

BIOGEOGRAPHY AND FLORISTIC AFFINITIES OF THE LIMESTONE FLORA IN SOUTHERN YUNNAN, CHINA¹

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ABSTRACT

The forests on limestone in southern Yunnan, in tropical southwest China, were inventoried, and their floristic composition and biogeographical affinities are discussed. These limestone forests were characterized by phanerophytes making up ca. 78% of the total species and those with mesophyllous leaves comprising 75%. Ecological species groups based on their habitat preferences were discerned from field observations: the species exclusive to the limestone habitats make up 10% and the preferents make up ca. 12% of the total limestone flora. From these limestone forests, 1394 vascular plant species belonging to 640 genera and 153 families were recorded. Based on their distributions, 12 biogeographic elements at the generic level and nine at the specific level were recognized. About 90% of the seed plant genera (over 90% of the species) were tropical; furthermore, 35% of the seed plant genera (65% of the species) have tropical Asian affinities. In a comparison with other regional floras from southern China and tropical Asia, the limestone flora of southern Yunnan revealed closer affinity to tropical floras than to temperate elements of eastern Asian floras. This limestone flora is thus tropical and part of the tropical Asian flora at its northern margin.

Key words: biogeography, China, limestone forest, southern Yunnan.

Limestone in tropical China occurs mainly in Yunnan and Guangxi Provinces of southern and central China. Because of the great diversity of edaphic conditions and topography, vegetation types on limestone are extremely diverse and rich in endemic taxa. Limestone vegetation in southern China has been destroyed as much as other vegetation types even though these limestone areas are more difficult to access and to farm. Limestone vegetation is also more vulnerable because it recovers much more slowly on usually thin soils. Our research was conducted mainly in the area of Xishuangbanna, in the southern part of Yunnan, where about 19% (3600 km²) of the total area is limestone (Liu et al., 1990). Most of this limestone area is still forested and is receiving increasing attention for its biodiversity and its urgent need of conservation. Primary floristic works in southern Yunnan have been written (Zhu et al., 1996, 1997, 1998a, 1998b; Wang et al., 1997). This paper represents a synthesis of its floristics, physiognomy, and biogeographical affinities.

GENERAL GEOGRAPHY

Xishuangbanna, the southern part of Yunnan, which borders Burma and Laos, is a mountainous area at the northern margin of tropical Southeast Asia (Fig. 1). Basically, the study area has a mountainous topography with the mountains running north-south and decreasing in elevation southward. Altitude varies from 480 m in the lowest valley in the south to 2400 m at the top of the highest mountain in the north. The limestone strata occur mainly in southeastern Xishuangbanna and range in altitude from 600 to 1600 m.

The region of Xishuangbanna has a typical tropical monsoon climate with an annual mean temperature of 22°C, annual temperature accumulation (the sum of daily temperature means where they are > 10°C) of 8000°C, and annual precipitation varying from 1200 to 1556 mm, of which more than 80% falls during the rainy season between May and the end of October (Xu et al., 1987).

The rock substrate is hard limestone of Permian origin with a rugged topography. The soil is mainly

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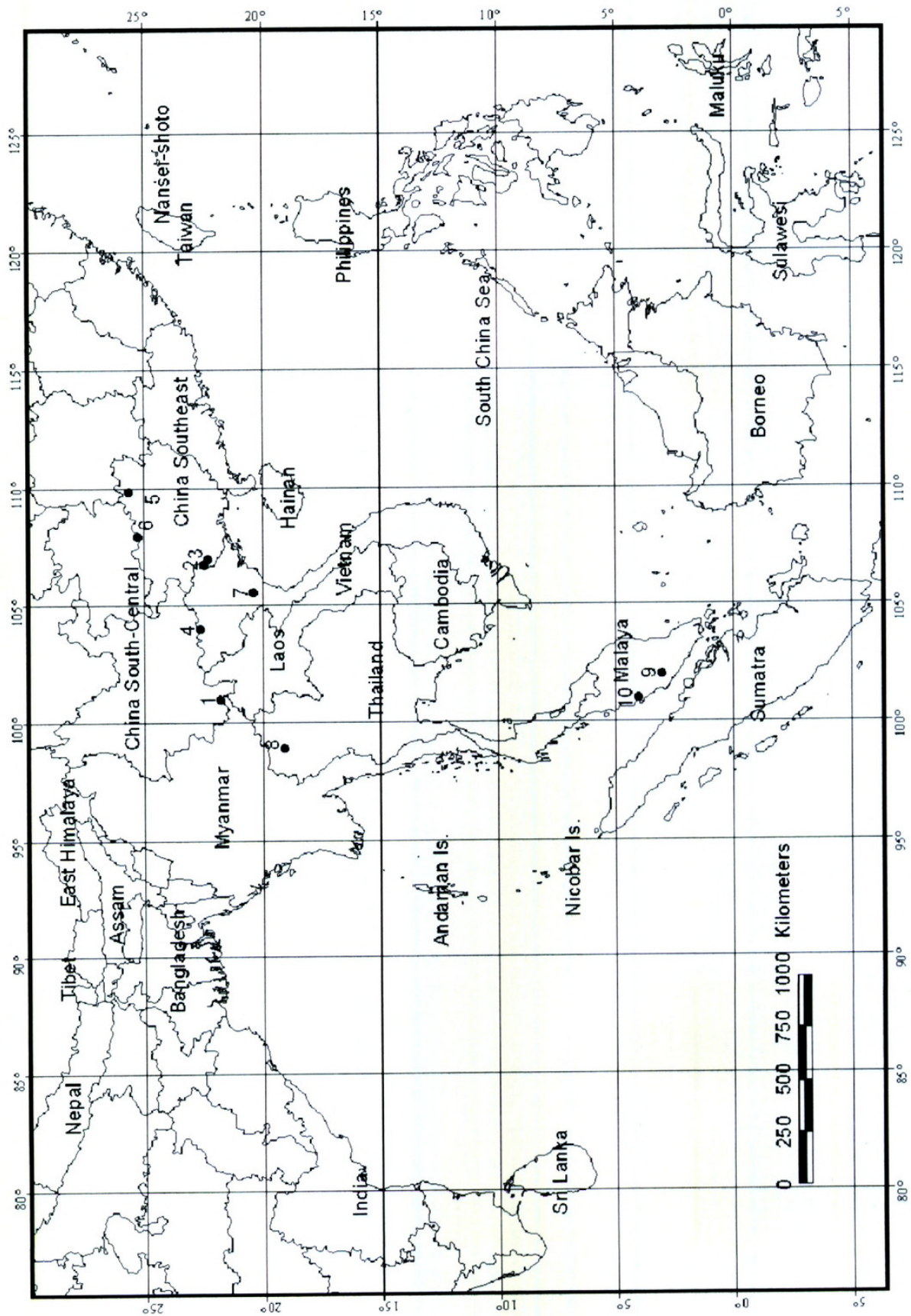


Figure 1. Locations of the research area in Xishuangbanna, southern Yunnan, China, and compared regional floras (see Table 6). —1. Our research area. —2. Longgan, SW China. —3. Daqinshan Mountains, SW China. —4. Gulinqing, SW China. —5. Huapin, China. —6. Dongyang Mountains, China. —7. Cucphuong, N Vietnam. —8. Chingdao, N Thailand. —9. The Malay Peninsula limestone. —10. Taiping, Malay Peninsula.

brown, coarse in texture, and composed of loamy limestone with a pH of ca. 6.75 and ca. 3.56% organic matter (Liu et al., 1990).

METHODS

A complete floristic inventory was made based on the identification of more than 5000 plant specimens collected from the limestone habitat in southern Yunnan during 1985–1995 and deposited mainly at HITBC and SYS. The flora of the vegetation on the limestone consisted of 153 families of vascular plants, including 640 genera and 1394 species. An initial floristic analysis was made based on the inventory (Zhu et al., 1996). Three main vegetation types occur on the limestone—tropical seasonal rain forest, tropical seasonal moist forest, and tropical montane dwarf forest—which were selected for establishing plots. For the tropical seasonal rain forest, seven separate plots ranging in size from 2000 to 2500 m² were established. For the tropical seasonal moist forest seven separate plots ranging in size from 500 to 2000 m² were laid out. For the tropical montane dwarf forest, only two plots of 10 by 10 m were made due to its restriction to limestone summits. These different plot sizes were used because of the differential coverage of forest type and site restrictions. The structure and species composition of the vegetation on the limestone were analyzed based on plot data already published (Zhu et al., 1998a). In the present paper, plant inventory lists of the two main forest types (excluding montane dwarf forest) were compiled from sample plots separately for the physiognomic (life form and leaf size) analysis. The criteria for life form and leaf size classes suggested by Raunkiaer (1934) and the importance value index (IVI) suggested by Curtis and McIntosh (1951) were used in the physiognomic or ecological analysis. Ecological species groups were discriminated from field observation and correspond to groups used in Shimizu (1964) and Chin (1977). Species-level biogeographical affinities were assessed for the total flora of the limestone vegetation. The floristic similarities between the limestone flora of southern Yunnan and the floras on limestone and non-limestone habitats from southwest China, northern Vietnam, northern Thailand, and the Malay Peninsula were also discussed.

CLASSIFICATION OF LIMESTONE VEGETATION

Based on plant physiognomy, forest profile, floristic composition, and habitat, the primary limestone vegetation can be classified into three vegetation types, i.e., tropical seasonal rain forest,

tropical seasonal moist forest, and tropical montane dwarf forest (Zhu et al., 1998a). Within these, six formations, including nine communities, were recognized:

- (1) Ravine seasonal rain forest (including the *Pometia tomentosa*–*Alphonsea monogyna* community and *Pometia tomentosa*–*Celtis philippensis* var. *wightii* community);
- (2) Lower hill seasonal rain forest (including only the *Celtis philippensis* var. *wightii*–*Lasiococca comberi* var. *pseudoverticillata* community);
- (3) Evergreen moist forest (including the *Osmanthus polyneurus*–*Dracaena cochinchinensis* community and *Lasiococca comberi* var. *pseudoverticillata*–*Cleistanthus sumatranus* community);
- (4) Semi-evergreen moist forest (including the *Bombax insignis*–*Colona floribunda* community and *Bombax insignis*–*Garcinia bracteata* community);
- (5) Evergreen dwarf forest (including only the *Phortinia angusta*–*Pistacia weinmannifolia* community);
- (6) Semi-evergreen dwarf forest (including only the *Ficus neriifolia*–*Dracaena cochinchinensis* community).

Detailed descriptions and ecological analyses of the communities have been reported earlier (Zhu et al., 1998a). Here the classification of the limestone vegetation is concisely enumerated so that the biogeographical components of the limestone vegetation can be better understood.

TROPICAL SEASONAL RAIN FOREST

Tropical seasonal rain forest on limestone, just as the regional tropical seasonal rain forest off limestone, shares characteristics with the equatorial lowland rain forest. These forests are mainly evergreen, but there are some deciduous trees in the emergent layer. This is equivalent to the tropical semi-evergreen rain forest of Southeast Asia (Whitmore, 1984), or the tropical semi-evergreen forest of India–Burma (Champion, 1936), as well as the evergreen seasonal forest of tropical America (Beard, 1944, 1955). In southern Yunnan, these limestone forests occur in wet valleys and on lower slopes of hills or mountains below 1000 m altitude. This same forest type also occurs in northern Thailand (Smitinand, 1966) and North Vietnam (Thin, 1997), although different names were used. The tropical seasonal rain forest represents Southeast Asian tropical rain forest at its latitudinal and altitudinal limits. The ecological structure of the tropical seasonal rain forest on limestone is almost exactly the same as the seasonal rain forest off limestone in the Xishuangbanna region (Zhu, 1992,

Table 1. Life forms of the limestone forest in southern Yunnan.

Life form*	Liana					Phanerophytes					Thero- phytes		
	Para	Epiph	Woody	Herb		Megaph	Mesoph	Microph	Nanoph	Hph	All	Cham	Geoph
Limestone seasonal rain forest (14800 m ² of 7 plots, total 249 species)	1	7	48	3		9	84	34	17	12	156	31	3
	0.4%	2.8%	19.3%	1.2%		3.6%	33.7%	13.7%	6.8%	4.8%	62.7%	12.4%	1.2%
Limestone seasonal moist forest (9650 m ² of 7 plots, total 211 species)	—	18	27	5		2	62	36	21	3	124	28	7
	—	8.5%	12.8%	2.3%		0.9%	29%	17%	9.9%	1.4%	58.8%	13%	3.3%

* Life form (Raunkiaer, 1934); Megaph = Megaphanerophyte (perennials over 30 m high); Mesoph = Mesophanerophyte (perennials 8 to 30 m high); Microph = Microphanerophyte (perennials 2 to 8 m high); Nanoph = Nanophanerophyte (perennials 0.25 to 2 m high); Hph = Herbaceous phanerophyte (herbaceous perennials over 0.25 m high); Cham = Chamaephytes (perennials less than 0.25 m high above ground); Geoph = Geophyte (perennials, dying back above ground); Para = Parasitic; Epiph = Epiphytes; Thero-phytes (annuals).

1997). Most species in the seasonal rain forest on limestone are also found in the adjacent non-limestone seasonal rain forest, but the latter is more diverse with additional species, which are not found on the limestone.

TROPICAL SEASONAL MOIST FOREST

Tropical seasonal moist forest occurs on the middle and upper limestone slopes ranging from 650 to 1300 m altitude. This vegetation type abuts the seasonal rain forest and was called monsoon forest by some Chinese authors (Liu, 1987; Wu, 1980). The term seasonal moist forest is preferred here because the forest is not equivalent to Schimper's monsoon forest (Schimper, 1903), in spite of the fact that it is affected by seasonal dryness and contains a variable percentage of deciduous trees. The seasonal dryness in the region is compensated to some extent by dense fog accompanied by low temperatures in the same months (November to April) (Whitmore, 1984). Some deciduous trees, such as *Gmelina arborea* Roxb., *Anthocephalus chinensis* (Lam.) Rich. ex Walp., and *Homalium laoticum* Gagn. var. *glabretum* C. Y. Wu, shed leaves toward the end of the dry season, while others, such as *Cratoxylon cochinchinensis* (Lour.) Bl., *Ficus religiosa* L., and *Elaeocarpus varunua* Buch.-Ham. ex Mast., shed their old leaves as new ones develop. This suggests that deciduousness in the region is more frequently associated with locally dry habitats than the seasonal dryness of climate. Therefore, using the term monsoon forest for the evergreen or semi-evergreen forest on limestone is confusing because Schimper's monsoon forest is more or less completely leafless during the dry season.

MONTANE DWARF FOREST

Montane dwarf forest occurs only on the tops of hills and summits of mountains at altitudes above 900 m. There is only one dwarf tree layer with a canopy height of 7–15 m. Epiphytic orchids, such as *Eria hainanensis* Rolfe and *Bulbophyllum nigrescens* Rolfe, and non-vascular epiphytes (bryophytes and lichens) are abundant. In some sites small woody climbers, such as *Derris caudatilimba* How (Papilionaceae) and *Pristimera arborea* (Roxb.) A. C. Smith (Hippocrateaceae), are also frequent.

PLANT PHYSIOGNOMY OR ATTRIBUTES

From plot data, life form spectra (Raunkiaer, 1934) of the two main forest types (seasonal rain forest and seasonal moist forest) are compiled in

Table 2. Physiognomic characteristics of the limestone forest in southern Yunnan.

Forest type		Leaf form		Leaf texture		Leaf size			
		S	C	P	L	Na	Mi	Me	Ma
Limestone seasonal rain forest ¹	Percentage of species	72.3	27.7	47.9	52.1	0	13.8	76.6	9.6
	Percentage of Importance Value Index (IVI) ³	76.3	23.7	52.8	47.2	0	3.8	91	5.3
Limestone seasonal moist forest ²	Percentage of species	68	32	51.5	48.5	1	21.5	74.2	3.1
	Percentage of Importance Value Index (IVI)	74.8	25.2	41.7	58.3	0.4	23.3	66.5	9.7

¹ From 14800 m² of 7 plots, total of 94 tree species > 5 cm DBH.
² From 9650 m² of 7 plots, total of 97 tree species > 5 cm DBH.
³ IVI = Relative dominant density + Relative frequency + Relative dominant breast area (Curtis & McIntosh, 1951).
S: Simple leaves; C: Compound leaves; P: Papery leaves; L: Leathery leaves; Ma: Macrophyll (large to 164,025 mm²); Me: Mesophyll (to 18,222 mm²); Mi: Microphyll (to 2025 mm²); Na: Nanophyll (to 225 mm²) (Raunkiaer, 1934).

Table 1. Leaf size spectra, leaf form, and leaf texture are shown in Table 2. Both forest types were dominated by phanerophytes. Including lianas, these perennial phanerophytes make up 73.9–83.2% of the total species, while annual chamaephytes account for only 12.4–13%. However, the seasonal moist forest shows lower percentages of woody lianas as well as megaphanerophytes and mesophanerophytes, but higher percentages of epiphytes as well as microphanerophytes and nanophanerophytes than the seasonal rain forest.

Both forest types have species with mesophyllous leaves making up ca. 75% of the total tree species, but the forests show clear differences if the species are weighted by importance value index (IVI). This increases the percentage of mesophyllous perennials and decreases the percentage of micro- and macrophyllous trees in seasonal rain forest, while the opposite trend is seen in seasonal moist forest. Seasonal moist forest occupies much more rugged habitats with thinner and drier soils, and has more microphyllous species. In weighting by IVI, the increase in percentage of macrophyllous trees in seasonal moist forest is mainly due to the dominant evergreen species *Dracaena cochinchinensis* (Lour.) S. C. Chen (Agavaceae), with its long leathery lanceolate leaves, and the dominant deciduous tree species *Colona floribunda* (Wall. ex Voigt) Craib (Tiliaceae) also with large leaves to 30 cm long. In

weighting the species by IVI, the percentage of leathery leaves decreases in seasonal rain forest but increases in seasonal moist forest due to the presence of some species with these leathery leaves such as *Cleistanthus sumatranus* (Miq.) Muell.-Arg. (Euphorbiaceae) and *Dracaena cochinchinensis*.

ECOLOGICAL SPECIES GROUP

Based on the study of the limestone floras of Japan and Taiwan, Shimizu (1964) divided limestone plants into five ecological groups:

- (1) plants exclusive to limestone habitat;
- (2) plants selective for and found mainly in limestone;
- (3) plants preferring and dominant on limestone;
- (4) taxa indifferent, with no special association with limestone;
- (5) plants found only occasionally on limestone or strangers to limestone.

To Shimizu, these first three groups were characteristic species for the limestone habitats and in particular his exclusive and selective taxa were calcicoles. Chin (1977) accepted this classification and similarly categorized plants on limestone in the Malay Peninsula into four groups, combining selective and preferent plants. Similar ecological species groups have been later recognized by Chinese botanists (Liang et al., 1985; Liu et al., 1994).

Table 3. The ecological species groups of the limestone flora of southern Yunnan.

Ecological species groups (see Shimizu, 1964; Chin, 1977)	Number of species	%
Plants found only on limestone: endemic to southern Yunnan	24	1.7
not endemic to southern Yunnan	117	8.4
Plants dominant on limestone	170	12.2
Plants no restriction on limestone	858	61.6
Plants found occasionally on limestone	225	16.1
Total	1394	100

Table 4. Predominant families found in limestone forests of southern Yunnan.

	No. of genera	No. of species	%*		No. of genera	No. of species	%
Orchidaceae	35	86	26.9	Verbenaceae	6	20	43.5
Rubiaceae	34	58	64.1	Labiatae	13	20	30.1
Euphorbiaceae	27	58	60.4	Gesneriaceae	13	19	63.3
Papilionaceae	22	55	43.4	Sterculiaceae	7	18	46.8
Moraceae	7	48	73.8	Dioscoriaceae	1	18	64.3
Vitaceae	7	38	79.5	Menispermaceae	10	17	60.7
Acanthaceae	26	36	65.4	Liliaceae	10	16	64.0
Rutaceae	11	35	71.4	Araceae	10	15	44.1
Asclepiadaceae	16	35	53.0	Compositae	8	15	14.6
Urticaceae	12	35	53.0	Myrsinaceae	4	14	38.2
Lauraceae	10	35	45.0	Commelinaceae	7	14	60.9
Apocynaceae	19	33	58.9	Zingiberaceae	6	14	42.4
Meliaceae	12	30	83.0	Myrtaceae	1	13	45.8
Annonaceae	12	30	50.9	Tiliaceae	3	12	57.1
Cucurbitaceae	9	24	52.3	Mimosaceae	6	12	66.6
Rhamnaceae	19	21	70.4	Anacardiaceae	7	11	64.7
Piperaceae	3	20	54.8	Convolvulaceae	4	11	37.4
				Ulmaceae	5	11	100

* % = $\frac{\text{the no. of species on limestone}}{\text{the total no. of species in southern Yunnan}} \times 100$

Following Shimizu and Chin’s classifications, we divided the limestone flora of southern Yunnan into these four ecological species groups (Table 3). In our study, 141 vascular plant species are restricted to limestone habitats and thus are exclusively found here. These include the following common species *Celtis philippensis* var. *wightii*, *Amoora calcicola*, *Murraya tetramera*, *Pistacia weinmannifolia*, as well as species in *Agapetes*, *Sageretia*, *Tupistra*, and *Pristimera*. Of these, 24 species are endemic to southern Yunnan. Taxa exclusive to limestone make up about 10% of the total limestone flora, which agrees with the results from Longgan limestone (exclusive taxa, 13%) (Liang et al., 1985) and Longhua limestone (exclusive taxa, 10%) (Liu et al., 1994) from Guangxi Province in China. Both the exclusive and preferent taxa make up 22.3% of the total sum. They could be termed as characteristic species for limestone habitats (see Appendix 1). This is similar to the results from Longgan in Guangxi (with these characteristic species making up 20% of the total sum) (Liang et al., 1985) and from the Malay Peninsula (27.5%) (Chin, 1977).

THE FLORA AND ITS BIOGEOGRAPHY

In the limestone forests of southern Yunnan, China, 153 families of vascular plants including 640 genera and 1394 species and varieties, were recorded, of which seed plants compose 129 families, 558 genera, and 1269 species (see Appendix 1).

More than 80% of the species also occur in the non-limestone habitats of the Xishuangbanna region.

The limestone flora makes up about one quarter of the total species of the regional flora. (The flora of the Xishuangbanna region was primarily documented with 3336 native species of 1218 genera and 207 families of seed plants; see Li, 1996.) Some families show relative preference for limestone habitats (with more than 60% of the total number of species in the region on limestone), for example, Acanthaceae, Euphorbiaceae, Gesneriaceae, Meliaceae, Menispermaceae, Moraceae, Rhamnaceae, Rubiaceae, Rutaceae, Vitaceae, and Ulmaceae (Table 4). Other families, such as Hippocrateaceae, Icacinaceae, and Vacciniaceae, show an even stronger preference for limestone (found almost exclusively in limestone habitats in southern Yunnan), although they are not among the predominant families in species richness.

The distribution types of Chinese seed plants at the generic level were documented by Wu (1991). Based on Wu’s document, 544 of the 558 genera of seed plants from the limestone forest of southern Yunnan can be divided into 12 distribution types or geographic elements (14 genera, which are cosmopolitan in distribution, are not included in the geographic statistics). One thousand two hundred forty-four of the 1269 species of seed plants from the limestone forest can be recognized in nine dis-

Table 5. Geographic affinities of the limestone forests of southern Yunnan.

Geographic element at the generic level (see Wu, 1991)		Percentage of genera	Geographic elements at the specific level		Percentage of species
1. Pantropic		21.1%	1. Pantropic		0.6%
2. Tropical Asia–Tropical America disjunct		2.9%	2. Tropical Asia–Tropical America disjunct		0.2%
3. Old World Tropics		13.8%	3. Old World Tropics		0.4%
4. Tropical Asia to Tropical Australia		9.0%	4. Tropical Asia to Tropical Australia		3.2%
5. Tropical Asia to Tropical Africa		7.9%	5. Tropical Asia to Tropical Africa		1.3%
6. Tropical Asia		35.3%	6. Tropical Asia		(64.5%)
7. Northern Temperate		2.8%	6a. India–Malaysia		17.0%
8. Temperate Eastern Asia and Northern America disjunct		2.8%	6b. Mainland Southeastern Asia to Malaysia		7.3%
9. Old World Temperate		0.9%	6c. Southern Asia to Mainland Southeastern Asia		19.9%
10. Temperate Mediterranean, Western Asia to Central Asia		0.2%	6d. Mainland Southeastern Asia to Southern China		20.3%
11. Eastern Asia		2.9%	7. Eastern Asia		0.5%
12. Endemic to China		0.4%	8. Southern China		10.6%
			9. Endemic to Yunnan		18.6%
Total of 544 genera		100%	Total of 1244 species		100%

tribution types based on their geographic distribution (25 species of seed plants are not included due to insufficient distribution references) (Table 5). At the generic level, the geographic elements of tropical distribution (1–6, Table 5) compose 90% of the total genera; the geographic elements of temperate distribution (7–10, Table 5) make up only 6.7%. At the specific level, the species that are of typical tropical distribution (1–6, Table 5) account for 70.2% of the total species. Among these, the geographic types that are considered to be from tropical Asia make up 64.5% of the total species from limestone forests in Xishuangbanna. If the species from the tropical areas adjacent to Xishuangbanna from southern China and Yunnan are included, these tropical species compose more than 90%. This indicates that the limestone flora at Xishuangbanna is principally tropical in nature and represents the tropical Asian flora at its northern tropical margin.

In a floristic comparison with nine similar floras, both limestone and non-limestone, from southwest China, northern Vietnam (Thin, 1997), northern Thailand (Smitinand, 1966), and the Malay Peninsula (Chin, 1977, 1979; Burkill & Henderson, 1925) (Table 6), the limestone flora of southern Yunnan displays explicit taxonomic affinities to the tropical floras and shows a closer affinity to the floras from the Malay Peninsula than to other floras from subtropical China (the floras of Huapin and Dongyang, see Li et al., 1986; Xu, 1984), even though these Malaysian floras lie farther away geographically from southern Yunnan. Our limestone flora in southern Yunnan shares the most genera with the limestone flora of northern Vietnam (Cuc-phuong, see Thin, 1997) among those floras compared in this study. The similarity at the generic level between our limestone flora and the limestone flora of northern Thailand (Doi Chiengdao) (Smitinand, 1966) is less than would be expected from its geographic proximity. This lack of correspondence could be because the plant list for Doi Chiengdao used here for comparison is an incomplete one consisting of only 512 species, less than half reported for most other sites in Table 6. The limestone flora of Xishuangbanna did not show a higher floristic similarity to other regional limestone floras than to non-limestone floras in our comparison. It appears that limestone floras develop from local or regional floras, supported also by the fact that only about 10% of the total species of limestone floras (the exclusive group) are restricted to limestone habitats in our study.

The floristic relationships between our limestone flora in southern Yunnan and neighboring floras of

Table 6. Comparison of floristic similarities between the limestone habitats of Xishuangbanna, southern Yunnan, and the limestone and non-limestone habitats from southwestern China and southeastern Asia.

Location	Habitat	Size of flora (Seed plants)	Shared taxa by both floras	Similarity coefficients
2. Longgan, SW China 22°14–33'N, 106°46'E	limestone	149 families	118	91.2
		669 genera	371	66.5
		1363 species		
3. Daqinshan Mountains, SW China 22°14'N, 107°E	non-limestone	182 fam.	126	97.4
		871 gen.	389	69.8
		1813 spp.		
4. Gulinqing, SW China 22°36'N, 104°E	limestone	143 fam.	116	89.9
		496 gen.	261	52.6
		1095 spp.		
5. Huapin, SW China 25°31–39'N, 109°50'E	non-limestone	151 fam.	83	72.8
		475 gen.	150	33.2
		1051 spp.		
6. Dongyang Mountains, SW China 25°14'N, 107°56'E	limestone	116 fam.	86	73.7
		367 gen.	153	41.6
		736 spp.		
7. Cucphuong, N Vietnam 20°14–24'N, 105°24–44 'E	limestone	167 fam.	120	93
		860 gen.	428	76.7
		1661 spp.		
8. Chiendae, N Thailand 19°2'N, 98°54'E	limestone	101 fam.	93	92.1
		342 gen.	181	52.9
		512 spp.		
9. Malay peninsula limestone 1–6°N, 100–104°E	limestone	117 fam.	93	81.6
		535 gen.	244	51.6
		1112 spp.		
10. Taiping, Malay peninsula 4°N, 101°E	non-limestone	115 fam.	94	82.5
		682 gen.	243	51.6
		1939 spp.		

Notes: The direct comparison of species composition between the different floras is not very significant before the local floras are updated and the taxa revised; therefore, the comparison of floristic similarities between the different floras at the specific level is not made.

References: location 2 (Chen, 1985); 3 (Daqinshan Forest station of Guanxi Forestry Bureau, 1980); 4 (Li, 1987); 5 (Li et al., 1986); 6 (Xu, 1984); 7 (Thin, 1997); 8 (Smitinand, 1966); 9 (Chin, 1977, 1979); 10 (Burkill & Henderson, 1925).

tropical Asia and southern China were discussed by Zhu (1997). This limestone flora shares all families and 88% of its genera with the flora of Indochina (Lecomte, 1907–1951; Aubréville et al., 1960–1996), 96% of its families and 68% of its genera with the flora of the Malay Peninsula (Ridley, 1967; Keng, 1978), 73% of its woody plant genera with Burma (Kurz, 1877), and more than 97% of its families and more than 80% of its genera with other tropical floras of south China (including Hainan Island; see Wu, 1994). The limestone flora of Xishuangbanna demonstrates strong affinity to other tropical Asian floras.

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Appendix 1. Ecological species groups of the limestone vegetation in southern Yunnan. *Flora Reipublicae Popularis Sinicae* is the authoritative source for specific and infraspecific names except for ones recently revised and in IPNI (www.ipni.org) and TROPICOS (<http://mobot.mobot.org/W3T/Search/vast.html>). The family names of angiosperms are according to the Angiosperm Phylogeny Website (<http://www.mobot.org/MOBOT/research/APweb/>).

Seed Plant Taxa exclusive to limestone habitats and endemic to southern Yunnan		
ACANTHACEAE		
<i>Baphicacanthus multibracteolata</i>	H. T. Chang & H. Chu	Chu Hua 1192 (holotype, SYS)
AGAVACEAE		
<i>Dracaena menglaensis</i>	G. Z. Ye	Ye Guang-zheng 9035 (holotype, YCE; isotype, KUN)
ALANGIACEAE		
<i>Alangium kurzii</i> var. <i>pachyphyllum</i>	W. P. Fang & H. Y. Su	Zhang Shun-cheng 24027 (HITBC); Li Yan-hui 1255 (holotype, KUN)
DIOSCOREACEAE		
<i>Dioscorea menglaensis</i>	H. Li	Pei Sheng-ji 10347 (holotype, KUN)
EBENACEAE		
<i>Diospyros atrotricha</i>	H. W. Li	Li Yan-hui 4215 (holotype, KUN; isotype, HITBC)
EUPHORBIACEAE		
<i>Croton yanhuii</i>	Y. T. Chang	Ch1050 (SYS); Li Yan-hui 03587 (holotype, KUN; isotype, HITBC)
<i>Trigonostemon lüi</i>	Y. T. Chang	Li Yan-hui 4576 (holotype, KUN)
FAGACEAE		
<i>Quercus yunnanensis</i>	Huang	Pei Sheng-ji 59-10040 (holotype, KUN)
GESNERIACEAE		
<i>Ornithoboea calcicola</i>	C. Y. Wu ex H. W. Li	Pei Sheng-ji 59-10072 (isotype, HITBC)
LAURACEAE		
<i>Lindera nacusua</i> var. <i>monglunensis</i>	H. P. Tsui	Li Yan-hui 4231 (HITBC), 386 (holotype, KUN)
<i>Neolitsea menglaensis</i>	Y. C. Yang & P. H. Huang	Li Yan-hui 20078 (holotype, KUN; isotype, HITBC)
MAIVACEAE		
<i>Pterospermum menglunensis</i>	H. H. Hsue	Ch378 (SYS); Li Yan-hui 4634 (holotype, KUN; isotype, HITBC)
<i>Pterospermum yunnanensis</i>	H. H. Hsue	Li Yan-hui 33830 (HITBC), 3717 (holotype, KUN); Tao Guo-da 13655 (HITBC)
MELIACEAE		
<i>Amoora calcicola</i>	C. Y. Wu & H. Li	Li Yan-hui 3712 (HITBC), 3814 (HITBC), 2804 (HITBC); Pei Sheng-ji 59-10292 (holotype, KUN)
PIPERACEAE		
<i>Piper mischocarpum</i>	Y. C. Tseng	Cai C.T. 59-10784 (holotype, KUN); Li Yan-hui 3771 (HITBC); Tao Guo-da 4177 (HITBC), 7152 (HITBC)
<i>Sageretia thea</i> var. <i>cordiformis</i>	Y. L. Chen & P. K. Chou	W. T. Wang 10496 (holotype, KUN)

Appendix 1. Continued.

THEACEAE*Pyrenaria menglaensis* G. D. Tao

Tao Guo-da 15933 (holotype, KUN; isotype, HITBC)

Seed Plant Taxa exclusive to limestone habitats but not endemic to southern Yunnan

ACANTHACEAE*Andrographis laxiflora* var. *glomeruliflora* (Bremek.) H. Chu

Ch1193 (SYS), Ch1219 (SYS)

Daedalacanthus tetragonus T. Anders.

Ch255 (SYS), Ch1175 (SYS), Ch1217 (SYS); Tao Guo-da 3797 (HITBC)

Pteracanthus alatus (Wall, ex Nees) Bremek.

Li Yan-hui 20047 (HITBC)

Strobilanthes psiotachys C. B. Clarke ex W. W. Smith

Li Yan-hui 4605 (HITBC)

Thunbergia coccinea Wall.

Ch454 (SYS), Ch1186 (SYS); Li Yan-hui 5190 (HITBC), 2911 (HITBC)

AGAVACEAE*Dracaena cambodiana* Pierre ex Gagnep.

Wang Hong 3159 (HITBC), 3160 (HITBC)

Dracaena terniflora Roxb.

Yang Zheng-hong 12178 (HITBC); Expedition 32120 (HITBC), 34923 (HITBC)

ANACARDIACEAE*Pistacia weinmannifolia* Poiss. ex Franch.

Expedition 32613 (HITBC); Pei Sheng-ji 10045 (HITBC); Tao Guo-da 1212 (HITBC)

Spondias lakonensis var. *hirsutus* C. Y. Wu & T. L. Ming

Wang Hong 1792 (HITBC)

Toxicodendron fulvum (Craib) C. Y. Wu & T. L. Ming

Pei Sheng-ji 10034 (HITBC); Tao Guo-da 13650 (HITBC)

ANNONACEAE*Alphonsea boniana* Finet & Gagnep.

Ch56 (SYS)

Alphonsea mollis Dunn

Li Yan-hui 1043 (HITBC), 4610 (HITBC)

Alphonsea squamosa Finet & Gagnep.

Ch815 (SYS)

Milusa velutina Hook. f. & Thoms.

Ch386 (SYS), Ch814 (SYS), Ch985 (SYS); Zhu Hua & Wang Hong 2416 (HITBC)

Mitrephora calcarea Diels ex Ast

Ch545 (SYS)

Polyalthia petilotii Merr.

Ch909 (SYS)

APOCYNACEAE*Aganasma acuminata* (Roxb.) G. Don

Ch584 (SYS)

Anodendron affine var. *pingpienense* Tsiang & P. T. Li

Ch802 (SYS), Ch715 (SYS)

Cosmostigma hainanense Tsiang

Ch870 (SYS)

ARACEAE*Amorphophallus yunnanensis* Engl.

Li Yan-hui 4225 (HITBC)

Gonatanthus pumilus Engl. & K. Krause

Tao Guo-da et al. 16166 (HITBC)

Remusatia vivipara Schott

Expedition 10201 (HITBC)

BOMBACACEAE*Bombax insignis* Wall.

Tao Guo-da 9007 (HITBC), 9008 (HITBC)

BORAGINACEAE*Ehretia dunniana* Lévl.

Ch29 (SYS), Ch373 (SYS); Li Yan-hui 3300 (HITBC), 3726 (HITBC)

Appendix 1. Continued.

BUXACEAE

Sarcococca vagans Stapf

CAPPARIDACEAE

Capparis bodinieri Lév.

CELASTRACEAE

Loeseneriella merrilliana A. C. Smith
Loeseneriella yunnanensis (Hu) A. C. Smith
Pristimera cambodiana (Pierre) A. C. Smith
Pristimera setulosa A. C. Smith

COMBRETACEAE

Anogeissus acuminata Wall.

COMPOSITAE

Pterocypselia indica (L.) C. Shih
Vernonia curtisii Craib & Hutchison

CONVOLVULACEAE

Porana paniculata Roxb.
Porana racemosa Roxb.
Tridynamia sinensis (Hemsl.) G. W. Staples
Tridynamia sinensis var. *delavayi* (Gagnep. & Courchet) G. W. Staples

CRUCIFERAE

Cardamine calcicola W. W. Smith

DIOSCOREACEAE

Dioscorea arachidna Prain & Burkill
Dioscorea aspersa Prain & Burkill
Dioscorea chingii Prain & Burkill
Dioscorea pulverea Prain & Burkill
Dioscorea tentaculigera Prain & Burkill

ERICACEAE

Agapetes burmanica W. E. Evans
Agapetes lobbii C. B. Clarke
Agapetes manii Hemsl.

EUPHORBIACEAE

Cleistanthus sumatranus (Miq.) Muell.-Arg.
Croton argyratus Blume
Phyllanthus clarkei Hook. f.
Trigonostemon bonianus Gagnep.

Tao Guo-da 15739 (HITBC), 13691 (HITBC)

*Ch*321 (SYS)

Li Yan-hui 455 (HITBC); *Tao Guo-da* 13672 (HITBC)
*Ch*1015 (SYS); *Ch*1063 (SYS); *Li Yan-hui* 2736 (HITBC); *Wang Hong* 1573 (HITBC)
*Ch*24 (SYS); *Wang Hong* 1575 (HITBC)
Li Yan-hui 3141 (HITBC)

Tong Shao-quan 24960 (HITBC)

*YB*004125 (HITBC)
Li Yan-hui 3780 (HITBC); *Tao Guo-da* 13664 (HITBC)

*Ch*1170 (SYS); *Wang Hong* 2655 (HITBC)
*Ch*469 (SYS); *Zhu Pei-zhi* 10527 (HITBC)
*Ch*1232 (SYS)
*Ch*513 (SYS)

Li Yan-hui 4217 (HITBC)

*Ch*845 (SYS)
*Ch*921 (SYS)
*Ch*473 (SYS); *Li Yan-hui* 2036 (HITBC)
*Ch*791 (SYS); *Wang Hong* 3147 (HITBC)
Pei Sheng-ji 9985 (HITBC)

Li Yan-hui 3718 (HITBC), 2739 (HITBC)
Li Yan-hui 3719 (HITBC)
Li Yan-hui 3629 (HITBC)

Li Yan-hui 3095 (HITBC), 2529 (HITBC)
*Ch*179 (SYS)
*Ch*563 (SYS), *Ch*812 (SYS)
*Ch*367 (SYS), *Ch*39 (SYS), *Ch*353 (SYS)

Appendix 1. Continued.

FABACEAE

Albizia odoratissima (L.) Benth.
Bauhinia carinophylla Merr.
Caesalpinia tsoongii Merr.
Callerya eurybotrya (Drake) A. M. Schot
Derris caudatilimba How
Millettia tetraptera Kurz
Sophora prazeri Prain
Sophora tonkinensis Gagnep.

Li Yan-hui 1411 (HITBC)
Ch1097 (SYS)
Ch118 (SYS)
Li Yan-hui 4200 (HITBC)
Ch398 (SYS), *Ch504* (SYS)
Li Yan-hui 4100 (HITBC)
Ch394 (SYS), *Ch559* (SYS); *Li Yan-hui 2802* (HITBC), *4277* (HITBC)
Ch619 (SYS)

FUMARIACEAE

Corydalis taliensis var. *siamensis* (Craib) X. Zhang

GESNERIACEAE

Raphiocarpus begoniifolius (H. Lévl.) B. L. Burtt
Didymocarpus margaritae W. W. Sm.
Lysionotus serratus D. Don
Ornithoboea henryi Craib

Ch947 (SYS); *Pei Sheng-ji 9892* (HITBC); *Tao Guo-da 15902* (HITBC)
Pei Sheng-ji 1054 (HITBC)
Ch624 (SYS), *Ch806* (SYS); *Pei Sheng-ji 59-9937* (HITBC); *Tao Guo-da 15750* (HITBC)
Expedition 32625 (HITBC); *Pei Sheng-ji 59-10069* (HITBC)

GUTTIFERAE

Garcinia bracteata C. Y. Wu ex Y. H. Li

ICACINACEAE

Gomphandra tetrandra (Wall.) Sleum.

LABIATAE

Coleus xanthanthus C. Y. Wu & Y. C. Huang
Gomphostemma parviflorum Wall.
Rabdosia ericalyx var. *laxiflora* C. Y. Wu & H. W. Li

Pei Sheng-ji 10138 (HITBC)
Cui Jing-yun 14659 (HITBC); *Tao Guo-da 15798* (HITBC)
Li Bao-gui 9911209 (HITBC); *Li Yan-hui 3759* (HITBC); *Wang Zhong-yu s.n.* (HITBC)

LAMIACEAE

Symphorema involucratum Roxb.

LAURACEAE

Cryptocarya acutifolia H. W. Li

LINACEAE

Reinwardtia indica Dum.

MAIVACEAE

Pterospermum chingtungense C. Y. Wu & Hsue
Pterospermum proteus Burkill

Expedition 34533 (HITBC)
Li Yan-hui 3586 (HITBC); *Wang Hong 831* (HITBC), *842* (HITBC)

Appendix 1. Continued.

MELIACEAE

Aglaia testicularis C. Y. Wu
Amoora tetrapetala (Pierre) C. Y. Wu
Munronia henryi Harms

Ch339 (SYS)
Ch529 (SYS); Wang Hong 1710 (HITBC), 1715 (HITBC)
Ch351 (SYS), Ch192 (SYS); Li Yan-hui 3327 (HITBC)

MENISPERMACEAE

Cyclea sutchuenensis Gagnep.
Stephania chingtungensis H. S. Lo
Stephania epigaea H. S. Lo

Ch901 (SYS)
Tao Guo-da 43898 (HITBC)
Tao Guo-da 15672 (HITBC)

MYRSINACEAE

Myrsine semiserrata Wall.

Li Yan-hui 20032 (HITBC); Tao-Guo-da 15729 (HITBC); Wang Hong 1960 (HITBC)

OLACACEAE

Natsiatopsis thunbergiaefolia Kurz

Tao Guo-da 42370 (HITBC)

OLEACEAE

Ligustrum sinense var. *coryanum* (W. W. Smith) Hand.-Mazz.

Li Yan-hui 429 (HITBC); Tao Guo-da 16440 (HITBC); Wang Hong 2101 (HITBC), 2091 (HITBC)

ORCHIDACEAE

Bulbophyllum ambrosia (Hance) Schltr.
Bulbophyllum kwangtungense Schltr.
Bulbophyllum nigrescens Rolfe
Dendrobium salaccense Lindl.
Eulophia bracteosa Lindl.
Pholidota chinensis Lindl.

Ch679 (SYS)
Ch22 (SYS)
Zhu Pei-zhi 8683 (HITBC)
Ch158 (SYS)
Li Yan-hui 4150 (HITBC)
Tao Guo-da 44107 (HITBC)

PALMAE

Caryota urens L.

Chen San-yang 18959 (HITBC)

PIPERACEAE

Peperomia leptostachya var. *cambodiana* (C. DC.) Merr.

Ch950 (SYS)

PRIMULACEAE

Lysimachia garrettii Fletcher

Li Yan-hui 3302 (HITBC)

RHAMNACEAE

Goutania javanica Miq.
Horenia acorda var. *kiukiangensis* (Hu & Cheng) C. Y. Wu ex Y. L. Chen
Sageretia laxiflora Hand.-Mazz.
Ventilago calyculata var. *trichoclada* Y. L. Chen & P. K. Chou

Ch798 (SYS), Ch850 (SYS); Li Yan-hui 3714 (HITBC)
Tao Guo-da 39915 (HITBC)
Ch399 (SYS); Zhu Pei-zhi 10478 (HITBC), 10479 (HITBC)
Ch350 (SYS); Li Yan-hui 5230 (HITBC)

Appendix 1. Continued.

RUBIACEAE

- Damnacanthus indicus* Gaertn. f.
Hymenopogon parasiticus var. *longiflorus* How ex W. C. Chen
Parettia polyantha R. Br.
Parettia scabrifolia Bremek.

RUTACEAE

- Murraya euchrestifolia* Hayata
Murraya tetramera Huang

SCROPHULARIACEAE

- Lindenbergia philippinensis* (Cham. & Schltdl.) Benth.

SIMARUBACEAE

- Brucea mollis* Wall.

STAPHYLEACEAE

- Turpinia robusta* Craib

ULMACEAE

- Celtis wightii* var. *philippinensis* (Planch.) E. Soepadmo

URTICACEAE

- Elatostema herbaseifolium* Hayata
Elatostema salvinoides W. T. Wang
Laportea urentissima Gagnep.
Pellionia scabra Benth.
Pilea cadierii Gagnep. & Guillaumin
Procris crenata C. B. Rob.

VERBENACEAE

- Garrettia siamensis* Fletcher

VITACEAE

- Tetrastigma cambodianum* Pierre ex Gagnep.
Tetrastigma dubium (Lawson) Planch.
Tetrastigma rupestre Planch.

ZINGIBERACEAE

- Pommeschea lackneri* Wittm.

- Ch361* (SYS), *Ch816* (SYS)
Tao Guo-da 13651 (HITBC)
Ch368 (SYS), *Ch270* (SYS); *Li Yan-hui 1773* (HITBC), *4111* (HITBC)
Li Yan-hui 4240 (HITBC), *3871* (HITBC)

Li Yan-hui 3716 (HITBC), *3309* (HITBC); *Tao Guo-da 15722* (HITBC); *Expedition 32673* (HITBC)
Li Yan-hui 3815 (HITBC), *4269* (HITBC)

Ch96 (SYS); *Li Yan-hui 363* (HITBC), *3952* (HITBC)

Li Yan-hui 4203 (HITBC)

Li Yan-hui 393 (HITBC); *Zhang Jian-hou 13707* (HITBC)

Ch32 (SYS), *Ch371* (SYS), *Ch1089* (SYS); *Li Yan-hui 391* (HITBC), *4211* (HITBC)

Ch877 (SYS)
Ch879 (SYS); *Li Yan-hui 4105* (HITBC); *Zhu Pei-zhi 8649* (HITBC)
Li Yan-hui 396 (HITBC)
Ch917 (SYS)
Ch572 (SYS), *Ch719* (SYS)
Ch514 (SYS), *Ch632* (SYS); *Li Yan-hui 3751* (HITBC)

Ch358 (SYS), *Ch710* (SYS), *Ch941* (SYS)

Ch91 (SYS), *Ch925* (SYS); *Zhang Jian-hou 13602* (HITBC)
Li Yan-hui 3700 (HITBC), *2737* (HITBC)
Ch139 (SYS)

Pei Sheng-ji 10073 (HITBC); *Tao Guo-da 44091* (HITBC)

Seed Plant Taxa preferent to limestone habitats

ACANTHACEAE

Andrographis laxiflora (Blume) Lindau
Eranthemum pulchellum Andr.
Goldfussia glomerata Nees
Pseuderanthemum palatiferrum Radlk.
Pseuderanthemum polyanthum (C. B. Clarke) Merr.
Rhapidospora vagabunda (R. Ben) C. Y. Wu
Semnostachya longispicata (Hayata) C. F. Hsieh & T. C. Huang

ANNONACEAE

Milusa chunii W. T. Wang
Mitrephora maingayi Hook. f. & Thoms.
Mitrephora thorelii Pierre

APOCYNACEAE

Antiosstema lantsangensis (Tsiang & P. T. Li) P. T. Li
Bidaria yunnanense (Tsiang) P. T. Li
Dischidia esquirolii (Lév.) Tsiang
Dischidia minor (Vahl) Merr.
Gynemna sylvestre (Retz.) Schult.
Gynemna latifolium Wall. ex Wight
Hoya carnosia (L. f.) R. Br.
Hoya lyi Lévl.
Hoya nervosa Tsiang & P. T. Li
Hoya villosa Costantin.
Jasminanthes saxatilis (Tsiang & P. T. Li) W. D. Stevens & P. T. Li
Marsdenia tenacissima (Roxb.) Moon
Toxocarpus villosus (Blume) Decne.

ARACEAE

Aglaonema pierreanum Engl.
Colocasia gigantea Hook. f.
Rhaphidophora decursiva (Roxb.) Schott
Rhaphidophora hongkongensis Schott

BEGONIACEAE

Begonia augustinei Hemsl.
Begonia dryadis Irmsch.
Begonia prostrata Irmsch.

BOMBACACEAE

Bombax ceiba L.

Ch376 (SYS), Ch808 (SYS), Ch974 (SYS); Li Yan-hui 3721 (HITBC)
Li Yan-hui 2898 (HITBC)
Ch1191 (SYS); Tao Guo-da 3775 (HITBC)
Ch137 (SYS); Ch172 (SYS), Ch180 (SYS), Ch310 (SYS)
Ch91 (SYS); Li Yan-hui 1011 (HITBC)
Ch36 (SYS), Ch247 (SYS); Li Yan-hui 2829 (HITBC)
Ch1182 (SYS)

Ch499 (SYS), Ch1211 (SYS); Unknown coll. 74317 (HITBC), 74318 (HITBC)
Li Yan-hui 3139 (HITBC)
Ch673 (SYS), Ch420 (SYS); Li Yan-hui 67493 (HITBC)

Ch658 (SYS)
Ch242 (SYS), Ch764 (SYS)
Ch23 (SYS)
Ch729 (SYS)
Expedition 34523 (HITBC)
Ch586 (SYS), Ch633 (SYS), Ch716 (SYS); Yang Zheng-hong 10976 (HITBC)
Ch651 (SYS)
Tao Guo-da 35474 (HITBC)
Zhang Jian-hou 18562 (HITBC)
Ch960 (SYS); Li Yan-hui 2574 (HITBC)
Tao Guo-da 44195 (HITBC)
Ch438 (SYS); Expedition 32621 (HITBC)
Ch544 (SYS), Ch587 (SYS), Ch646 (SYS)

Ch233 (SYS), Ch240 (SYS); Pei Sheng-ji 10274 (HITBC)
Ch1169 (SYS); Tao Guo-da 9123 (HITBC)
Ch1160 (SYS); Li Jie 722 (HITBC)
Ch706 (SYS), Ch1179 (SYS)

Ch265 (SYS); Tao Guo-da 15926 (HITBC)
Zhu Pei-zhi 10364 (HITBC)
Ch976 (SYS)

Li Yan-hui 2946 (HITBC)

Appendix 1. Continued.

BORAGINACEAE

Ehretia tsangii I. M. Johnst.

CAPPARIDACEAE

Capparis membranifolia Kurz

Capparis urophylla F. Chun

CAPRIFOLIACEAE

Viburnum tsangii Rehder

CARDIOPTERIDACEAE

Peripterygium quinquelobum Hassk.

COMMELINACEAE

Porandra scandens D. Y. Hong

COMPOSITAE

Youngia japonica (L.) DC.

EBENACEAE

Diospyros yunnanensis Rehder & Wils.

EUPHORBIACEAE

Adenochlaena silhetensis Benth.

Antidesma montanum var. *microphyllum* (Hensl.) P. Hoffmann

Cleidion bracteosum Gagnep.

Cleidion brevipetiolatum Pax & K. Hoffm.

Lasiococca comberi var. *pseudoverticellata* (Merr.) H. S. Ku

Sumbaviopsis albicans (Blume) J. J. Smith

FABACEAE

Bauhinia geniflexa Craib

Millettia yunnanensis Pampan.

Whitfordiodendron filipes (Dunn) Dunn

FLACOURTIACEAE

Flacourtia rukam Zoll. & Mor.

GESNERIACEAE

Chirita dimidiata R. Br.

Paraboea rufescens (Franch.) B. L. Burt

Paraboea dictyoneura (Hance) B. L. Burt

Paraboea sinensis f. *macrophylla* (Stapf) C. Y. Wu

Li Yan-hui 3360 (HITBC), 3726 (HITBC)

Ch612 (SYS); *Zhao Shi-wang* 22582 (HITBC)

Ch853 (SYS), *Ch136* (SYS), *Ch153* (SYS), *Ch195* (SYS); *Li Yan-hui* 2112 (HITBC)

Li Yan-hui 4235 (HITBC); *Zhu Pei-zhi* 10470 (HITBC)

Expedition 34761 (HITBC)

Ch902 (SYS); *Pei Sheng-ji* 9947 (HITBC); *Unknown coll.* 262 (HITBC)

Ch1201 (SYS), *Ch326* (SYS); *Tao Guo-da* 1742 (HITBC)

Ch516 (SYS), *Ch1214* (SYS); *Cui Jing-yun* 14656 (HITBC); *Pei Sheng-ji* 10300 (HITBC)

Ch807 (SYS); *Zou Shuang-yun* 356 (HITBC)

Li Yan-hui 3575 (HITBC)

Li Yan-hui 4250 (HITBC)

Ch922 (SYS); *Li Yan-hui* 399 (HITBC)

Ch309 (SYS), *Ch226* (SYS), *Ch38* (SYS); *Li Yan-hui* 1694 (HITBC)

Ch131 (SYS); *Li Yan-hui* 2423 (HITBC)

Ch25 (SYS), *Ch97* (SYS); *Li Yan-hui* 1500 (HITBC)

Tao Guo-da 13668 (HITBC)

Zhao Shi-wang 22492 (HITBC)

Ch784 (SYS)

Ch948 (SYS)

Ch379 (SYS); *Wang Hong* 2724 (HITBC)

Ch842 (SYS); *Wang Hong* 2707 (HITBC)

Ch272 (SYS); *Expedition* 34359 (HITBC); *Tao Guo-da* 16748 (HITBC), 3792 (HITBC)

Appendix 1. Continued.

GRAMINEAE

Dendrocalamus strictus (Roxb.) Nees

ICACINACEAE

Apodytes dimidiata E. Meyer ex Arn.

LABIATAE

Colebrookea oppositifolia Sm.

Elsholtzia stachyodes (Link) C. Y. Wu

LAMIACEAE

Clerodendron henryi Pei

Garrettia siamensis Fletcher

Premna hamiltonii J. L. Ellis

Sphenodesme mollis Craib

LAURACEAE

Litsea dilleniifolia P. Y. Bai & P. H. Huang

Litsea elongata (Wall. ex Nees) Benth. & Hook. f.

Phoebe lanceolata (Wall. ex Nees) Nees

LILIACEAE

Polygonatum punctatum Royle ex Kunth

Tupistra uatitii Hook. f.

MALPIGHIACEAE

Hiptage benghalensis var. *tonkinensis* (Dop) S. K. Chen

MALVACEAE

Sterculia villosa Roxb.

MELIACEAE

Chukrasia tabularia var. *velutina* King

Dysoxylum lenticellatum C. Y. Wu & H. Li

Dysoxylum spicatum H. L. Li

Toona ciliata var. *pubescens* (Franch.) Hand.-Mazz.

MORACEAE

Cudrania jinghongensis S. S. Chang

Ficus orthoneura Lévl. & Vaniot

Ficus prostata Wall. ex Miq.

Ficus pubigera var. *maliformis* (King) Corner

MYRSINACEAE

Ardisia garrettii Fletcher

Ch1058 (SYS); Sun Ji-liang 18151 (HITBC)

Tao Guo-da 16690 (HITBC)

Ch51 (SYS); Li Yan-hui 252 (HITBC), Sun Ji-liang 18005 (HITBC)

Tao Guo-da 3798 (HITBC)

Wang Hong 2921 (HITBC), 2922 (HITBC), 2940 (HITBC)

Expedition 32276 (HITBC); Unknown coll. 2434 (HITBC), 456 (HITBC); Wang Hong 2727 (HITBC)

Ch177 (SYS), Ch278 (SYS); Expedition 32617 (HITBC)

Ch864 (SYS)

Li Yan-hui 3053 (HITBC)

Ch269 (SYS), Ch119 (SYS)

Ch161 (SYS), Ch61 (SYS), Ch324 (SYS); Li Yan-hui 754 (HITBC)

Ch711 (SYS)

Expedition 34321 (HITBC); Yang Zhen-hong 6971 (HITBC); Wang Hong 3102 (HITBC)

Ch45 (SYS); Li Yan-hui 1051 (HITBC)

Zou Shuang-yun 324 (HITBC)

L. Yan-hui 385 (HITBC)

Ch508 (SYS); Cui Jing-yun 22658 (HITBC)

Unknown coll. 250 (SYS)

Ch680 (SYS), Ch566 (SYS), Ch581 (SYS)

Li Yan-hui 3135 (KUN)

Ch41 (SYS); Li Yan-hui 3802 (HITBC)

Zhu Hua & Wang Hong 88-11 (HITBC)

Li Yan-hui 3223 (HITBC)

Ch130 (SYS), Ch170 (SYS), Ch47 (SYS); Li Yan-hui 3867 (HITBC)

Appendix 1. Continued.

MYRTACEAE

Syzygium claviflorum (Roxb.) Wall ex A. M. & J. M. Cowan

ORCHIDACEAE

Gastrochilus obliquus (Lindl.) Kuntze

Nervilia plicata (Andr.) Schltr.

Tropidia angulosa (Lindl.) Blume

OROBANCHACEAE

Aeginetia indica L.

OXALIDACEAE

Averrhoa carambola L.

Biophytum esquirolii Lév.

PALMAE

Caryota ochlandra Hance

PIPERACEAE

Peperomia heyneana Miq.

Piper arboricola C. DC.

Piper curtipedunculatum C. DC.

RHAMNACEAE

Ventilago leiocarpa var. *pubescens* Y. L. Chen & P. K. Chou

Zizyphus altopenensis Pierre

RUBIACEAE

Ixora cephalophora Merr.

Pavetta arenosa Lour.

Pavetta hongkongensis Bremek.

Psychotria pilifera Hutch.

Psychotria siamica (Craib) Hutch.

Spiradialis caespitosa f. *subimmersa* Lo

RUTACEAE

Glycosmis citrifolia (Willd.) Lindl.

Murraya koenigii (L.) Spreng.

Murraya microphylla (Merr. & Chun) Swingle

Murraya paniculata (L.) Jack.

Zanthoxylum armatum var. *ferrugineum* (Rehder & E. H. Wilson) C. C. Huang

Zanthoxylum lactum Drake

Zanthoxylum utile C. C. Huang

Ch501 (SYS), Ch492 (SYS)

Li Yan-hui 2734 (HITBC)

Ch713 (SYS); Li Yan-hui 3138 (HITBC)

Li Yan-hui 392 (HITBC); Wang Pei-qun 11115 (HITBC)

Zhao Shi-xiang 165 (HITBC)

Li Yan-hui 3129 (HITBC)

Li Yan-hui 4004 (HITBC)

Chen Yu 62079 (HITBC)

Ch804 (SYS); Li Yan-hui 2738 (HITBC)

Ch585 (SYS), Ch924 (SYS), Ch1216 (SYS); Unknown coll. 865 (HITBC)

Cui jing-yun 22811 (HITBC)

Ch1088 (SYS), Ch645 (SYS)

Li Yan-hui 1289 (HITBC), Ch251 (SYS)

Ch1218 (SYS), Ch1229 (SYS)

Li Yan-hui 246 (HITBC), 2814 (HITBC)

Ch355 (SYS); Zhu Hua & Wang Hong 3004 (HITBC)

Ch712 (SYS), Ch165 (SYS); Li Yan-hui 1498 (HITBC)

Ch836 (SYS); Li Yan-hui 2473 (HITBC), 258 (HITBC)

Li Yan-hui 12675 (HITBC)

Ch222 (SYS), Ch146 (SYS); Zou Shuang-yun 333 (HITBC)

Ch176 (SYS), Ch330 (SYS), Ch352 (SYS), Ch313 (SYS); Li Yan-hui 1859 (HITBC)

Expedition 34267 (HITBC); Tao Guo-da 44056 (HITBC)

Li Yan-hui 3315 (HITBC)

Ch887 (SYS); Unknown coll. 1010 (HITBC)

Ch475 (SYS), Ch578 (SYS)

Ch636 (SYS), Ch777 (SYS)

STAPHYLEACEAE

Tapiscia yunnanensis W. C. Cheng & S. D. Chu

TETRAMELACEAE

Tetrameles nudiflora R. Br.

TILIACEAE

Colona floribunda (Wall.) Craib

Colona thorelii (Gagnep.) Burret

URTICACEAE

Boehmeria zollingeriana Wedd.

Debregeasia edulis (Siebold & Zucc.) Wedd.

Elatostema rupestre (Buch.-Ham.) Wedd.

Pilea monilifera Hand.-Mazz.

Pilea plataniflora C. H. Wright

Pouzolzia sanguinea (Blume) Merr.

VITACEAE

Leuca aequata L.

Yua austro-orientalis (Metcalfe) C. L. Li

Tetrastigma cauliflorum Merr.

Tetrastigma delavayi Gagnep.

Tetrastigma erubescens var. *monospermum* Gagnep.

Tetrastigma pubinerve Merr. & Chun

Vitis balansaeana Planch.

Vitis betulifolia Diels & Gilg

ZINGIBERACEAE

Hedychium sino-aureum Stapf

Hedychium villosum var. *tenuiiflorum* Wall. ex Baker

Pommereschea spectabilis (King & Prain) K. Schum.

Peridophyta preferent to limestone habitats

ADIANTACEAE

Adiantum capillus-veneris L.

Adiantum caudatum L.

Adiantum caudatum var. *edgeworthii* (Hook.) Bedd.

Adiantum malesianum J. Ghatak

ANTROPHYACEAE

Antrophyum callifolium Blume

Zhu Hua 93011 (HITBC)

Li Yan-hui 8541 (HITBC)

Ch700 (SYS), Ch932 (SYS); Pei Sheng-ji 10084 (HITBC)

Li Yan-hui 1696 (HITBC)

Ch1064 (SYS); Cui Jing-yun 19416 (HITBC)

Ch311 (SYS); Tao Guo-da 41641 (HITBC)

Ch168 (SYS), Ch388 (SYS), Ch359 (SYS); Wang Hong 1494 (HITBC)

Ch984 (SYS); Wang Hong 1484 (HITBC)

Ch381 (SYS); Ch657 (SYS); Li Yan-hui 4210 (HITBC); Tao Guo-da 16090 (HITBC)

Cui Jing-yun 22793 (HITBC)

Ch468 (SYS), Ch714 (SYS); Pei Sheng-ji 9359 (HITBC)

Ch844 (SYS)

Ch268 (SYS); Li Yan-hui 11915 (HITBC)

Ch507 (SYS); Ch811 (SYS)

Ch463 (SYS), Ch1054 (SYS); Tao Guo-da 9189 (HITBC)

Ch653 (SYS), Ch616 (SYS)

Ch668 (SYS), Tao Guo-da 16447 (HITBC)

Ch654 (SYS), Ch408 (SYS)

Ch1240 (SYS); Wang Hong 3066 (HITBC); Tao Guo-da 16049 (HITBC)

Li Yan-hui 4866 (HITBC)

Tao Guo-da 13661 (HITBC); Zhu Pei-zhi 8642 (HITBC)

Expedition 34430 (HITBC)

Li Yan-hui 2554 (HITBC)

Li Bao-gui 734 (HITBC)

Zhu Pei-zhi 8668 (HITBC)

Li Bao-gui 803 (HITBC)

Appendix 1. Continued.

ASPLENIACEAE

Asplenium austrochinense Ching
Asplenium excisum C. Presl
Asplenium interjectum H. Christ
Asplenium prolongatum Hook.
Asplenium saxicola Rosenst.
Asplenium varians Wall. ex Hook. & Grev.
Hymenasplenium chellosorum (Kunze ex Mett.) Tagawa
Neottopteris antrophyoides (H. Christ) Ching

Li Yan-hui 3810 (HITBC)
Li Bao-gui 737 (HITBC); *Unknown coll.* 9498 (HITBC)
Li Bao-gui 880 (HITBC)
Li Yan-hui 3739 (HITBC)
Li Yan-hui 2749 (HITBC)
Tao Guo-da 43453 (HITBC)
Li Qing-jun 42749 (HITBC)
Zhu Pei-zhi 10487 (HITBC)

ATHYRIACEAE

Allantodia alata (Christ) Ching
Allantodia pinnatifido-pinnata (Hook.) Ching
Kunivatsukia cuspidata (Bedd.) Pic. Serm.

Li Bao-gui 674 (HITBC)
Tao Guo-da 43571 (HITBC)
Tao Guo-da 17161 (HITBC)

BOLBITIDACEAE

Egenolfia tonkinensis C. Chr. ex Ching

Li Bao-gui 756 (HITBC)

DRYNARIACEAE

Drynaria bonii H. Christ
Drynaria fortunei (Kunze ex Mett.) J. Sm.
Drynaria rigidula (Sw.) Bedd.

Li Yan-hui 2735 (HITBC)
Tao Guo-da 38772 (HITBC)
Expedition 34292 (HITBC)

DRYOPTERIDACEAE

Dryopteris cochlaeta (D. Don) C. Chr.
Polystichum deltodon (Baker) Diels

Li Bao-gui 98085 (HITBC)
Tao Guo-da 15730 (HITBC)

HEMONITIDACEAE

Pityrogramma calomelanos (L.) Link

Li Bao-gui 45749 (HITBC)

NEPHROLEPIDACEAE

Nephrolepis auriculata (L.) Trimen

Tao Guo-da 16010 (HITBC)

POLYPODIACEAE

Lepisorus bicolor (Takeda) Ching
Lepidogrammitis rostrata (Bedd.) Ching
Lemmaphyllum microphyllum C. Presl
Lemmaphyllum carnosum (Wall.) C. Presl
Phymatodes cuspidata (D. Don) J. Sm.
Pyrrrosia assimilis (Baker) Ching
Pyrrrosia mollis (Kunze) Ching
Pyrrrosia nuda (Giesenh.) Ching
Pyrrrosia nummularifolia (Sw.) Ching
Pyrrrosia subfurfuracea (Hook.) Ching
Pyrrrosia tonkinensis (Giesenh.) Ching

Tao Guo-da 39738 (HITBC)
Li Bao-gui 774 (HITBC)
Li Bao-gui 600 (HITBC)
Li Bao-gui 604 (HITBC)
Li Yan-hui 3808 (HITBC)
Expedition 34719 (HITBC)
Tao Guo-da 38843 (HITBC)
Tao Guo-da 38875 (HITBC)
Li Qing-jun 42624 (HITBC)
Li Bao-gui 9904152 (HITBC)
Pei Sheng-ji 9933 (HITBC)

Appendix 1. Continued.

PTERIDACEAE	<i>Pteris actiniopteroides</i> H. Christ	<i>Li Bao-gui</i> 921 (HITBC)
SELAGINELLACEAE	<i>Selaginella involvens</i> (Sw.) Spring	<i>Li Bao-gui</i> 960463 (HITBC)
	<i>Selaginella pulvinata</i> (Hook. & Grev.) Maxim.	<i>Li Bao-gui</i> 45178 (HITBC)
SINOPTERIDACEAE	<i>Aleuritopteris pseudofarinosa</i> Ching & S. K. Wu	<i>Mengliandui</i> 10242 (HITBC)
	<i>Cheilosoria tenuifolia</i> (Burn. f.) Trev.	<i>Mengliandui</i> 10140 (HITBC)
TECTARIACEAE	<i>Ctenitopsis devexa</i> (Kunze) Ching & C. H. Wang	<i>Li Qing-jun</i> 42687 (HITBC)
	<i>Tectaria decurrens</i> (C. Presl) Copel.	<i>Pei Sheng-ji</i> 9277 (HITBC)
	<i>Tectaria simaoensis</i> (Bedd.) Ching & C. H. Wang	<i>Sun Ji-liang</i> 18185 (HITBC)
THELYPTERIDACEAE	<i>Cyclosorus papilio</i> (Hope) Ching	<i>Li Bao-gui</i> 98086 (HITBC)
	<i>Cyclosorus parasitica</i> (L.) Tardieu	<i>Li Yan-hui</i> 1326 (HITBC)



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