. Kuo (1985) indicated similar observations on Taiwanese pteridophyte flora. He found that the pteridophytes of warm-temperate forests (500–1800 m a.s.l.) were closely related to SW China and the Himalayan regions, whilst lowland species showed higher affinity to Ryukyu, south-eastern China and Indo-China.

The simplest explanation for the lower epiphyte affinity of Taiwan with adjacent coastal regions of south-eastern China is lack of suitable habitats (Kuo, 1985). Due to long-term population pressure and associated agricultural activities, south-eastern China has endured extensive habitat change. Since epiphytes are most diverse and abundant in old-growth forests (Cascante-Marin et al., 2006; Köhler et al., 2007; Wolf, 2005), epiphyte diversity is especially affected. Furthermore, lowland south-eastern China shows little habitat similarity with Taiwan mountain areas.

Late Quaternary climate change offers another explanation. On an evolutionary time-scale, epiphytism is relatively recent, occurring in evolutionary advanced families of ferns and seed plants. Orchidaceae did not evolve until the Quaternary (1.6 Ma ago) (Benzing, 1990). Zotz (2005) discussed the possibility that the Pleistocene extinction was one of the limits of epiphytism in temperate zones, whilst few temperate areas (e.g. Chile, New Zealand, Himalayas, Japan) have a high number of epiphytes for being Tertiary refugia. The common feature of the flora in these areas is a high proportion of autochthonous and monotypic taxa. During the ice age in the Quaternary, the sea level in the Taiwan Strait dropped, connecting Taiwan with mainland Eurasia. According to the projected vegetation map of Last Glacial Maximum (LGM, 18,000 ago), Eurasia had relatively scarce tree cover with scattered areas of close forests in the uplands across south-western China and along the south-eastern coast of Eurasia (Ray and Adams, 2001). Presumably, the oceanic climate facilitated Taiwan as a refuge during Quaternary glaciations. Moreover, apart from high endemicity, more than half of plant genera in Taiwan are monotypic (Hsieh, 2003). There is an endemic monotypic epiphyte genus *Haraella* (Orchidaceae) in Taiwan. Thus, we propose that Late Quaternary climate change helps explain the disjunctive distribution of many vascular epiphytes between Taiwan and south-western China as well as eastern Himalayan regions.

Interestingly, the epiphyte flora of Lanyu and Lutao is phytogeographically distinct. Lanyu has more affinity with the Philippines (22%) in the Malesian region than Lutao (8%), whereas Lutao shares more species with China, Japan and Korea in the Eastern Asiatic Region (40%) than Lanyu (22%) (Table 2). This pattern is in agreement with the proposed Neo-Wallace Line based on insect distributions (Kanto, 1933).

In summary, this one of the few epiphyte inventories in Asia shows that the Taiwanese epiphyte flora is rich in species and has an extraordinarily high endemicity. Regional mountain isolation is probably the most effective driver for epiphyte diversification in Taiwan. Regarding the proportional contribution of epiphytic ferns and orchids, Taiwan is transitional between tropical and temperate zones. The disjunctive distribution of epiphytes between Taiwan and SW China as well as E Himalaya suggests low habitat similarity to adjacent China and/or a legacy of Late Quaternary climate change. Taiwanese vascular epiphyte distributions are in agreement with the Neo-Wallace Line.

Acknowledgement

We thank Chung S.-W., Yu S.-K., Lu P.-F., Chang Y.-H., for sharing personal observations on Taiwanese epiphytes in the field.

Appendix A

See Table A1.

Table A1. The vascular epiphyte checklist of Taiwan.

No	Family	Species/taxon	Habit	Floristic_Region
	Pteridophytes			
1	Aspleniaceae	*Asplenium adiantoides*	FacuE	15, 18, 22, 29
2	Aspleniaceae	*Asplenium antiquum*	E	2
3	Aspleniaceae	*Asplenium australasicum*	E	18, 22, 29
4	Aspleniaceae	*Asplenium bullatum*	E	16, 17
5	Aspleniaceae	*Asplenium cuneatiforme*	E	EndemicF
6	Aspleniaceae	*Asplenium ensiforme*	FacuE	2–25, 17, 16
7	Aspleniaceae	*Asplenium griffithianum*	FacuE	2–20, 16, 17
8	Aspleniaceae	*Asplenium incisum*	FacuE	2
9	Aspleniaceae	*Asplenium laciniatum*	E	2–27
10	Aspleniaceae	*Asplenium neolaserpitiifolium*	E	2–20, 17
11	Aspleniaceae	*Asplenium nidus*	E	2–20, 17, 18, 19, 20, 21, 22, 23, 29, 15, 12
12	Aspleniaceae	*Asplenium normale*	FacuE	2, 15, 17, 18, 20, 29, 12, 21
13	Aspleniaceae	*Asplenium oldhami*	FacuE	2–20, 17
14	Aspleniaceae	*Asplenium planicaule*	FacuE	2, 17, 18–104
15	Aspleniaceae	*Asplenium prolongatum*	FacuE	16, 17, 2
16	Aspleniaceae	*Asplenium pseudolaserpitiifolium*	E	17

Table A1. (*continued*)

No	Family	Species/taxon	Habit	Floristic_Region
17	Aspleniaceae	*Asplenium ritoense*	FacuE	2, 17
18	Davalliaceae	*Araiostegia parvipinnata*	E	2–25
19	Davalliaceae	*Davallia formosana*	E	17
20	Davalliaceae	*Davallia mariesii*	E	2
21	Davalliaceae	*Davallia solida*	E	17, 18, 22
22	Davalliaceae	*Humata chrysanthemifolia*	E	18–104
23	Davalliaceae	*Humata griffithiana*	E	2–27, 2–25
24	Davalliaceae	*Humata pectinata*	E	18, 20, 29
25	Davalliaceae	*Humata repens*	E	2, 15, 17, 18, 29
26	Davalliaceae	*Humata trifoliata*	E	2–20, 17, 18
27	Davalliaceae	*Humata vestita*	E	17, 18
28	Davalliaceae	*Leucostegia immersa*	E	2–27, 16, 17, 18
29	Grammitidaceae	*Calymmodon cucullatus*	E	16, 18, 22, 29
30	Grammitidaceae	*Calymmodon gracilis*	E	17, 18
31	Grammitidaceae	*Ctenopteris curtisii*	E	18
32	Grammitidaceae	*Ctenopteris merrittii*	E	18
33	Grammitidaceae	*Ctenopteris mollicoma*	E	18
34	Grammitidaceae	*Ctenopteris obliquata*	E	16, 17, 18
35	Grammitidaceae	*Ctenopteris subfalcata*	E	16, 17, 18
36	Grammitidaceae	*Ctenopteris tenuisecta*	E	18
37	Grammitidaceae	*Grammitis adspera*	E	18, 29
38	Grammitidaceae	*Grammitis congener*	E	17, 18
39	Grammitidaceae	*Grammitis fenicis*	E	18–104
40	Grammitidaceae	*Grammitis intromissa*	E	18
41	Grammitidaceae	*Grammitis jagoriana*	E	18
42	Grammitidaceae	*Grammitis nuda*	E	EndemicF
43	Grammitidaceae	*Grammitis reinwardtia*	E	18
44	Grammitidaceae	*Prosaptia contigua*	E	16, 18, 19, 20, 22, 29
45	Grammitidaceae	*Prosaptia urceolaris*	E	17, 18
46	Grammitidaceae	*Scleroglossum pusillum*	E	17, 18
47	Grammitidaceae	*Xiphopteris okuboi*	E	2, 17
48	Hymenophyllaceae	*Abrodictyum cumingii*	E	2, 18
49	Hymenophyllaceae	*Crepidomanes bilabiatum*	E	2–20, 17, 18
50	Hymenophyllaceae	*Crepidomanes birmanicum*	E	2, 17, 16
51	Hymenophyllaceae	*Crepidomanes kurzii*	E	16, 17, 18, 29
52	Hymenophyllaceae	*Crepidomanes latealatum*	FacuE	2, 16, 17, 18
53	Hymenophyllaceae	*Crepidomanes latemarginale*	FacuE	2–20, 16, 17, 18
54	Hymenophyllaceae	*Crepidomanes palmifolium*	E	EndemicF
55	Hymenophyllaceae	*Crepidomanes schmidtianum* var. *latifrons*	FacuE	2–27, 18–104
56	Hymenophyllaceae	*Gonocormus minutus*	E	2, 16, 17, 18, 20, 22
57	Hymenophyllaceae	*Hymenophyllum barbatum*	E	2, 16, 17
58	Hymenophyllaceae	*Hymenophyllum devolii*	E	EndemicF
59	Hymenophyllaceae	*Hymenophyllum fimbriatum*	E	18–104
60	Hymenophyllaceae	*Hymenophyllum productum*	E	17, 18
61	Hymenophyllaceae	*Hymenophyllum simonsianum*	E	2–27
62	Hymenophyllaceae	*Hymenophyllum taiwanense*	E	EndemicF
63	Hymenophyllaceae	*Mecodium badium*	E	2, 16, 17, 18
64	Hymenophyllaceae	*Mecodium javanicum*	E	16, 18, 19
65	Hymenophyllaceae	*Mecodium oligosorum*	E	2
66	Hymenophyllaceae	*Mecodium polyanthos*	E	2, 15, 17, 18
67	Hymenophyllaceae	*Mecodium wrightii*	E	2, 4
68	Hymenophyllaceae	*Meringium blandum*	E	18
69	Hymenophyllaceae	*Meringium denticulatum*	FacuE	2–20, 16, 17, 18, 19
70	Hymenophyllaceae	*Meringium holochilum*	FacuE	18
71	Hymenophyllaceae	*Microgonium bimarginatum*	FacuE	2–20, 16, 17, 18, 20, 29
72	Hymenophyllaceae	*Microgonium motleyi*	FacuE	2–20, 16, 17, 18, 20

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Table A1. (*continued*)

No	Family	Species/taxon	Habit	Floristic_Region
73	Hymenophyllaceae	*Microgonium omphalodes*	FacuE	2–20, 18, 20, 29
74	Hymenophyllaceae	*Microtrichomanes nitidulum*	E	16, 17, 18, 29
75	Hymenophyllaceae	*Pleuromanes pallidum*	E	16, 17, 18, 20
76	Hymenophyllaceae	*Vandenboschia auriculata*	E	2, 16, 17, 18, 20
77	Hymenophyllaceae	*Vandenboschia maxima*	FacuE	2–20, 17, 18
78	Hymenophyllaceae	*Vandenboschia radicans*	E	2–27, 2–20, 6, 12, 16, 17, 18, 23, 24, 25, 27
79	Lomariopsidaceae	*Elaphoglossum callifolium*	E	17, 18
80	Lomariopsidaceae	*Elaphoglossum commutatum*	E	10, 12, 15, 16, 18, 21, 25
81	Lomariopsidaceae	*Elaphoglossum luzonicum*	E	18
82	Lomariopsidaceae	*Elaphoglossum marginatum*	E	EndemicF
83	Lomariopsidaceae	*Elaphoglossum yoshinagae*	E	2, 17
84	Lomariopsidaceae	*Lomariopsis spectabilis*	E	2–20, 18
85	Lycopodiaceae	*Lycopodium carinatum*	E	2–20, 17, 18, 20, 29
86	Lycopodiaceae	*Lycopodium cryptomerianum*	E	2
87	Lycopodiaceae	*Lycopodium cunninghamioides*	E	2
88	Lycopodiaceae	*Lycopodium fargesii*	E	2
89	Lycopodiaceae	*Lycopodium fordii*	E	2, 16, 17
90	Lycopodiaceae	*Lycopodium phlegmaria*	E	2, 18, 22, 29, 15, 12
91	Lycopodiaceae	*Lycopodium salvinioides*	E	2–20, 18–104
92	Lycopodiaceae	*Lycopodium sieboldii*	E	2
93	Lycopodiaceae	*Lycopodium squarrosum*	E	2, 20, 18, 22
94	Lycopodiaceae	*Lycopodium taiwanense*	E	2–27, 2–20, 16
95	Oleandraceae	*Nephrolepis auriculata*	FacuE	2–20, 16, 17, 18, 9, 23, 24, 25, 26, 27, 22, 21, 15, 29
96	Oleandraceae	*Nephrolepis biserrata*	FacuE	2–20, 19, 20, 18, 23, 12, 15, 16, 10, 29, 27, 25
97	Oleandraceae	*Nephrolepis multiflora*	FacuE	2–20, 16, 17, 18–104
98	Oleandraceae	*Oleandra wallichii*	E	2–25, 2–27, 16, 17
99	Opioglossaceae	*Ophioderma pendula*	E	17, 18, 15, 21, 29
100	Polypodiaceae	*Aglaomorpha meyeniana*	E	18–104
101	Polypodiaceae	*Arthromeris lehmanni*	E	2, 16, 17, 18–104
102	Polypodiaceae	*Belvisia mucronata*	E	16, 18, 20, 22, 19, 29
103	Polypodiaceae	*Colysis hemionitidea*	FacuE	2–27, 16, 17, 18–104
104	Polypodiaceae	*Colysis pothifolia*	FacuE	2, 16, 17, 18–104
105	Polypodiaceae	*Colysis shintenensis*	FacuE	2
106	Polypodiaceae	*Colysis wrightii*	FacuE	2–20, 17
107	Polypodiaceae	*Crypsinus echinosporus*	E	EndemicF
108	Polypodiaceae	*Crypsinus engleri*	E	2
109	Polypodiaceae	*Crypsinus hastatus*	FacuE	2, 18–104
110	Polypodiaceae	*Crypsinus quasidivaricatus*	FacuE	2–27, 16
111	Polypodiaceae	*Crypsinus taeniatus* var. *palmatus*	FacuE	18, 20
112	Polypodiaceae	*Crypsinus taiwanensis*	FacuE	EndemicF
113	Polypodiaceae	*Crypsinus yakushimensis*	FacuE	2–20
114	Polypodiaceae	*Drymotaenium miyoshianum*	E	2
115	Polypodiaceae	*Drynaria fortunei*	E	17
116	Polypodiaceae	*Lemmaphyllum diversum*	E	2
117	Polypodiaceae	*Lemmaphyllum microphyllum*	E	2
118	Polypodiaceae	*Lepisorus clathratus*	E	2, 8, 16
119	Polypodiaceae	*Lepisorus kawakamii*	E	EndemicF
120	Polypodiaceae	*Lepisorus kuchenensis*	E	2–25
121	Polypodiaceae	*Lepisorus megasorus*	E	EndemicF
122	Polypodiaceae	*Lepisorus monilisorus*	E	EndemicF
123	Polypodiaceae	*Lepisorus morrisonensis*	E	2–25, 2–27
124	Polypodiaceae	*Lepisorus obscurevenulosus*	E	2
125	Polypodiaceae	*Lepisorus pseudoussuriensis*	E	EndemicF

Table A1. (*continued*)

No	Family	Species/taxon	Habit	Floristic_Region
126	Polypodiaceae	*Lepisorus suboligolepidus*	E	2
127	Polypodiaceae	*Lepisorus thunbergianus*	E	2, 18–104
128	Polypodiaceae	*Lepisorus tosaensis*	E	2
129	Polypodiaceae	*Leptochilus decurrens*	FacuE	16, 17, 18, 20
130	Polypodiaceae	*Loxogramme confertifolia*	E	EndemicF
131	Polypodiaceae	*Loxogramme formosana*	E	2–25
132	Polypodiaceae	*Loxogramme grammitoides*	E	2
133	Polypodiaceae	*Loxogramme remotefrondigera*	E	EndemicF
134	Polypodiaceae	*Loxogramme salicifolia*	E	2, 17
135	Polypodiaceae	*Microsorium buergerianum*	E	2, 17
136	Polypodiaceae	*Microsorium dilatatum*	E	2–20, 16, 17
137	Polypodiaceae	*Microsorium fortunei*	FacuE	2–27, 2–20
138	Polypodiaceae	*Microsorium membranaceum*	FacuE	2–25, 2–27, 16, 17, 18–104
139	Polypodiaceae	*Microsorium punctatum*	E	16, 17, 22, 29
140	Polypodiaceae	*Microsorium rubidum*	E	2–20, 16, 17, 18, 20
141	Polypodiaceae	*Polypodium amoenum*	E	2–27, 17
142	Polypodiaceae	*Polypodium argutum*	E	2–25, 2–27, 17, 18–104
143	Polypodiaceae	*Polypodium formosanum*	E	2–20
144	Polypodiaceae	*Polypodium microrhizoma*	E	2–25, 2–27
145	Polypodiaceae	*Polypodium raishanense*	E	EndemicF
146	Polypodiaceae	*Polypodium transpianense*	E	EndemicF
147	Polypodiaceae	*Pseudodrynaria coronans*	E	2–20, 2–25, 2–27, 17
148	Polypodiaceae	*Pyrrosia adnascens*	E	2–20, 16, 17, 18, 20
149	Polypodiaceae	*Pyrrosia gralla*	E	2–25
150	Polypodiaceae	*Pyrrosia linearifolia*	E	2
151	Polypodiaceae	*Pyrrosia lingua*	E	2, 17
152	Polypodiaceae	*Pyrrosia matsudae*	E	EndemicF
153	Polypodiaceae	*Pyrrosia polydactylis*	E	EndemicF
154	Polypodiaceae	*Pyrrosia sheareri*	E	17
155	Polypodiaceae	*Pyrrosia transmorrisonensis*	E	EndemicF
156	Polypodiaceae	*Saxiglossum angustissimum*	E	2
157	Psilotaceae	*Psilotum nudum*	E	2, 17, 18, 21, 22, 29, 10, 12, 15, 23, 9, 3, 25, 27, 26
158	Selaginellaceae	*Selaginella delicatula*	E	2, 16, 17, 18, 20
159	Selaginellaceae	*Selaginella involvens*	E	2, 16, 17, 18
160	Selaginellaceae	*Selaginella stauntoniana*	FacuE	2
161	Selaginellaceae	*Selaginella tamariscina*	FacuE	2, 16, 18
162	Vittariaceae	*Antrophyum formosanum*	FacuE	2–20
163	Vittariaceae	*Antrophyum obovatum*	FacuE	2, 16, 17
164	Vittariaceae	*Antrophyum parvulum*	FacuE	2–20, 18
165	Vittariaceae	*Antrophyum sessilifolium*	FacuE	18–104
166	Vittariaceae	*Vaginularia paradoxa*	E	16, 18, 20, 21
167	Vittariaceae	*Vaginularia trichoidea*	E	18, 21
168	Vittariaceae	*Vittaria anguste-elongata*	E	18
169	Vittariaceae	*Vittaria flexuosa*	E	2, 16, 17, 18
170	Vittariaceae	*Vittaria taeniophylla*	E	2–27, 2–25, 17, 18–104
171	Vittariaceae	*Vittaria zosterifolia*	E	2–20, 18, 20
	Dicotyledons			
172	Araliaceae	*Schefflera arboricola*	E	17
173	Asclepiadaceae	*Dischidia formosana*	E	EndemicF&L
174	Asclepiadaceae	*Hoya carnosa*	E	2, 16, 17
175	Ericaceae	*Rhododendron kawakamii*	E	EndemicF
176	Ericaceae	*Vaccinium dunalianum* var. *caudatifolium*	E	EndemicF
177	Ericaceae	*Vaccinium emarginatum*	E	EndemicF
178	Gesneriaceae	*Aeschynanthus acuminatus*	E	2–27, 16, 17, 18

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Table A1. (*continued*)

No	Family	Species/taxon	Habit	Floristic_Region
179	Gesneriaceae	*Lysionotus pauciflorus*	E	2
180	Gesneriaceae	*Lysionotus pauciflorus* var. *ikedae*	E	EndemicL
181	Melastomataceae	*Medinilla formosana*	E	EndemicF
182	Melastomataceae	*Medinilla hayataina*	E	EndemicL
183	Melastomataceae	*Pachycentria formosana*	E	EndemicF
184	Moraceae	*Ficus benjamina*	HemiE-P	17, 18, 29
185	Moraceae	*Ficus caulocarpa*	HemiE-P	2–20, 17, 18, 16
186	Moraceae	*Ficus heteropleura*	HemiE-P	2–27, 18, 17
187	Moraceae	*Ficus microcarpa* var. *microcarpa*	HemiE-P	2–20, 18, 17, 16, 29
188	Moraceae	*Ficus microcarpa* var. *crassifolia*	HemiE-P	18–104
189	Moraceae	*Ficus pumila*	HemiE-S	2, 16
190	Moraceae	*Ficus pumila L.* var. *awkeotsang*	HemiE-S	EndemicF
191	Moraceae	*Ficus sarmentosa* var. *henryi*	HemiE-S	2
192	Moraceae	*Ficus sarmentosa* var. *nipponica*	HemiE-S	2
193	Moraceae	*Ficus superba* var. *japonica*	HemiE-P	2, 16, 17, 18
194	Moraceae	*Ficus virgata*	HemiE-P	2–20, 16, 17, 18, 29, 22
195	Piperaceae	*Peperomia japonica*	E	2
196	Piperaceae	*Peperomia nakaharai*	E	EndemicF
197	Piperaceae	*Peperomia reflexa*	E	2, 23, 26, 25, 21, 12, 10, 15, 25, 29
198	Piperaceae	*Peperomia rubrivenosa*	E	18–104
199	Piperaceae	*Peperomia sui*	E	EndemicF
200	Piperaceae	*Piper arborescens*	HemiE-S	18
201	Piperaceae	*Piper betle*	HemiE-S	18
202	Piperaceae	*Piper interruptum* var. *multinervum*	HemiE-S	18
203	Piperaceae	*Piper kadsura*	HemiE-S	2
204	Piperaceae	*Piper kawakamii*	HemiE-S	EndemicF
205	Piperaceae	*Piper kwashoense*	HemiE-S	EndemicL&G
206	Piperaceae	*Piper sintenense*	HemiE-S	EndemicF
207	Piperaceae	*Piper taiwanense*	HemiE-S	EndemicF
208	Rubiaceae	*Psychotria serpens*	HemiE-S	2, 17
209	Saxifragaceae	*Hydrangea integrifolia*	E	18–104
210	Saxifragaceae	*Pileostegia viburnoides*	E	2–20, 16, 17
211	Urticaceae	*Procris laevigata*	E	2–25, 15, 16, 17, 18
	Monocotyledons			
212	Araceae	*Epipremnum formosanum*	HemiE-S	EndemicF
213	Araceae	*Epipremnum pinnatum*	HemiE-S	2, 18, 20, 29
214	Araceae	*Pothoidium lobbianum*	HemiE-S	18
215	Araceae	*Pothos chinensis*	HemiE-S	2
216	Araceae	*Remusatia vivipara*	E	2–25, 15, 16, 17, 18, 12, 29, 10, 25
217	Orchidaceae	*Acampe rigida*	E	2–27, 16, 17, 18
218	Orchidaceae	*Appendicula fenixii*	E	EndemicL
219	Orchidaceae	*Appendicula reflexa*	E	17, 18
220	Orchidaceae	*Arachnis labrosa*	E	17
221	Orchidaceae	*Ascocentrum pumilum*	E	EndemicF
222	Orchidaceae	*Bulbophyllum affine*	E	2–27, 16, 17
223	Orchidaceae	*Bulbophyllum albociliatum*	E	EndemicF
224	Orchidaceae	*Bulbophyllum aureolabellum*	E	EndemicF
225	Orchidaceae	*Bulbophyllum chitouense*	E	EndemicF
226	Orchidaceae	*Bulbophyllum drymoglossum*	E	2
227	Orchidaceae	*Bulbophyllum electrinum*	E	2–25, 17

Table A1. (*continued*)

No	Family	Species/taxon	Habit	Floristic_Region
228	Orchidaceae	*Bulbophyllum hirundinis*	E	17
229	Orchidaceae	*Bulbophyllum insulsum*	E	17
230	Orchidaceae	*Bulbophyllum japonicum*	E	2
231	Orchidaceae	*Bulbophyllum macraei*	E	2, 16
232	Orchidaceae	*Bulbophyllum melanoglossum*	E	EndemicF
233	Orchidaceae	*Bulbophyllum omerandrum*	E	2
234	Orchidaceae	*Bulbophyllum pectenveneris*	E	17
235	Orchidaceae	*Bulbophyllum pectinatum*	E	17
236	Orchidaceae	*Bulbophyllum pingtungense*	E	EndemicF
237	Orchidaceae	*Bulbophyllum retusiusculum*	E	2–27, 17, 16
238	Orchidaceae	*Bulbophyllum riyanum*	E	17
239	Orchidaceae	*Bulbophyllum rubrolabellum*	E	EndemicF
240	Orchidaceae	*Bulbophyllum setaceum*	E	EndemicF
241	Orchidaceae	*Bulbophyllum taitungianum*	E	EndemicF
242	Orchidaceae	*Bulbophyllum taiwanense*	E	EndemicF
243	Orchidaceae	*Bulbophyllum tokioi*	E	EndemicF
244	Orchidaceae	*Bulbophyllum umbellatum*	E	2–27, 16, 17
245	Orchidaceae	*Bulbophyllum wightii*	E	16
246	Orchidaceae	*Chiloschista segawai*	E	EndemicF
247	Orchidaceae	*Cleisostoma paniculatum*	E	17
248	Orchidaceae	*Cleisostoma uraiensis*	E	2–20, 18–104
249	Orchidaceae	*Cymbidium dayanum*	E	2, 16, 17, 18
250	Orchidaceae	*Dendrobium catenatum*	E	2
251	Orchidaceae	*Dendrobium chameleon*	E	18–104
252	Orchidaceae	*Dendrobium chryseum*	E	2, 16, 17
253	Orchidaceae	*Dendrobium crumenatum*	E	16, 17, 18
254	Orchidaceae	*Dendrobium equitans*	E	18–104
255	Orchidaceae	*Dendrobium falconeri*	E	2–27, 16, 17
256	Orchidaceae	*Dendrobium furcatopedicellatum*	E	EndemicF
257	Orchidaceae	*Dendrobium goldschmidtianum*	E	18–104
258	Orchidaceae	*Dendrobium leptocladum*	E	EndemicF
259	Orchidaceae	*Dendrobium linawianum*	E	2
260	Orchidaceae	*Dendrobium moniliforme*	E	2
261	Orchidaceae	*Dendrobium somae*	E	EndemicF
262	Orchidaceae	*Dendrochilum uncatum*	E	18–104
263	Orchidaceae	*Diploprora championii*	E	2–27, 16, 17
264	Orchidaceae	*Epigeneium fargesii*	E	2–27, 17
265	Orchidaceae	*Epigeneium nakaharae*	E	EndemicF
266	Orchidaceae	*Eria amica*	E	2–25, 2–27, 17
267	Orchidaceae	*Eria corneri*	E	2–20, 17
268	Orchidaceae	*Eria japonica*	E	2–20, 17
269	Orchidaceae	*Eria javanica*	E	2, 16, 17, 18
270	Orchidaceae	*Eria ovata*	E	2–20, 18
271	Orchidaceae	*Eria robusta*	E	18
272	Orchidaceae	*Eria tomentosiflora*	E	18–104
273	Orchidaceae	*Flickingeria comata*	E	18, 29, 19, 20, 22
274	Orchidaceae	*Flickingeria tairukounia*	E	EndemicF
275	Orchidaceae	*Gastrochilus ciliaris*	E	2
276	Orchidaceae	*Gastrochilus formosanus*	E	2
277	Orchidaceae	*Gastrochilus fuscopunctatus*	E	EndemicF
278	Orchidaceae	*Gastrochilus hoii*	E	EndemicF
279	Orchidaceae	*Gastrochilus japonicus*	E	2
280	Orchidaceae	*Gastrochilus linii*	E	EndemicF
281	Orchidaceae	*Gastrochilus matsudai*	E	EndemicF
282	Orchidaceae	*Gastrochilus rantabunensis*	E	2
283	Orchidaceae	*Gastrochilus raraensis*	E	EndemicF

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Table A1. (*continued*)

No	Family	Species/taxon	Habit	Floristic_Region
284	Orchidaceae	*Goodyera bilamellata*	E	EndemicF
285	Orchidaceae	*Goodyera pendula*	E	2
286	Orchidaceae	*Goodyera nantoensis*	E	EndemicF
287	Orchidaceae	*Haraella retrocalla*	E	EndemicF
288	Orchidaceae	*Holcoglossum quasipinifolium*	E	2
289	Orchidaceae	*Liparis bootanensis*	E	2, 17, 18
290	Orchidaceae	*Liparis caespitosa*	E	17, 18, 16, 12, 15, 19, 20
291	Orchidaceae	*Liparis condylobulbon*	E	17, 18
292	Orchidaceae	*Liparis cordifolia*	FacuE	2–27, 2–25, 16
293	Orchidaceae	*Liparis elliptica*	E	2, 16, 17
294	Orchidaceae	*Liparis grossa*	E	17, 18–104
295	Orchidaceae	*Liparis nakaharai*	E	EndemicF
296	Orchidaceae	*Liparis somai*	E	EndemicF
297	Orchidaceae	*Liparis viridiflora*	E	2–27, 16, 17, 18
298	Orchidaceae	*Luisia cordata*	E	EndemicF
299	Orchidaceae	*Luisia megasepala*	E	EndemicF
300	Orchidaceae	*Luisia teres*	E	2
301	Orchidaceae	*Microtatorchis compacta*	E	18–104
302	Orchidaceae	*Oberonia arisanensis*	E	2–20
303	Orchidaceae	*Oberonia caulescens*	E	2–25, 2–27, 17
304	Orchidaceae	*Oberonia gigantea*	E	EndemicF
305	Orchidaceae	*Oberonia japonica*	E	2
306	Orchidaceae	*Oberonia pumila*	E	EndemicF
307	Orchidaceae	*Oberonia rosea*	E	17
308	Orchidaceae	*Oberonia seidenfadenii*	E	EndemicF
309	Orchidaceae	*Papilionanthe taiwaniana*	E	EndemicF
310	Orchidaceae	*Phalaenopsis aphrodite*	E	18–104
311	Orchidaceae	*Phalaenopsis equestris*	E	18–104
312	Orchidaceae	*Pholidota cantonensis*	E	17
313	Orchidaceae	*Phreatia caulescens*	E	18–104
314	Orchidaceae	*Phreatia formosana*	E	2–25, 17
315	Orchidaceae	*Phreatia morii*	E	EndemicF
316	Orchidaceae	*Phreatia taiwaniana*	E	EndemicF
317	Orchidaceae	*Pleione bulbocodioides*	FacuE	2
318	Orchidaceae	*Pomatocalpa acuminata*	E	EndemicF
319	Orchidaceae	*Schoenorchis vanoverberghii*	E	18–104
320	Orchidaceae	*Staurochilus luchuensis*	E	2–20
321	Orchidaceae	*Sunipia andersonii*	E	2–27, 16, 17
322	Orchidaceae	*Taeniophyllum complanatum*	E	EndemicF
323	Orchidaceae	*Taeniophyllum glandulosum*	E	2, 17, 18, 29
324	Orchidaceae	*Thelasis pygmaea*	E	2–27, 16, 17, 18
325	Orchidaceae	*Thrixspermum annamense*	E	17
326	Orchidaceae	*Thrixspermum eximium*	E	18–104
327	Orchidaceae	*Thrixspermum fantasticum*	E	2–20, 18–104
328	Orchidaceae	*Thrixspermum formosanum*	E	17
329	Orchidaceae	*Thrixspermum laurisilvaticum*	E	2
330	Orchidaceae	*Thrixspermum merguense*	E	17, 18
331	Orchidaceae	*Thrixspermum pensile*	E	17, 18
332	Orchidaceae	*Thrixspermum saruwatarii*	E	EndemicF
333	Orchidaceae	*Thrixspermum subulatum*	E	17, 18
334	Orchidaceae	*Trichoglottis rosea*	E	18–104
335	Orchidaceae	*Tuberolabium kotoense*	E	EndemicL
336	Orchidaceae	*Vanda lamellata*	E	2–20, 18–104

Abbreviations: E: epiphyte, FacuE: facultative epiphyte, HemiE-P: primary hemi-epiphytes, HemiE-S: secondary hemi-epiphyte, EndemicF: endemic species in Taiwan, EndemicL: endemic species in Lanyu, EndemicG: endemic species in Lutao, floristic codes refer to Fig. 2.

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