A PRELIMINARY REPORT ON THE SPECIES DIVERSITY OF *SHOREA CHINENSIS* FOREST IN SOUTHWEST CHINA

Cao Min

Kunming Institute of Ecology, Academia Sinica, Kunming 650223, Yunnan, P.R. China

CAO MIN. 1993. A preliminary report on the species diversity of *Shorea chinensis* forest in southwest China. *Shorea chinensis* forest is distributed in Xishuangbanna in southwest China which constitutes a part of the northernmost border of tropical southwest Asia and covers about 800 *ha* of wet valleys and gentle slopes. As an important representative of local rainforests under the prevalence of tropical monsoon climate, *Shorea chinensis* forest has both ecological similarity and difference in comparison with typical humid rainforests in tropical Asia. The present paper makes up one of the contributions to the systematic study on the tropical rainforests in Xishuangbanna. Several diversity indices of trees (DBH $\geq$ 110 *cm*) in this forest were determined by applying 'minimum programme' to the field survey : Shannon's H'; the complement of Simpson's index, d'; Fisher's α, S$_{(100)}$ and b. A S-N curve showing the species diversity of this forest was also completed. The results demonstrate that the *Shorea chinensis* forest in Xishuangbanna is more diversified in the tree species composition than some insular forests in Micronesia and some continental rainforests in Thailand and equatorial Amazon.

Key words: *Shorea chinensis* - Xishuangbanna - tropical rainforest - minimum programme - species diversity

CAO MIN. 1993. Laporan awal kepelbagaian spesies hutan *Shorea chinensis* di barat daya China. Hutan *Shorea chinensis* di Xishuangbanna, yang terletak di baratdaya China merangkumi bahagian terutara sempadan tropika Asia tenggara dan merangkumi hampir 800 *ha* kawasan lembah dan cerun-cerun landai. Sebagai wakil utama hutan hujan beriklim tropika, hutan *Shorea chinensis* mempunyai persamaan ekologi dan perbezaan dari segi perbandingan dengan hutan hujan yang tipikal di bahagian tropika Asia. Beberapa index kepelbagaian pokok (DBH > 10 *cm*) dalam hutan ini di ukur dengan menggunakan "program minima" di tapak bancian: Shannon's H'; Index komplementasi Simpsons, d'; Fisher α, S$_{(100)}$ dan b. Lengkok S-N terhadap kepelbagaian spesies di hutan ini juga telah dilengkapkan. Keputusan yang diperolehi menunjukkan bahawa hutan *Shorea chinensis* di Xishuangbanna mempunyai lebih kepelbagaian dari segi komposisi spesies pokok berbanding dengan beberapa hutan di kepulauan Micronesia, hutan hujan di Thailand dan bahagian Khatulistiwa Amazon.

Introduction

Shorea chinensis is a rare tree species endemic to southwestern China and northern Vietnam and forms the tallest and lushest rainforest in Xishuangbanna, southern Yunnan. Due to the local water condition, the forest is scattered in the humid valleys and gentle slopes and covers an area of 800 *ha* in all. A number of papers related to such a unique forest in the fields of taxonomy, coenology, population ecology and seed dispersal have been published (in Chinese) since this

forest was found at the end of 1970s. The species diversity measurement of this forest has not been reported yet. The present paper makes a theoretical contribution to the systematic research in ecology and effective conservation of the *Shorea chinensis* forest.

Materials and methods

Site

Xishuangbanna is situated on the northernmost border of tropical Southeast Asia contiguous to Laos on the south and Myanmar on the southwest (Figure 1). As part of the southward extension of Hengduan Mountains, its terrain is high in the north and low in the south. Lancang River winds through this area before entering Laos.

Figure 1. The geographical location of Xishuangbanna (shaded part)

Lying in the east Asian monsoon region, Xishuangbanna is dominated by the air   mass of the Indian Ocean in summer and the continental air mass of subtropical region in winter, which   results in a May-October rainy season and a November-April dry season. Due to the separation of the Himalayas, cold waves from the north rarely reach this area.   As for Mengla County (altitude 631.9 *m*),

the core area for the distribution of local tropical forests, the annually accumulated temperature $\geq 10°C$ is 7,639°C, the annual average temperature is 21°C, the average temperature is 24.6°C for the hottest month and 15.2°C for the coldest month; the annual precipitation is 1,532 *mm*, of which 1,250 *mm* (around 82%) occurs in the rainy season and another 282 *mm* (around 18%) in the dry season. Fortunately, the heavy fog makes up for the rainfall shortage in winter (dry season) and leads to the increase of local air humidity.

The field site selected for the study is located at Bubeng, in eastern Mengla County, covered with seasonal rainforest and characterized by *Shorea chinensis, Pometia tomentosa, Terminalia myriocarpa, Machilus tenuigilis, Pterospermum menglunense, Semecarpus reticulata, Garcinia cowa, et cetera. Shorea chinensis* forest has been recognized to be the northward extension of the dipterocarp forests in Southeast Asia (Zhu 1990).

Study methods

In this study the minimum programme proposed by Itow (1984) was employed in the field survey with the purpose of diversity measurement. The scientific names of tree species and DBH (diameter at breast height) of each individual in a random sample of 257 trees (DBH ≥ 10 *cm*) were taken.

Forest species diversity may be described by several indices (Mugurran 1988). The diversity indices applied in this paper were Shannon's H', the complement of Simpson's index, d' (Itow & Miyata 1977), Fisher's alpha (α) (Williams 1947), $S_{(100)}$ and b (Hurlbert 1971, Itow 1984, 1986, 1988):

$$H' = - \Sigma \, pi \log 2 \, pi$$
$$d' = 1 - \Sigma \, pi^2$$
$$S = \alpha \ln (1 + N/\alpha)$$
$$S_{(n)} = \Sigma \, [1 - \frac{(N - N_i)}{n} / \frac{(N)}{n}]$$
$$b = [S_{(100)} - S_{(50)}] / [\log 100 - \log 50]$$

where N is the number of individuals; and S is the number of species recorded in the sample; pi is the proportional abundance of i-th species of N individuals (N_i/N). $S_{(50)}$ and $S_{(100)}$ are the numbers of species at 50 and 100 individuals respectively.

On the basis of the number of species for an individual estimated by Hurlbert's equation (1971), a species - individual (S-N) curve of *Shorea chinensis* forest was also drawn.

The field survey was conducted in November 1990.

Results and discussions

Table 1 shows the diversity values of *Shorea chinensis* forest in Xishuangbanna as well as those of other tropical forests in the world with the objective of

comparison. Through the table, we may make out that the species diversity of *Shorea chinensis* forest is notably more diverse than that of Micronesia (insular community), although the latter is at a lower latitude than the former. This insular community is geographically isolated by the Pacific Ocean from the continent, which prevents the insular forest flora from intermixing and blending with the continental forest flora. Xishuangbanna, on the other hand, intermediate between tropical and subtropical areas, serves as a unique ecotone where the subtropical vegetation and tropical vegetation merge and east Asian flora and Himalayan flora mingle in some degree so as to constitute such a complex forest ecosystem with great richness in species composition. Moreover, the values of the species diversity indices of this forest in Xishuangbanna are even higher than those of some continental tropical rainforests in Thailand and equatorial South America (Figure 2).

Table 1. The species diversity values of *Shorea chinensis* forest in Xishuangbanna in comparison with those of other tropical forests (both insular and continental communities) in the world (quoted from Itow 1986, 1988)

Locality	Xishuangbanna China	Ponape & Kosrea Micronesia	Chao Chong Thailand	Armenia Vieja, Araki & Borja Equador
S	77	6 - 15		27 - 42
N	257	50 - 114		52 - 101
H'	5.61	2.46 (0.95 - 3.30)	5.26 (5.20 - 5.31)	4.65 (4.41 - 4.96)
d'	0.97	0.72 (0.29 - 0.87)	0.96 (0.96 - 0.96)	0.95 (0.94 - 0.96)
α	37.3	3.4 (1.8 - 4.9)	28.0 (26.2 - 30.0)	26.5 (22.6 - 29.6)
$S_{(100)}$	49.8	11.7 (8.5 - 15.0)	43.0 (41.5 - 44.4)	40.5 (37.2 - 42.6)
b	60.2	7.4 (2.9 - 10.5)	46.5 (44.4 - 48.6)	41.8 (36.1 - 45.0)

However, if only the Shannon's H' is concerned, a further discussion may be made. Table 2 demonstrates the difference between the value of species diversity of *Shorea chinensis* in southwestern China and those of evergreen broad-leaved forest and montane rainforest in southern China. As the latitude goes higher, the value becomes smaller. On the other hand, this table also shows a similarity in Shannon's H' between the values of *Shorea chinensis* forest in Yunnan and those of the montane rainforest in Hainan, which indicates once again the interim feature in species composition of the tropical rainforest in Xishuangbanna. Of course, to reveal its relations to the species compositions of Southeast Asia, much more ecological and floristic studies are needed.
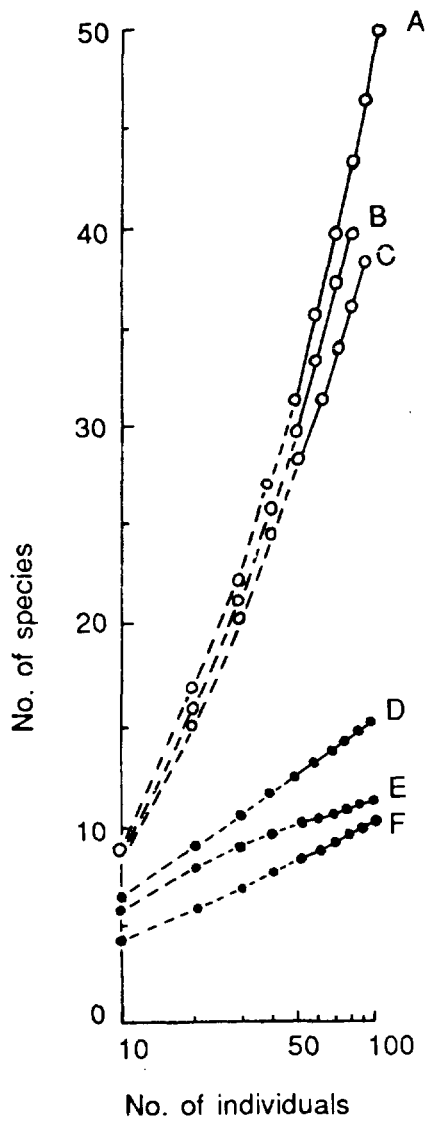
Figure 2. S-N curve showing the species diversity of *Shorea chinensis* forest
in Xishuangbanna (curve A) and those of the forests in Micronesia
(curves D-F), Thailand (curve B) and equatorial Amazon (curve C).
The curves B-F are quoted from Itow (1988)

Table 2. The values of Shannon's H' of the forests in Xishuangbanna of Yunnan, Dinghushang Reserve of Guangdong and Jianfengling Reserve of Hainan

Forest community	Locality	Altitude (*m*)	Annual average temperature (°C)	Annual rainfall (*mm*)	Shannon's H'
Shorea chinensis forest	Xishuangbanna, Yunan 101°35' E 21°37' N	700	21.0	1,532	5.61
Evergreen broad-leaved forest	Dinghushang Reserve, Guangdong 112°34' E 23°10' N	100-450	20.0	1600-2200	4.35
Montane rain-forest	Jianfengling Reserve, Hainan 108°50' E 18°42' N	700-950	24.5	1649.9	5.66

Conclusions

From the comparisons observed the following conclusions were reached:

1. *Shorea chinensis* forest in Xishuangbanna is more diversified in tree species composition than the insular forests in Micronesia and some continental rainforests in Thailand and equatorial Amazon.

2. As compared with the forest communities in southern China in Shannon's H', the *Shorea chinensis* forest in Xishuangbanna reflects a great difference from the evergreen broad-leaved forest at higher latitude and great similarity to the montane rainforest at lower latitudes.

Acknowledgements

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