SPECIES COMPOSITION AND DIVERSITY OF LIANAS IN TROPICAL FORESTS OF SOUTHERN YUNNAN (XISHUANGBANNA), SOUTH-WESTERN CHINA

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ZHU, H. 2008. Species composition and diversity of lianas in tropical forests of southern Yunnan (Xishuangbanna), south-western China. We conducted a floristic inventory in fourteen 50 × 50 m plots across two main vegetation formations including seven forest types in southern Yunnan, south-western China. A total of 165 liana species with diameter at breast height (dbh) ≥ 1 cm in 44 families were recorded and the liana diversity varied from 15 to 41 species in a plot of 0.25 ha. The majority of liana species occurred only in one or two forest types. Liana species contributed from 13.8 to 27.1% of the total species (comprising tree, shrub, herb and liana) or 16.8 to 30.2% of the woody species across forest types. Conspicuous correspondence of liana diversity to other life-form groups was not seen. The similarity coefficients of lianas across forest types were generally low. In floristic composition, Leguminosae with 20 species, was the largest family, followed by Annonaceae (12 species), Vitaceae (12 species), Apocynaceae (10 species) and Rubiaceae (8 species), while a total 13 families were represented by single species. Among the liana species recorded, only five species occurred in more than ¾ of forest types, which indicated a high degree of heterogeneity in distribution. The forests in southern Yunnan do not show lower liana diversity than equatorial Asian forests, although they occur at a higher latitude and altitude.

Keywords: Liana diversity, across forest types, tropical China

ZHU, H. 2008. Komposisi spesies dan kepelbagaian pokok akar di hutan tropika selatan Yunnan (Xishuangbanna), barat daya China. Kami menjalankan inventori flora di 14 plot yang setiap satunya berukuran 50 m × 50 m merentasi dua bentukan vegetasi utama yang melibatkan tujuh jenis hutan di selatan Yunnan, barat daya China. Sebanyak 165 spesies pokok akar berdiameter pada aras dada (dbh) > 1 cm dalam 44 famili direkodkan dan kepelbagaian pokok akar adalah berjulat antara 15 spesies hingga 41 spesies bagi setiap plot 0.25 ha. Kebanyakan spesies pokok akar wujud di satu atau dua jenis hutan. Spesies pokok akar menyumbang sebanyak 13.8% hingga 27.1% daripada keseluruhan spesies (yang termasuk pokok, pokok renek, pokok herba dan pokok akar). Ini bersamaan dengan 16.8% hingga 30.2% daripada spesies berkayu dalam semua jenis hutan yang dikaji. Hubungan jelas antara kebelbagaian pokok akar dan kumpulan hidupan lain tidak didapati. Pekali keserupaan pokok akar dalam semua jenis hutan pada umumnya adalah rendah. Dari segi komposisi flora, Leguminosae yang mempunyai 20 spesies merupakan famili terbesar diikuti dengan Annonaceae (12 spesies), Vitaceae (12 spesies), Apocynaceae (10 spesies) and Rubiaceae (8 spesies). Sementara itu 13 famili mempunyai satu spesies sahaja. Antara spesies pokok akar yang direkod, hanya lima spesies didapati dalam ¾ jenis hutan dan ini menunjukkan darjah keheterogenan yang tinggi. Walaupun berada di latitud dan altitud yang lebih tinggi hutan di selatan Yunnan tidak menunjukkan kepelbagaian yang lebih rendah berbanding hutan Asia.

INTRODUCTION

Abundant lianas are a conspicuous feature of tropical forests (Molina-Freaner *et al.* 2004) and make a substantial contribution to the overall plant diversity (Nabe-Nielsen 2001). Lianas constitute about 25% of the woody stem density and species diversity in tropical forests (Gentry 1991). Lianas also play an important role in forest regeneration, competition and ecosystem-level process, particularly in the tropics (Schnitzer & Bongers 2002). Lianas are even more common in forests disturbed by logging and along edges of forest fragments (Zhu *et al.* 2004, Schnitzer *et al.* 2004). Richness and abundance of liana differ greatly from one forest to another and between

forest locations (Reddy & Parthasarathy 2003). Liana density and diversity increase dramatically with decreasing latitude, more so than most other plant life-forms, with the exception of epiphytic plants (Schnitzer & Bongers 2002, Parthasarathy *et al.* 2004).

Lianas have been of major concern in tropical ecology and biodiversity conservation since Putz's (1984) work. Studies of lianas related to tropical forests have focused on abundance and species richness, relationships between lianas and forest fragmentation or logging, reproductive attributes of lianas, as well as ecological relationships between lianas and trees. A few studies have focused on abundance and diversity of lianas along chronosequence (DeWalt *et al.* 2000) and across environmental gradients such as landscape (Ibarra-Manriquez & Martinez-Ramos 2002), latitude and rainfall (Molina-Freaner 2004), as well as elevation gradients (Kelly 1985, Siebert 2005). Here we discuss the species composition and diversity of lianas across forest types based on comparison of plots in various forest types in southern Yunnan, south-western China.

MATERIALS AND METHODS

Study site

Topography

This study was carried out in Xishuangbanna, an administrative region of southern Yunnan, south-western China. Xishuangbanna lies between 21° 09' and 22° 36' N and 99° 58' and 101° 50' E (Figure 1) and has an area of 19 690 km^2. It borders Myanmar and Laos and has a mountainous topography with mountain ridges running in a north-south direction and decreasing in elevation southward. Its elevation varies from 480 m at the bottom of the lowest valley in the south (Mekong River) to 2430 m at the top of the mountain in the north. The Mekong River runs through the region from north-west to south-east. The western and northern parts of the region with higher basins over 1000 m elevation have a mountainous topography and experience a southern-subtropical climate, while the south is mostly hills with lower basins under 1000 m elevation and a tropical climate (Zhu 2006).

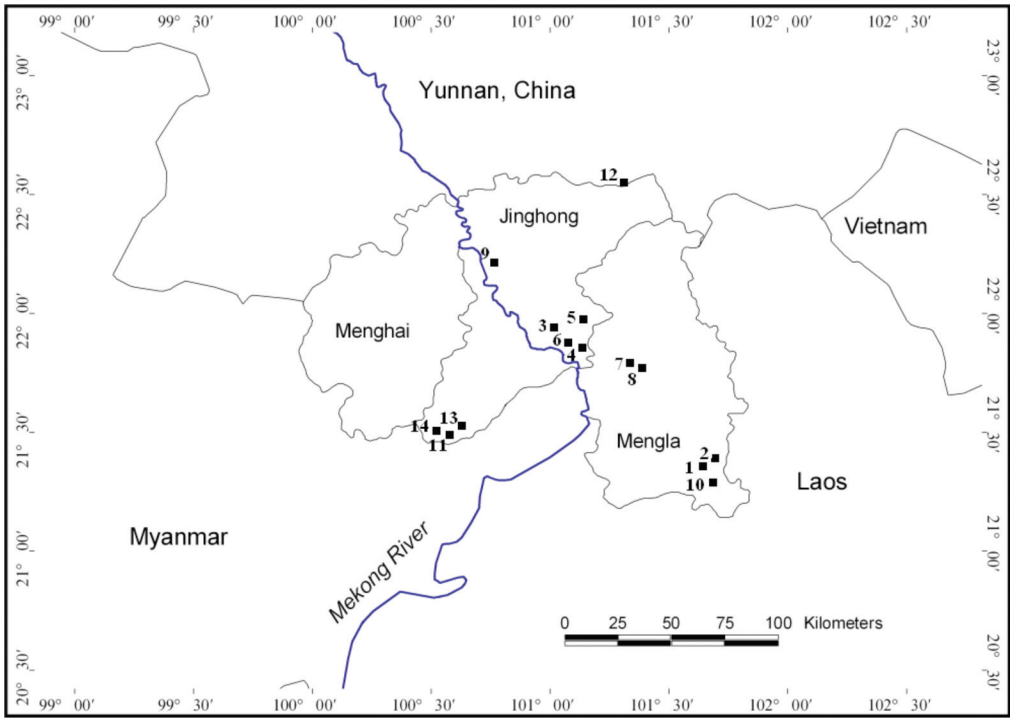

Figure 1 Study site in southern Yunnan, south-western China. Serial number of plots: 1 and 2: dipterocarp seasonal rain forest; 3 and 4: ravine seasonal rain forest; 5 and 6: lower hill seasonal rain forest; 7 and 8: limestone seasonal rain forest; 9 and10: transitional forest between tropical seasonal rain forest and tropical montane evergreen broad-leaved forest; 11 and 12: tropical montane evergreen broad-leaved forest; 13 and 14: tropical montane rain forest.

Climate

The region has a typical monsoon climate. The annual mean temperature varies from 21.7 °C at an elevation of 550 m asl to 15.1 °C at 1979 m asl. The hottest month is June (17.9–25.3 °C) and the coldest, January (8.8–15.6 °C). The annual precipitation increases from 1193 mm at Mengyang (740 m asl) to 2491 mm at the summit of Nangongshan (1979 m asl), of which more than 80% falls during the rainy season from May till October.

Dense fog always exists during the entire dry season on the lower hills and in the valleys, averaging 146 foggy days per year and 1 mm precipitation per foggy day is recorded in Mengla County in southern Xishuangbanna, 116 foggy days per year in Menglun in the central area of the region and 126 foggy days per year in Mangao in the north-west of the region. This compensates for the insufficient precipitation so that a tropical moist climate can form locally in spite of its relatively low mean annual precipitation.

Soils

There are three main soil types in the region. Laterite soil which developed from siliceous rocks such as granite and gneiss occur between 600–1000 m asl with a deep solum but a thin humus horizon and a pH of 4.5–5.5. The lateritic red soil from the rock substrate of sandstone occurs in the area above 1000 m asl. Limestone hills have soil from rock substrate of hard limestone of Permian origin with a pH of 6.75.

Vegetation

The primary vegetation of southern Yunnan was classified into four vegetation formations: tropical rain forest, tropical seasonal moist forest, tropical montane evergreen broad-leaved forest and tropical monsoon forest (Zhu 2006, Zhu *et al.* 2006). Our study covered two of these, namely, tropical rain forest and tropical montane evergreen broad-leaved forest. The tropical rain forest was classified into two subformations, i.e. tropical seasonal rain forest in lowlands and a tropical montane rain forest at higher elevations. The tropical seasonal rain forest, which occurs usually in wet valleys and on lower slopes of hills or mountains below 1000 m asl and has almost the same forest profile and physiognomic characteristics as equatorial lowland rain forests, is a type of lowland tropical rain forests. The tropical montane rain forest which occurs at wet montane habitats is similar to the lower montane rain forests in equatorial Asia in floristic composition and physiognomy. It is a type of lower montane rain forests within the broader category of tropical rain forests. The tropical montane evergreen broad-leaved forest is the main montane forest type in the region and is considered to be a distinct vegetation formation from the northern margin of mainland south-eastern Asia, based on its floristic and physiognomic characteristics.

Seven main forest types in the two vegetation formations were plotted: (1) dipterocarp seasonal rain forest (DSRF), (2) ravine seasonal rain forest (RSRF), (3) lower hill seasonal rain forest (LHSRF), (4) limestone seasonal rain forest (LSRF), (5) transitional forest between tropical seasonal rain forest and tropical montane evergreen broad-leaved forest (TF), (6) tropical montane rain forest (TMRF) and (7) tropical montane evergreen broad-leaved forest (TMEBF). Types (1)–(4) and (6) belong to the vegetation formation of tropical rain forest and are included in its two subformations, i.e. a tropical seasonal rain forest in lowlands and a tropical montane rain forest respectively (Zhu 2006, Zhu *et al.* 2006), while type (7) is the only forest type of tropical montane evergreen broad-leaved forest formation. The dipterocarp seasonal rain forest locally occurs in the valleys and on the lower slopes at 700–1000 m asl in the southern-most part of the region. It is dominated by *Shorea wantianshuea* (Dipterocarpaceae). The ravine seasonal rain forest widely occurs in the wet valleys and on lower slopes as well as shaded slopes, and is dominated by tree species *Pometia tomentosa* and *Terminalia myriocarpa*. The lower hill seasonal rain forest occurs in the less wet habitats on lower hills and lower sun-facing slopes. It is dominated by tree species *Antiaris toxicaria* and *Pouteria grandiflora*. The limestone seasonal rain forest occurs in valleys and on lower slopes of the limestone in the region. It is floristically characterized by *P. tomentosa, Celtis philippensis* var. *wightii* and *Lasiococca comberi* var. *pseudoverticillata*. The transitional forest between tropical seasonal rain forest and tropical montane evergreen broad-leaved forest occurs on lower slopes at 900–1200 m asl. It is floristically characterized by *Metadina trichotoma, Paramichelia baillonii* and

Syzygium cathayense. The tropical montane rain forest occurs mainly in wetter montane valleys and on wetter upper montane at 1600–1800 m asl. It is dominated by broad-leaved tree species *Mastixia euonymoides, Phoebe megacalyx, Parakmeria yunnanensis* and *Gymnanthes remota*. The tropical montane evergreen broad-leaved forest occurs mainly on montane slopes between 900 – 1600 m asl. The forest is dominated largely by the families Fagaceae, Theaceae and Lauraceae with species such as species *Castanopsis hystrix, C. echinocarpa, Lithocarpus fohaiensis* and *Schima wallichii*. The classification and nomenclature of the vegetation formations and forest types follow Zhu's classification (Zhu 2006).

Methods

We set up fourteen, 50 × 50 m plots across two main vegetation formations which include seven forest types (two plots in each forest type), with elevation gradients from 620 to 1670 m. All trees in these plots were identified and their diameter at breast height (dbh) (minimum 5 cm) measured. All lianas ≥ 1 cm dbh that rooted within these plots, were enumerated and their abundance estimated. In each plot, five 5 × 5 m subplots were established to investigate saplings (trees with dbh < 5 cm), shrubs and herbaceous plants.

The contribution of lianas to the plant diversity was analyzed by counting the percentage of liana species in the plots across forest types. The similarity of lianas between forest types were calculated by means of the Sørensen similarity index (S):

$$S = 2C/[a + b]$$

where
C = number of species shared by the sites being compared
a = number of species in site A
b = number of species in site B.

Specimens were identified and voucher material was lodged in the herbarium of Xishuangbanna Tropical Botanical Garden (HITBC). Nomenclature follows '*Flora Reipublicae Popularis Sinicae*' (Wu 1959–2004).

RESULTS

Liana species composition and distribution across forest types

All liana species with dbh ≥ 1 cm recorded in the plots across forest types were enumerated and tabulated in the appendix. A total of 165 liana species was recorded from these 14 plots across the seven forest types. Among them, 28 species were herbaceous and usually small lianas; the rest were woody and usually big lianas. Only one species, *Piper flaviflorum,* was recorded in all forest types. *Gentum montanum* and *Salacia cochinchinensis* were recorded in six forest types while *Bythneria integrifolia* and *Toddalia asiatica,* in five forest types. As much as 57% liana species were recorded from the plots of only one forest type. Also many species were recorded as occasional or rare in the forests. A small portion of lianas was abundant or very abundant in at least one forest type although *B. integrifolia* was abundant in three forest types at lower elevations. *Piper flaviflorum* occurred in low numbers although it was present in all forest types.

Species diversity across forest types

Liana diversity varied from 15 to 41 species in sampling plots of 0.25 ha each across forest types (Table 1). No significant difference was seen in the two plots of the same forest types. The liana species contributed 13.8 to 27.1% of the total sum of liana, tree, shrub and herb species across forest types. No significant difference in the ratio of liana contribution to the same forest type was observed except that in the lower hill seasonal rain forest. No conspicuous relationship of liana diversity to other life-form groups was seen. However, the species richness of lianas was generally higher in the forest types at lower elevations compared with higher elevations.

Floristic composition at family level

The 165 liana species recorded from the plots belonged to 44 families. Fourteen families with the highest number of species are shown in Table 2. Leguminosae with 20 species is the largest

Table 1 Species diversity across life forms and across forest types in Xishuangbanna, southern Yunnan

Forest types	DSRF	DSRF	RSRF	RSRF	LHSRF	LHSRF	LSRF	LSRF	TF	TF	TMEBF	TMEBF	TMRF	TMRF
Serial number of plot*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Altitude (m)	700	800	700	620	680	650	740	700	1150	920	1350	1470	1600	1670
Size of plot (m^2)	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
Number of total species**	177	166	144	135	146	129	67	85	159	146	150	163	174	142
Number of tree species including saplings	89	91	82	75	81	70	35	43	89	93	87	81	83	87
Number of shrub species	19	16	12	13	14	11	7	7	20	12	15	15	19	11
Number of herb species	28	19	26	25	20	13	12	20	28	18	26	39	48	22
Number of liana species	41	40	24	22	31	35	13	15	22	23	22	28	24	22
Share of tree species (%)	50.28	54.82	56.94	55.56	55.48	54.26	52.24	50.59	55.97	63.70	58.00	49.69	47.70	61.27
Share of shrub species (%)	10.73	9.64	8.33	9.63	9.59	8.53	10.45	8.24	12.58	8.22	10.00	9.20	10.92	7.75
Share of herb species (%)	15.82	11.45	18.06	18.52	13.40	10.08	17.91	23.53	17.61	12.33	17.33	23.93	27.59	15.49
Share of liana species (%)	23.16	24.10	16.67	16.30	21.23	27.13	19.40	17.65	13.84	15.75	14.67	17.18	13.79	15.49

DSRF = dipterocarp seasonal rain forest; RSRF = ravine seasonal rain forest; LHSRF = lower hill seasonal rain forest; LSRF = limestone seasonal rain forest; TF = transitional forest between tropical seasonal rain forest and tropical montane evergreen broad-leaved forest; TMEBF = tropical montane evergreen broad-leaved forest; TMRF = tropical montane rain forest

*Serial number of plot in the table is the same as in Figure 1.

**The number of epiphytic species was not included because the accurate number of epiphytic species in plots was usually hard to obtain, owing to their occurrence on high branches of canopy.

family followed by Annonaceae (12), Vitaceae (12), Apocynaceae (10) and Rubiaceae (8). A total of 13 families were represented by single species which contributed to 29.5% of the total liana families.

Similarity coefficients of lianas across forest types

Liana species from the plots were compared and their similarity coefficients across forest types were calculated (Table 3). The highest similarity (0.53933) was observed between the ravine seasonal rain forest and the lower hill seasonal rain forest. The lowest similarity (0.142857) was between the limestone seasonal rain forest and the tropical montane rain forest. The liana similarities across forest types were generally low with one exception, that of between the ravine seasonal rain forest and the lower hill seasonal rain forest. However, forest types at lower elevation had relatively high similarities of lianas.

DISCUSSION

From our study, liana species contributed 13.8 to 27.1% of the total sum of liana, tree, shrub and herb species across forest types in southern Yunnan. Generally, lianas contributed more to the species diversity of lower elevation compared with higher elevation. There was no relationship between liana diversity and other life-form groups. However, tree and shrub had more

Table 2 Top 14 most species-rich families of lianas in study plots

Family	Number of species	% of the total liana species
Leguminosae	20	12.05
Annonaceae	12	7.23
Vitaceae	12	7.23
Apocynaceae	10	6.02
Rubiaceae	8	4.82
Hippocrateaceae	7	4.22
Smilacaceae	7	4.22
Menispermaceae	6	3.61
Rhamnaceae	6	3.61
Asclepiadaceae	5	3.01
Myrsinaceae	5	3.01
Combretaceae	4	2.41
Convolvulaceae	4	2.41
Cucurbitaceae	4	2.41

Table 3 Similarity coefficients of lianas across forest types

Forest types	RSRF	LHSRF	LSRF	TF	TMEBF	TMRF
DSRF	0.34955		0.232558	0.25490	0.19512	0.170213
RSRF		0.53933	0.33846	0.17284	0.181818	0.21918
LHSRF			0.361111	0.27273	0.202247	0.200000
LSRF				0.1875	0.184615	0.142857
TF					0.30380	0.17143
TMEBF						0.301370

DSRF = dipterocarp seasonal rain forest; RSRF = ravine seasonal rain forest; LHSRF = lower hill seasonal rain forest; LSRF = limestone seasonal rain forest; TF = transitional forest between tropical seasonal rain forest and tropical montane evergreen broad-leaved forest; TMEBF = tropical montane evergreen broad-leaved forest; TMRF = tropical montane rain forest

constant contributions to species diversity across forest types than other groups. The contributions to the total species were 47.7 to 63.7 % in trees and 7.8 to 12.6% in shrubs.

The majority of liana species occurred only in one or two forest types although a few occurred across most forest types. Similarly some lianas were abundant in one or two forest types but a few were abundant across most forest types. This implies that the majority of lianas are rare or occasional species in the forests.

The similarity coefficients of lianas across forest types were generally low. The highest similarity was between the ravine seasonal rain forest and the lower hill seasonal rain forest, while the lowest was between the limestone seasonal rain forest and the montane rain forest. These results are reasonable because the types of seasonal rain forest off limestone grow under similar habitat conditions, while the limestone seasonal rain forest which occurs at a relatively dry limestone habitat, and the montane rain forest which occurs at a cloudy and wet montane habitat, are very different ecologically. The occurrence of liana species could be attributed more to habitat types than vegetation formations. The generally low similarity coefficient of lianas across forest types implies that lianas are diverse in the region.

We compared our results with those obtained by other workers from various locations, namely southern India (Parthasarathy *et al.* 2004), tropical Africa (Hemp 2006), afromontane rains forests (Senbeta *et al.* 2005), Lambir National Park, Sarawak, Malaysia (Putz & Chai 1987), Pasoh, Negeri Sembilan, Malaysia (Appanah *et al.* 1993), Costa Rica (Nabe-Nielsen 2001, Mascaro *et al.* 2004), and Yasuni National Park, Ecuador (Burnham 2002).

We found 165 liana species in 44 families with dbh ≥ 1 cm in the fourteen 50 × 50 m plots measuring 3.50 ha across seven forest types. In a plot of 0.25 ha the liana diversity varied from 15 to 41 species. In southern India, a total of 148 liana species in 47 families with dbh ≥ 1.6 cm were recorded from a total sampling area of 47 ha in five sites, and the liana richness for every 1 ha plot varied from 24 to 29 species. A total of 79 species of woody lianas in 24 families, with dbh ≥ 1 cm were recorded from ten 0.1-ha sampling plots situated in the ridge and valley of Lambir; the authors found 39 species in the five ridge plots and 53 species in the five valley plots. However, higher liana species richness were found in lowland rain forest in Pasoh whereby 57 species with dbh ≥ 1 cm occurred in a 0.1-ha sampling plot. The species richness of lianas in Yunnan is generally higher than those in southern India, and slightly higher than those in the rain forest in Lambir, but lower compared with Pasoh.

In our study, only five out of 165 liana species recorded occurred in more than ¾ of forest types, which indicated a higher degree of heterogeneity in distribution compared with the 12 plots in Ecuador; of 331 species 26 occurred in more than ¾ plots (Burnham 2002).

Similarity coefficients between forest types in southern Yunnan generally showed low similarity values (0.142857–0.361111) with one exception (0.53933). This is comparable with five afromontane rain forests (Senbeta *et al.* 2005), which also showed low similarity values (Jaccard's coefficient of similarity = 0.08–0.30).

We also observed that Leguminosae was the largest family in southern Yunnan, followed by Annonaceae, Vitaceae, Apocynaceae and Rubiaceae. In southern India, families with the highest number of species were Vitaceae, Leguminosae and Apocynaceae. In Lambir and Pasoh, the highest number of species occurred in Leguminosae, Annonaceae, Connaraceae, Celastraceae and Apocynaceae and Annonaceae, Leguminosae, Connaraceae and Palmae respectively. Asclepiadaceae, Leguminosae, Annonaceae and Cucurbitaceae were the most species-rich families in afromontane rain forests in Ethiopia. In the neotropical rain forest, Sapindaceae, Leguminosae, Menispermaceae, Bignoniaceae and Malpighiaceae were the most species-rich families. The liana flora in southern Yunnan is most similar to the one in southern India at family level.

The lianas in this study area constituted from 16.8 to 30.2% (average value of 22.1% from 14 plots) of the woody species diversity, and from 13.8 to 27.1% (18.3%) of the total sum of liana, tree, shrub and herb species across forest types (Table 1), which was slightly lower than the 25% reported by Gentry (1991) for tropical forests.

Liana diversity decreased with increasing altitude in the tropics (Gentry 1991, Schnitzer & Bongers 2002). In the current study the diversity was generally higher in the forest types

at lower elevations. This concurs with results obtained from southern India (600–700 m asl; Parthasarathy *et al.* 2004) and Costa Rica (300 m asl; Lieberman *et al.* 1996). However, in southern Yunnan, at altitude below 1200 m asl, the variation of liana diversity corresponded more to habitat variety than elevation. In addition, we also observed that the liana diversity in southern Yunnan is not lower than equatorial Asian forests, although the former is located at higher latitude. Our study also showed that the highest diversity of lianas occurred in areas with marked dry season and this was also reported by Gentry (1991).

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Appendix Liana species across forest types in southern Yunnan

Forest types		DSRF	RSRF	LHSRF	LSRF	TF	TMEBF	TMRF	Presence (%)
Altitude (m)		700–800	620–700	650–680	700–740	920–1150	1320–1500	1500–1780	
Sampling area (m^2)*		5000	5000	5000	5000	5000	5000	5000	
Number of liana species		62	41	53	24	40	41	32	
Piper flaviflorum	HS	II	II	III	III	III	I	II	100.0
Gentum montanum	WB	III		III	I	II	III	IV	85.7
Salacia cochinchinensis	WB	II	III	III	III	III	III		85.7
Bythneria integrifolia	WB	IV	II	IV	III	IV			71.4
Toddalia asiatica	WB	I	I	I	II		II		71.4
Celastrus monospermu	WB				I	III	III	III	57.1
Celastrus paniculatus	WB	I	II				III	I	57.1
Combretum latifolium	WB	III	III	IV	III				57.1
Embelia parviflora	WB	I				III	II	I	57.1
Millettia pachycarpa	WB	II		II		III		II	57.1
Parameria laevigata	WB	IV	III	II			II		57.1
Paramignya rectispina	WB	I	I	III				I	57.1
Randia bispinosa	WB	IV	III	V		II			57.1
Strychnos nitida	WB	I	IV	IV	III				57.1
Tetrastigma cruciatum	WB	II	III		III	II			57.1
Tetrastigma henryi	WB	I		II			II	II	57.1
Acacia pennata	WB		II	IV		I			42.9
Alyxis balansae	WB		I	I				III	42.9
Connaris paniculatus	WB		II				I	III	42.9
Craspedolobium schochii	WB			I		III	IV		42.9
Diploclisia glaucescens	WB	II		I		II			42.9
Fissistigma acuminatis-simum	WB	III	I	II					42.9
Goniostemma punctatum	WB		I	I	II				42.9
Gymnostemma pentaphylla	HS		I		II			I	42.9
Jasminum nervosum	WB			I	II		III		42.9
Jasminum wangii	WB	I				II	II		42.9
Mappianthus iodioides	WB		I	I		II			42.9
Millettia dorwardii	WB	I					II	I	42.9
Salacia polysperma	WB		I	III				III	42.9
Trichosanthes quinquefolia	HS	I	I	II					42.9
Ventilago leiocarpa var. pubescens	WB	II		I	IV				42.9
Ventilago madraspetana	WB		II	II	II				42.9
Alangium faberi	WB		II	I					28.6
Argyreia capitata	WB		II					II	28.6
Artabotrys hongkongensis	WB	II	I						28.6
Bauhinia carcinophylla	WB	I	II				II		28.6
Bousigonia angustifolia	WB						III	III	28.6
Bowringia callicarpa	WB		II	I					28.6
Cissus subtetragona	HS	I		III					28.6
Combretum punctatum	WB			I		II			28.6
Dalbergia pinnata	WB			II				II	28.6
Embelia ribes	WB					II	III		28.6

(continued)

Appendix (continued)

Erythropalum scandens	WB	I			I				28.6
Fissistigma minuticalyx	WB	II	II						28.6
Fissistigma polyanthum	WB						II	I	28.6
Gymnema latifolia	WB		II	I					28.6
Heterostemma alatum	WB		I		II				28.6
Hodgoonia macrocarpa	WB			I		II			28.6
Illigera rhodantha	WB	I	I						28.6
Iodes cirrhosa	WB	I				II			28.6
Loeseneriella lenticellata	WB			III	IV				28.6
Mucuna interrupta	WB					II		II	28.6
Mucuna macrocarpa	WB		I	II					28.6
Mussaenda elongata	WB					I	III		28.6
Salacia aurantica	WB		III	I					28.6
Santaloides roxburghii	WB			I			II		28.6
Schizandra plena	WB	II				I			28.6
Smilax glabra	HS					II	I		28.6
Smilax hypoglauca	HS					III	III		28.6
Smilax perfoliata	HS					II	II		28.6
Spatholobus varians	WB		I				II		28.6
Stephania hernandifolia	HS						II	I	28.6
Strychnos cathayensis	WB	II		III					28.6
Tetrastigma jinhongensis	HS			II	III				28.6
Tetrastigma planicaule	WB	II				II			28.6
Tinomiscium tonkinensis	WB		II	I					28.6
Uvaria tonkinensis	WB	II	II						28.6
Ventilago leiocarpa	WB		II			I			28.6
Ziziphus attopensis	WB	II		I					28.6
Ziziphus fungii	WB		II	III					28.6
Adenia penangiana	HS	I							14.3
Aganosma cymosa	WB					I			14.3
Aganosma navillei	WB	I							14.3
Aristolochia tagala	WB			I					14.3
Aspidopterys floribunda	WB				II				14.3
Aspidopterys obcordata	WB	I							14.3
Atylosia mollis	HS						I		14.3
Bauhinia claviflora	WB							II	14.3
Bauhinia genuflexa	WB		I						14.3
Byttneria grandifolia	WB					IV			14.3
Calamus gracilis	WB	IV							14.3
Calamus henryanus	WB							IV	14.3
Campanumoea javanica	HS						II		14.3
Capparis fohaiensis	WB					II			14.3
Chonemorpha parviflora	WB	I							14.3
Cissus adnata	HS			I					14.3
Combretum griffithii	WB	II							14.3
Combretum yunnanense	WB	III							14.3
Congea tomentosa	WB	II							14.3

(continued)

Appendix (continued)

Cudrania fruticosa	WB							I	14.3
Dalbergia henryana	WB	I							14.3
Dalbergia rimosa	WB	I							14.3
Derris marginata	WB						I		14.3
Desmos dumosus	WB				I				14.3
Dinochloa bannaensis	WB							III	14.3
Dioscorea bulbifera	HS						I		14.3
Dioscorea collettii	HS					I			14.3
Embelia scandens	WB					II			14.3
Embelia subcoriacea	WB	II							14.3
Embelia vestita	WB					I			14.3
Epigium auritum	WB							III	14.3
Erycibe subspicata	WB			I					14.3
Evonymus fortunei	WB						II		14.3
Fissistigma balansae	WB	II							14.3
Fissistigma bracteolatum	WB	II							14.3
Fissistigma oldhamii	WB					III			14.3
Fissistigma polyanthoides	WB							I	14.3
Gnetum pendulum	WB							III	14.3
Gymnema sylvestra	WB				I				14.3
Hypserpa nitida	WB			I					14.3
Jasminum lanceiolarium	WB						II		14.3
Kadsura anamosa	WB							II	14.3
Loeseneriella yunnanensis	WB						III		14.3
Lygodium conforme	HS			II					14.3
Lygodium polystachyum	HS			I					14.3
Lygodium salicifolium	HS			I					14.3
Maesa permollis	WB	I							14.3
Marsdenia tinctoria	WB				II				14.3
Melodinus henryi	WB					II			14.3
Mezoneuron cucullatum	WB	I							14.3
Micrechites polyantha	WB		II						14.3
Millettia eurybotrya	WB	III							14.3
Millettia leptobotrya	WB					III			14.3
Morinda cochinchinensis	WB			I					14.3
Mussaenda hossei	WB						II		14.3
Mussaenda macrophylla	WB					III			14.3
Neuropeltis racemosa	WB			IV					14.3
Papilionaceae sp	WB							II	14.3
Parthenocissus austro-orientalis	HS						I		14.3
Pericampylus glaucus	WB					II			14.3
Piper boehmerifolium	HS			I					14.3
Porana spectabilis	WB		II						14.3
Premuna scandens	-		I						14.3
Pristimera arborea	WB			I					14.3
Pristimera cambodiana	WB							I	14.3

(continued)

Appendix (continued)

Rourea microphylla	WB	II							14.3
Rubus alcearfolius	WB						II		14.3
Rubus pirifolius var. cordatus	WB	I							14.3
Sabia parviflora	WB							I	14.3
Schizandra henryi	WB				I				14.3
Securidaca inappendiculata	WB		II						14.3
Smilax bracteata	HS	I							14.3
Smilax indica	HS						II		14.3
Smilax lanceofolia	HS						I		14.3
Smilax ocreata	HS				II				14.3
Spatholobus pulcher	WB						I		14.3
Stixis suaviolens	WB						III		14.3
Strychnos axillaries	WB	II							14.3
Symphorema invulucrata	WB			I					14.3
Tetracera scandens	WB	III							14.3
Tetrastigma cambodiana	WB	II							14.3
Tetrastigma membranaceum	HS			II					14.3
Tetrastigma obovatum	WB							I	14.3
Thladiantha hookeri	HS	I							14.3
Thunbergia grandiflora	HS	I							14.3
Tinospora sp.	WB							I	14.3
Toxocarpus himalensis	WB	I							14.3
Uncaria laevigata	WB	II							14.3
Uncaria macrophylla	WB						I		14.3
Uncaria scandens	WB	I							14.3
Uvaria microcarpa	WB	I							14.3
Uvaria rufa	WB	I							14.3
Vitis flexuosa var. malayana	HS						I		14.3
Zanthoxylum dissitoides	WB		I						14.3
Zizyphus rugosa	WB				III				14.3

* Combination of two plots of 50 × 50 m in each forest types
Habits of lianas: WB = woody and usually big lianas; HS = herbaceous and usually small lianas
Classes of liana abundance: V = very abundant; IV = abundant; III = common; II = occasional; I = rare
Forest types: DSRF = dipterocarp seasonal rain forest; RSRF = ravine seasonal rain forest; LHSRF = lower hill seasonal rain forest; LSRF = limestone seasonal rain forest; TF = transitional forest between tropical seasonal rain forest and tropical montane evergreen broad-leaved forest; TMEBF = tropical montane evergreen broad-leaved forest; TMRF = tropical montane rain forest