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SPECIES DISPERSIONS ALONG SOIL GRADIENTS IN A *CRYPTOCARYA* COMMUNITY, DINGHUSHAN, SOUTH CHINA

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Abstract. Tree and shrub dispersions are examined in relation to 10 soil variables. Individualistic species adaptations to prevailing environmental regimes are revealed. This suggests niche differentiation among populations.

Introduction

If R.H. Whittaker's contention that "The community is an assemblage of niche-differentiated species..." (Whittaker 1967, p. 228) is true, it should be possible to demonstrate differences in species distributions in relation to key environmental variables. But this is not a simple matter, considering that species distributions are affected by a complex of interacting physical and biotic factors. For this reason, a claim that the distribution of species with respect to, for instance, soil moisture is revealed in simple plots of population performance and moisture regime levels would be frivolous. In fact, the form of the graph would not be unique to soil moisture, but most likely to a complex of factors:

(a) soil moisture,
(b) environmental variables which change with soil moisture in an orderly way,
(c) environmental variables which vary independently from soil moisture,
(d) environmental variables having higher order interactions with soil moisture, and
(e) competition with other organisms.

What may render the task even more difficult is the expected nonlinear form of effect and response relations (Groenewoud 1965), such as the Gaussian (Beals 1969, Swann 1970, Noy-Meir and Austin 1970, Jeglum *et al.* 1971, Austin and Noy-Meir 1971, Austin 1972, Gauch and Whittaker 1972, Gauch 1973a, b, Bachacou 1974, Ihm and Groenewoud 1975, Phillips 1978), and its consequences. Adding further to the complexities, the responses could be multimodal. Whittaker's (1967, pp. 218-229) graphs are examples.

Survey and experimental studies when combined may unfold some of the complexities. Surveys give the initial clues and generate hypotheses; the experiments test these under controlled conditions. Experiments are, however, expensive to set up and to run, and have weak points in handling interactions, and especially, competition. Furthermore, experimentation is a difficult task with plants, particularly with trees and shrubs, owing to size and longevity. The obvious alternative is to examine species response within the community, such as in the approach followed by Feoli and Orlóci (1985), with focus upon behaviour and contributions to community patterns.

Putting the species into focus, a typical Gleasonian proposition (Gleason 1926), when strong experimental controls do not exist, is not without pitfalls. For one thing, the analytical partition of species response into meaningful components with respect to the factor variables, their interactions, and competition with other species, is virtually impossible. The best that can be hoped for is to isolate the trended and trendless components of response and to subject the trended component to scrutiny based on specific methods in order to reveal unexpected characteristics, revealing of the species niche.

Survey data abound, stored in data banks. Recognizing that such data may not have been collected with rigorous population studies in mind, there is information in such data about the niche differentiation of species in the communities. With the data in hands, the main problem is to find effective ways to extract the niche information. Our objectives are along these lines as we describe a case study from a phytosociological survey conducted in subtropical south China.

The study site

The study site is located within the Dinghushan Nature Reserve which lies just south of the Tropic of Cancer (23°08' N, 112°35' E) in Guangdong Province, 86 kilometers west from Guangzhou (Canton). Dinghushan was designated as a conservation area in the early 1950s, and in 1978 it became part of the World Biosphere Reserves Network. The reserve's total area is about 1200 ha, encompassing a landscape of rolling hills and a low mountain chain from north east to south west. The elevation above sea level varies from 50 m to 1000 m. The landscape ascends from south east to the north

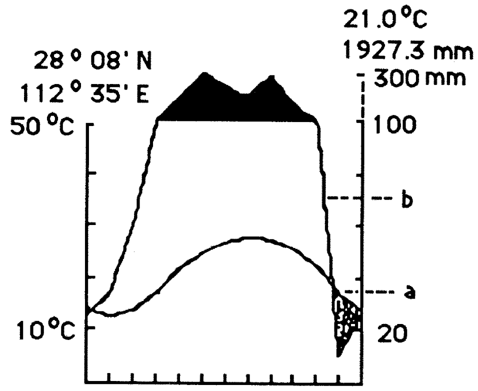

Fig. 1. Climate diagram based on long-term averages for Dinghushan. Legend: a - temperature, b - precipitation.

west. The bedrock is mainly sandstone and sand-shales of different types, dated from the Devonian Period. The valleys tend to be deep, 100 to 300 m, and narrow with small streams.

The climate is subtropical, monsoon. The sunshine duration is long (average 1811.6 hours per year) and the total solar radiation averages 11.6 k cal./cm ^{2}/year. The mean annual temperature is 21.0° C, warmest in July (28.0° C) and coldest in January (12.6° C). The mean annual precipitation is 1927.3 mm. Figure 1 displays the annual distribution of monthly temperatures and precipitation. The mean annual relative humidity is 80%. The soils are red and yellow, lateritic. The forest soils are rich in humus, and the pH is mostly in the range 4.5 to 5. Soil texture is mainly loam. Occasional outcropping of the bedrock occurs.

Studies of the local vegetation began in the early 1950s (Chang 1955). Since then, a series of publications described the forest ecosystem (*e.g.*, Wang 1982, Wang and Ma 1982, Yu 1985). Three main forest community types are recognized:

Type a. Lower subtropical evergreen broad-leaf forest. This is the climax community of the region. It covers about 23% of the total area within Dinghushan. The characteristic species include *Cryptocarya chinensis, C. concinna, Castanopsis chinensis, Schima superba*. It is believed that this community existed in its present composition for over 400 years.

Type b. Pine-broad-leaf mixed forest. This type covers about 33% of the total area in the reserve. Its characteristic species include *Pinus massiniana* and

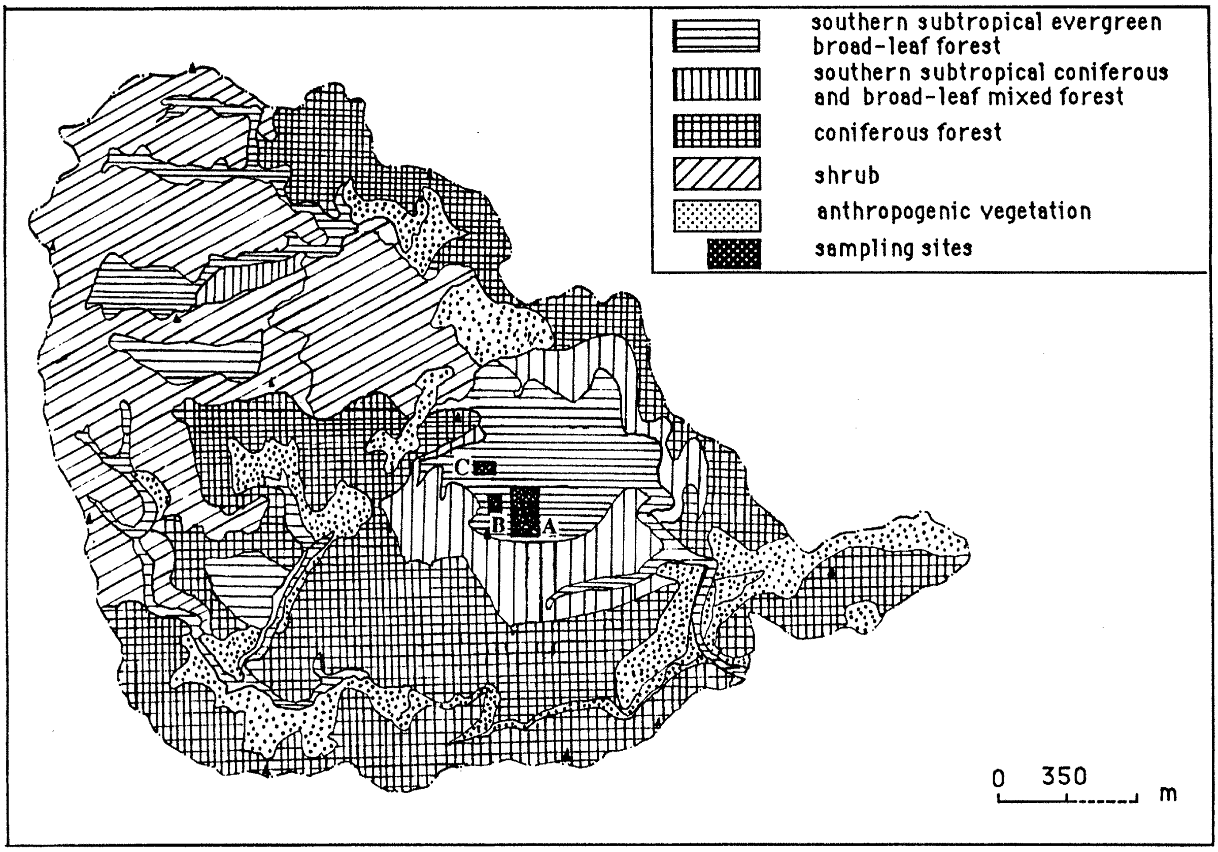

Fig. 2. Vegetation types of Dinghushan, Kwangdong province (map after Wang et al. 1982, modified). Sampling sites are indicated. See explanation of A, B, C in the text.

Schima superba.

Type c. Pine forest. This type is anthropogenic. Its characteristic species include *Pinus massiniana.*

Type a is considered further in this paper. A total of 3610 m sq quadrats were surveyed. The sampling locations are shown in Fig. 2 (points A, B, C). Leading dominant trees, other common tree species, and shrubs are considered (see list in Table 1). The importance values in Table 1 follow Curtis (1947).

Table 1. Tree and shrub performance in the Cryptocarya community of Dinghushan. Legend to symbols: RA - Relative abundance, RF - Relative frequency, RD - Relative dominance, IV - Importance value. Taxonomic names follow "Handbook of Plants of Ding-Hu-Shan" by the Ding-Hu-Shan Arboretum, South China Institute of Botany, Academia Sinica, Guangdong (1978).

Species no.	Name	RA	RF	RD	IV
Dominant trees:					
1	*Cryptocarya chinensis*	9.50	5.86	8.81	24.17
2	*Cryptocarya concinna*	16.22	6.62	19.21	42.05
3	*Castanopsis chinensis*	1.93	4.35	55.45	61.73
4	*Schima superba*	1.32	3.03	3.95	8.29
Codominant and suppressed trees:					
5	*Aporosa yunnanensis*	13.16	6.43	3.12	22.71
6	*Syzygium rehderianum*	4.94	5.67	1.00	11.60
7	*Acmena accuminatissima*	1.32	2.08	1.52	4.92
8	*Lindera chunii*	5.78	4.73	1.69	12.20
9	*Sarcosperma laurinum*	1.65	3.59	0.21	5.45
10	*Craibiodendron kwangtungense*	2.12	3.78	0.62	6.52
11	*Ormosia glaberrima*	3.24	4.35	0.43	8.02
12	*Acronychia pedunculata*	0.71	1.70	0.42	2.82
13	*Gironniera subaequalis*	0.75	1.51	0.30	2.57
14	*Xanthophyllum hainanense*	0.28	1.13	0.01	1.43
15	*Canarium album*	0.19	0.76	0.16	1.10
16	*Schefflera octophylla*	0.19	0.76	0.08	1.02
17	*Helicia reticulata*	0.33	0.76	0.26	1.35
18	*Diospyros morrisiana*	0.19	0.76	0.10	1.04
19	*Aquilaria sinensis*	0.47	0.57	0.15	1.19
Shrubs:					
20	*Blastus cochinchinensis*	10.39	5.86	0.20	16.45
21	*Ardisia quinquegona*	6.91	5.48	0.34	12.73
22	*Psychotria rubra*	8.32	6.81	0.36	15.50
23	*Randia canthioides*	1.04	2.45	0.19	3.68
24	*Calophyllum membranaceum*	1.60	3.21	0.02	4.83

Although species density and species frequency are often used in vegetation surveys, they are not reliable to measure species performance within forest communities. Their weakness is owing to the drastic differences in plant size. From this point of view basal area, which we use, is much better. We use soil data from chemical analysis of soil samples taken from 2 to 15 cm depths along the quadrats' main diagonal. 10 soil variables were measured: pH, Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Sodium (Na), Magnesium (Mg), Manganese (Mn), Iron (Fe), and Organic matter content (Org). Each soil variable is divided into 6 classes. The class intervals and the number of sampling units within the classes are defined in Tables 2, 3.

Table 2. Class intervals for soil variables. N, P, K, Ca, Na, Mg, Mn, Fe refer to available totals. pH determination is electrometric in water solution, and organic matter (Org) by carbon content.

	Class interval					
Variable	1	2	3	4	5	6
1. pH	<4.48	4.48-4.56	4.56-4.64	4.64-4.72	4.72-4.80	>4.80
2. N %	<0.225	.225-.262	.262-.298	.298-.334	.334-.371	>0.371
3. P %	<0.077	.077-.084	.084-.091	.091-.098	.098-.105	>0.105
4. K %	<0.811	.811-1.085	1.085-1.359	1.359-1.632	1.632-1.906	>1.906
5. Ca ppm	<71	71-95	95-120	120-145	145-170	>170
6. Na %	<0.022	.022-.031	.031-.039	.039-.048	.048-.057	>0.057
7. Mg %	<0.168	.168-.193	.193-.219	.219-.245	.245-.271	>0.271
8. Mn ppm	<30	30-35	35-39	39-44	44-49	>49
9. Fe %	<2.845	2.845-3.095	3.095-3.345	3.345-3.595	3.595-3.845	>3.845
10. Org %	<4.234	4.234-5.380	5.380-6.525	6.525-7.671	7.671-8.816	>8.816

Table. 3. Sample size within environmental classes (variable intervals). See the class descriptions in Table 2.

	Class					
Variable	1	2	3	4	5	6
1. pH	2	8	13	5	6	2
2. N %	3	5	4	8	7	9
3. P %	8	6	8	6	6	2
4. K %	14	8	1	6	3	4
5. Ca ppm	3	14	13	4	1	1
6. Na %	14	12	2	4	3	1
7. Mg %	5	11	3	5	8	4
8. Mn ppm	2	4	14	5	8	3
9. Fe %	3	7	12	6	4	4
10. Org %	5	6	8	4	10	3

Methods

The data for each soil variable and the selected species are arranged in separate contingency tables. The species represent the row categories, the soil variable classes the column categories, and the cell entries the total basal area, expressed in terms of equal sampling intensity within the class intervals. Canonical analysis (Williams 1952, Feoli and Orlóci 1979, Orlóci 1981, Feoli and Orlóci 1985, Orlóci and Orlóci 1988), performed on the tables, supplies the output for the construction of scatter diagrams and dispersion profiles. Species vs. soil class affinities are measured locally according to

$$F_{ik} = \frac{\delta_{i\,(INF)}}{\delta_{ik}}$$

where $\delta_{i\,(INF)}$ is the minimum observed distance of species i from any soil class and

$$\delta_{ik} = \sqrt{\sum_{j=1}^{r} (S_{ij} - C_{kj})^2}$$

is the actual distance of species i and soil class k. S_{ij} is the score of species i on the jth canonical variate, C_{kj} is the score of soil class k on the jth canonical variate, and r índicates the rank of the product matrix, *i.e.*, the number of non-zero canonical correlations. We note for clarity that δ_{ik} is the distance of two points (species i and environmental class k) in r-dimensional space, assuming a perfect correlation of the ith row and column canonical variates. Deviations from this assumptions introduce scrambling in the distances which may be negligible. Further, the global affinity of species i and a soil variable is defined by

$$F_i = \frac{1}{L} \sum_{k=1}^{n} L_k F_{ik}$$

where L_k is the number of quadrats (sampling units) within soil class k, L is the total number of quadrats in

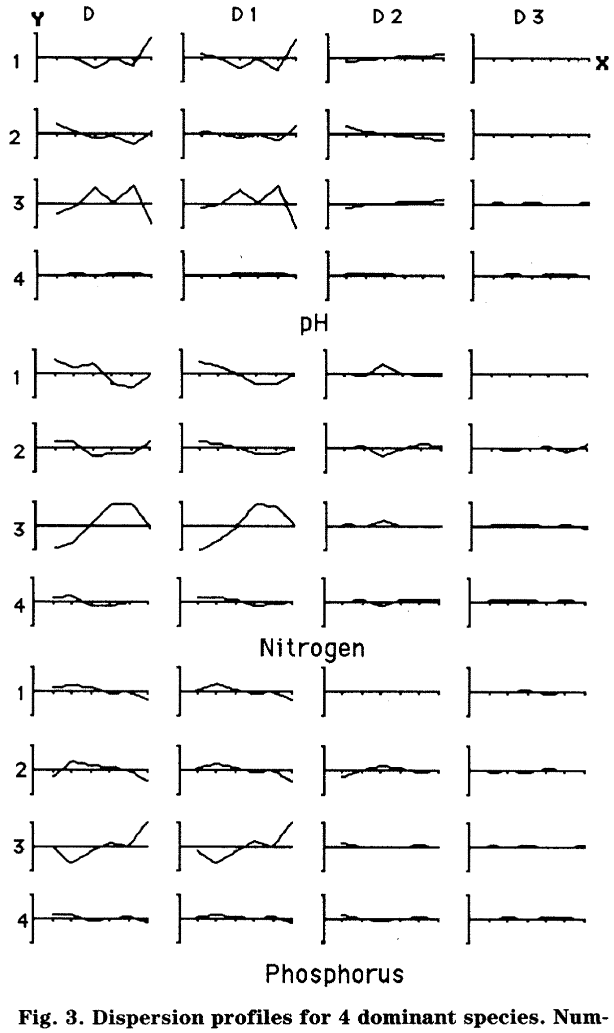

Fig. 3. Dispersion profiles for 4 dominant species. Numbers at margin correspond to species names in Table 1. The vertical scale measures deviations from expectations. The horizontal scale indicates increasing levels of the soil variable. The method of construction is canonical contingency table analysis. The symbols D1, D2 and D3 identify lattices of deviations which partition the total deviations D according to successive canonical variables. 3 soil variables are involved: pH, nitrogen content, phosphorus content.

the sample, and n the number of soil classes. The index

$$O_{hi} = 1 - \frac{d_{hi}}{d_{(SUP)}}$$

where $d_{(SUP)}$ is the highest possible d and

$$d_{hi} = \sum_{j=1}^{n} |S_{hj} - S_{ij}|$$

is a dissimilarity measure through which species h and i are compared. The d_{hi} form is justified since the successive canonical variates are orthogonal. The comparison is conditional upon a soil variable.

Results

The dispersion profiles of the dominant trees (Table 1) for pH, nitrogen, and phosphorus are given in Fig. 3. The X axis in this figure displays 6 class intervals. The Y axis displays deviations from random expectations. D is the total deviation, and D_i is the ith (canonical) component of total deviation. Species profiles for other soil variables and other species groups were constructed, and will be interpreted, but will not be shown. A summary of the D_1 and D_2 profiles is in Table 4.

Point positions on X_1, Y_1 and X_2, Y_2 in Figure 4 are defined by the canonical scores for species (X) and soil classes (Y). The distance δ_{ik} (see definition above) from any species i (point S_i in the scattergram) to a soil class k (point C_k) is a complement to their affinity. From the δ_{ik} a global affinity measure F_i is calculated (see above) which are given in Table 5. The distance d_{hi} from species h (point S_h) to species i (point S_i) indicates dissimilarity in resource utility, *i.e.*, a complement of niche overlap. The O_{hi} values for the dominant trees are listed in Table 6. O_{hi} values for the other species were calculated, but not given.

Discussion

Species response is investigated in relation to gradients of environmental variables, considered as niche dimensions. We think such an investigation is important, since knowing how the responses vary, we can suggest what role the species play in the community, whether dominant or subordinate, generalist or a specialist (Pianka 1981). Generalist species are adapted to having no locally limiting niche dimensions, unlike the specialists which are confined by a single niche dimension.

We divided the species set into three groups (dominant trees, codominant and suppressed trees, shrubs) and analyzed these groups separately. The intention was to avoid difficulties with interpretation owing to drastic performance differences among the different type of species. The information in Tables 4, 5 and Fig. 4

Table 4. Dominant shapes of dispersion profiles for species on soil variables. Legend: A - ascending, D - descending, Ce - concave, Cv - convex, F - flat, O - oscillating. D $_1$ and D $_2$ are symbols for lattices of deviations described in the text.

Species		Soil variable pH	N	P	K	Ca	Na	Mg	Mn	Fe	Or
Dominant trees:											
Cryptocarya chinensis	D1	Ce	D	Cv	F	F	Ce	F	F	A	D
	D2	A	Cv	F	O	O	F	O	F	Ce	D
Cryptocarya concinna	D1	Ce	D	Cv	O	A	F	Cv	Cv	Cv	F
	D2	D	Ce	Cv	O	F	Ce	F	F	O	O
Castanopsis chinensis	D1	Cv	Cv	Ce	O	D	Cv	Ce	Ce	Cv	Cv
	D2	A	Cv	F	F	O	Cv	Cv	Ce	F	O
Schima superba	D1	F	D	F	O	D	F	F	D	F	Ce
	D2	F	F	F	F	F	F	O	D	F	F
Codominant and suppressed trees:											
Aporosa yunnanensis	D1	F	Ce	Ce	O	Ce	O	F	A	Cv	Cv
	D2	F	F	Cv	O	F	O	Cv	Cv	A	F
Syzygium rehderianum	D1	D	Ce	D	O	Ce	O	Ce	D	F	A
	D2	F	D	D	O	F	O	F	F	O	Cv
Acmena accuminatissima	D1	A	Cv	Cv	O	Cv	O	Ce	A	Cv	Ce
	D2	Ce	F	F	O	A	F	D	Ce	O	Ce
Lindera chunii	D1	D	S	S	S	Cv	S	Cv	F	F	F
	D2	F	A	F	O	D	F	D	Cv	O	A
Sarcosperma laurinum	D1	F	F	A	F	F	F	F	F	F	F
	D2	F	F	F	F	D	F	F	F	F	F
Craibiodendron kwangtungense	D1	F	F	D	O	Cv	Cv	F	F	F	F
	D2	F	A	F	O	F	F	F	F	F	F
Ormosia glaberrima	D1	F	D	F	F	F	F	F	D	F	F
	D2	F	F	D	F	D	F	F	F	F	F
Acronychia pedunculata	D1	F	A	A	F	Cv	Cv	F	F	F	A
	D2	F	F	F	F	D	F	F	F	F	A
Gironniera subaequalis	D1	F	Ce	F	F	F	F	F	A	Cv	F
	D2	F	F	F	F	F	F	F	F	A	F
Xanthophyllum hainanense	D1	F	F	F	F	F	F	F	D	F	D
	D2	F	F	D	F	A	F	F	F	D	F
Canarium album	D1	F	F	F	A	Ce	O	F	F	F	Cv
	D2	F	F	F	Cv	A	Cv	F	F	F	F
Schefflera octophylla	D1	F	F	F	F	F	F	F	F	F	F
	D2	F	F	F	F	F	F	F	F	F	F
Helicia reticulata	D1	F	F	D	F	F	F	F	F	F	F
	D2	F	F	F	F	F	F	F	F	F	Cv
Diospyros morrisiana	D1	F	F	F	F	F	F	F	F	F	F
	D2	F	F	F	F	F	F	F	F	F	F
Aquilaria sinensis	D1	F	F	F	F	F	F	F	F	F	F
	D2	F	D	D	F	F	F	F	F	F	F
Shrubs:											
Blastus cochinchinensis	D1	F	F	A	O	Ce	Ce	A	A	F	A
	D2	F	O	Cv	A	O	A	Ce	F	A	A
Ardisia quinquegona	D1	Cv	Cv	D	F	Ce	Ce	D	Ce	Cv	Cv
	D2	F	O	Cv	D	A	D	D	F	O	Cv
Psychotria rubra	D1	Ce	F	A	F	Cv	F	A	Cv	F	F
	D2	D	A	O	F	Cv	F	A	O	O	A
Randia canthioides	D1	Cv	Cv	D	O	A	Cv	F	A	D	Ce
	D2	O	D	F	A	A	F	Cv	O	F	F
Calophyllum membranaceum	D1	F	F	A	F	F	F	F	F	F	F
	D2	F	F	F	F	F	F	F	F	F	F

helps to characterize the species within the different groups in a niche related context. It is quite clear that the species have similarities and also differences in their individualistic performance with respect to the soil variables (Table 4). Generally speaking, *Cryptocarya chinensis* and *C. concinna* have considerable niche overlap, although in some specific niche dimensions the overlap is small. Furthermore, *Cryptocarya chinensis* and *C. concinna* have contrasting profile shapes when compared to *Castanopsis chinensis*. This indicates that, on the one hand, *Cryptocarya chinensis* and *C. concinna*, and on the other, *Castanopsis chinensis* are potentially competing species. The rather flat oscillating profile of *Schima superba* is typical of a pioneer tree with declining dominance as succession progresses. Comparatively, total potassium content (K) seems to have little influence on species dispersion. Most species show a flat or oscillating profile shape with respect to this soil variable.

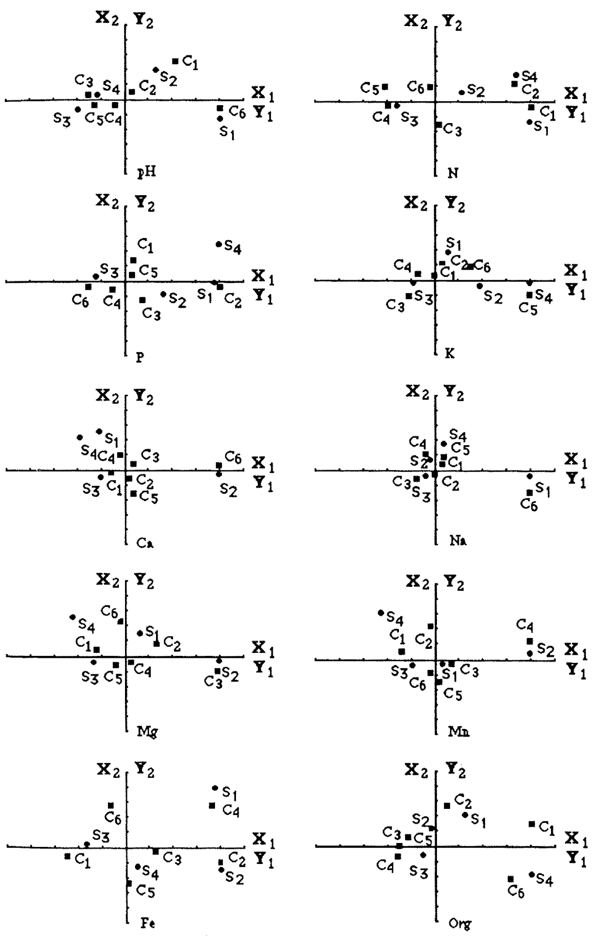

Fig. 4. Joint scatter of canonical variables. Canonical scores for species are shown as axes X_1 and X_2. S_i represents the ith species population. Canonical scores for soil variable classes are shown as axes Y_1 and Y_2. C_k represents the kth soil variable class. The graph distance between any S and C indicates an approximate relationship. The true distance can be larger.

Fig. 4 shows species differences in another way. Generally, each species has a close affinity with one or

Table 5. Species to soil class affinities. The affinity measure is F_i in the text. Soil variable symbols are those given in Table 2.

Species	pH	N	P	K	Ca	Na	Mg	Mn	Fe	Org
	Soil variables									
Dominant trees:										
Cryptocarya chinensis	.19	.31	.54	.66	.40	.29	.57	.48	.38	.58
Cryptocarya concinna	.35	.62	.68	.86	.29	.61	.32	.40	.41	.63
Castanopsis chinensis	.62	.41	.55	.49	.49	.43	.44	.64	.50	.52
Schima superba	.67	.29	.73	.44	.67	.79	.59	.55	.70	.38
Codominant trees:										
Aporosa yunnanensis	.82	.86	.73	.86	.50	.66	.83	.76	.79	.71
Syzygium rehderianum	.68	.74	.77	.85	.50	.87	.61	.70	.73	.84
Acmena accuminatissima	.38	.46	.61	.62	.38	.71	.56	.57	.46	.61
Lindera chunii	.74	.70	.79	.60	.61	.76	.41	.52	.63	.68
Sarcosperma laurinum	.78	.62	.61	.69	.83	.48	.52	.84	.78	.72
Craibiodendron kwangtungense	.72	.71	.61	.54	.48	.55	.81	.48	.65	.81
Ormosia glaberrima	.78	.53	.72	.83	.63	.80	.38	.52	.66	.80
Acronychia pedunculata	.82	.78	.44	.56	.63	.76	.80	.73	.63	.69
Gironniera subaequalis	.56	.67	.57	.77	.53	.69	.51	.37	.34	.49
Xanthophyllum hainanense	.50	.41	.73	.54	.78	.85	.48	.52	.59	.37
Canarium album	.32	.21	.27	.23	.10	.18	.28	.20	.36	.40
Schefflera octophylla	.30	.38	.32	.70	.51	.31	.65	.51	.52	.35
Helicia reticulata	.47	.40	.45	.30	.75	.28	.63	.58	.63	.36
Diospyros morrisiana	.34	.72	.57	.48	.24	.52	.72	.76	.34	.36
Aquilaria sinensis	.49	.36	.36	.29	.68	.47	.56	.66	.69	.35
Shrubs:										
Blastus cochinchinensis	.29	.38	.43	.21	.34	.24	.26	.60	.42	.23
Ardisia quinquegona	.20	.25	.68	.51	.29	.56	.33	.19	.46	.30
Psychotria rubra	.46	.39	.41	.58	.74	.67	.41	.67	.70	.42
Randia canthioides	.44	.15	.52	.62	.69	.27	.43	.51	.31	.24
Calophyllum membranaceum	.68	.53	.27	.35	.38	.56	.74	.84	.48	.55

Table 6. Species similarities. The measure O_{hi} is described in the text. Conditionality upon soil variables is noted.

Species	S2	S3	S4	S2	S3	S4
		pH			N	
Cryptocarya chinensis (S1)	.69	.57	.61	.75	.59	.74
Cryptocarya concinna (S2)		.71	.78		.78	.78
Castanopsis chinensis (S3)			.91			.59
Schima superba (S4)						
		P			K	
Cryptocarya chinensis (S1)	.81	.62	.81	.81	.81	.69
Cryptocarya concinna (S2)		.78	.73		.80	.78
Castanopsis chinensis (S3)			.60			.62
Schima superba (S4)						
		Ca			Na	
Cryptocarya chinensis (S1)	.60	.78	.88	.69	.68	.68
Cryptocarya concinna (S2)		.64	.54		.92	.84
Castanopsis chinensis (S3)			.79			.82
Schima superba (S4)						
		Mg			Mn	
Cryptocarya chinensis (S1)	.72	.80	.73	.69	.82	.67
Cryptocarya concinna (S2)		.62	.52		.63	.50
Castanopsis chinensis (S3)			.78			.74
Schima superba (S4)						
		Fe			Org	
Cryptocarya chinensis (S1)	.61	.52	.53	.77	.75	.64
Cryptocarya concinna (S2)		.57	.66		.83	.63
Castanopsis chinensis (S3)			.74			.65
Schima superba (S4)						

two environmental classes. Taking into account unequal sample sizes within the classes of a specific environmental variable, values of index F_i incorporates resource availability indirectly and can serve as an index of niche breadth. In the group of dominant trees and in comparison with other species, *Schima superba* has a high F_i value on most soil variables, except soil nitrogen (N), potassium (K), and soil organic matters. This indicates that *Schima superba* has wider adaptability to soil variables than the other species. It has the highest F_i value on pH, which may be the reason for being a successful pioneer broad-leaf tree, invading the Pine forest habitat, and a leading dominant in the mixed forest. Also, in the same group, *Cryptocarya concinna* has comparatively high F_i values on soil nitrogen (N), potassium (K), and organic matter (Org), on which *Schima superba* scored lowest. As could be expected, soil organic matter content is positively correlated with soil nitrogen content. It therefore follows that soil nitrogen content may be the limiting resource, accounting for the high relative abundance and relative frequency of *Cryptocarya concinna* within community Type a. The F_i value on soil nitrogen (N) roughly coincides not only with the dominance of *Cryptocarya chinensis, Castanopsis chinensis, Schima superba*, but also with the dominance of almost all species in the codominant and suppressed tree and shrub groups. The three dominant trees *(Aporosa yunnanensis, Syzygium rehderianum, Lindera chunii)* in the second layer of the forest, have high F_i values on almost all soil variables.

Different formulae are offered in the literature to measure niche overlap (*e.g.*, Levins 1968, Horn 1966, Colwell and Futuyma 1972, Pielou 1972, Hurlbert 1978, Petraitis 1979). The measure O_{hi} can be regarded as an index of niche overlap in one dimension in the sense of a similarity measure, relating species distributions, conditional on a particular environmental variable. It is interesting that *Cryptocarya chinensis* has a high O_{hi} value with only *Cryptocarya concinna* on all soil variables except calcium content (Ca column in Table 6) and soil manganese content (Mn column in Table 6).

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The Awards Committee solicists nominations for the Distinguished Statistical Ecologist Award of the International Association for Ecology/Statistical Ecology Section. Anyone is encouraged to submit nominations. Letters of nomination should indicate why the nominee is especially deserving; additional documentation (e.g. curriculum vitae) may be included when appropriate. The nominee may be from any country and need not be a member of INTECOL.

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