VEGETATION PATTERNS AND STRUCTURE OF A SECONDARY FOREST ON MT. LONLON, NORTHEASTERN TAIWAN

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Abstract: Floristic composition and structure of a lowland secondary forest was studied in detail on Mt. Lonlon of northeastern Taiwan. The study plot contained 241 species, of which 70 were trees, 39 shrubs, 48 climbers, 45 herbs, and 39 pteridophytes. Diversity of the trees with dbh $\geq$1.0 cm was calculated as Shannon-Wiener index (3.09), Simpson index (0.08), and Equitability index (0.79). The dominance-diversity curve seemed to conform to a lognormal species distribution. The community structure was characterized by a relative dominance of *Myrsine sequinii*, *Ardisia sieboldii*, *Persea thunbergii*, *Wendlandia formosana*, *Gardenia jasminoides*, and *Schefflera octophylla* in the canopy, and *Psychotria rubra* and *Lasianthus plagiophyllus* in the understory. Detrended correspondence analysis and cluster analysis led to the recognition of three ecologically meaningful groupings. Diameter distribution curves for vegetation types were observed to fit the negative exponential function. However, slight under-representation in the smallest size-class of the upper slope vegetation might be indicative of some minor anthropogenic disturbances. Compared to the mature lowland rain forests of other areas the Lonlon forest showed a lower basal area, and seemed to be indicative of structural immaturity.

INTRODUCTION

The forest of northeastern Taiwan lies within the lowland subtropical rain forest formation (Liu 1968). By 1970, most of the arable land along the coastal region was under cultivation. The remainder was exploited for plantation and wood over the subsequent 20 years. Recently poor farming practices resulted in sporadic land abandonment. Thus, much of the area is today a mosaic of field and forests in different stages of secondary succession.

The study focused on secondary stand. The objectives are (1) to provide a detailed analysis of the composition, structure, and forest types, and (2) to compare and contrast the compositional and structural attributes of the secondary forest and the mature forest of the same formation.

STUDY AREA

The study area (Fig. 1) is located at the northern side of Mt. Lonlon (121°57′30″ east longitude and 25°1′0″ north latitude). Its elevation varies from 75 to 200 m and slopes average >80%.

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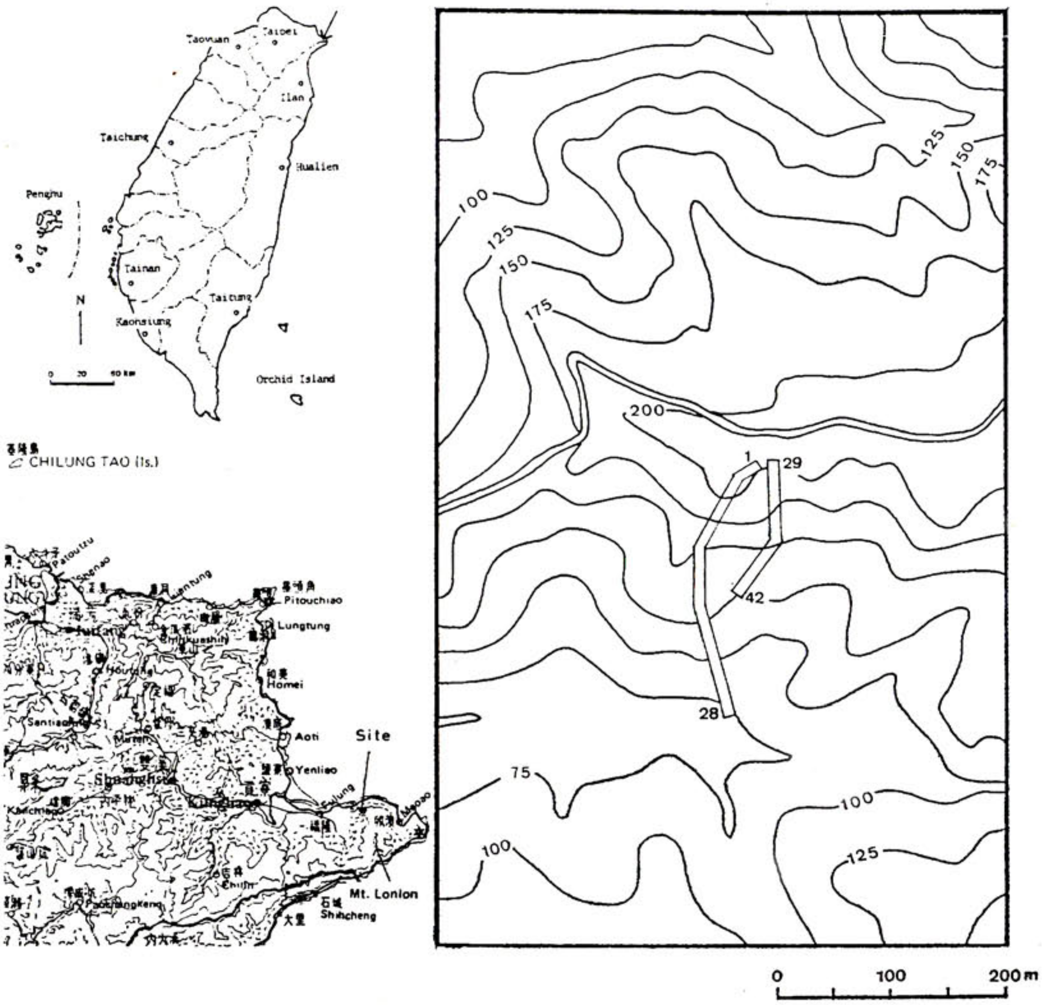

Fig. 1. Location of the study area in northeastern Taiwan.

The bedrock forms part of the Mushan Formation of the Lower Miocene Hsichih Group. Lithologically, the Mushan Formation consists of the thick, coarse- to medium-grained, white sandstone with intercalations of shale and thin coal seams (Tang and Yang 1976). Soils of the area are classified as Ultisol or Alfisol in gentle slopes, and Inceptisol or Entisol in steep slopes with serious erosion (Huang *et al.* 1986).

The mean annual temperature was 21.9°C. The hottest month is July with a mean maximum temperature of 32.4°C, and the coldest is January with a mean minimum temperature of 12.6°C. The mean annual precipitation is 2,778.7 mm. The distribution of the rainfall over the year is unequal. A relatively dry season occurs from July to November. The area is affected by strong north wind from December to April.

METHODS

Field sampling

During 1989, canopy and subcanopy trees were sampled in two transects (Fig. 1) running in a north-south direction (parallel to the slope). Transect distances were 280 m and 180 m. Each transect was further divided into contiguous 5×10 m plots. This resulted in a total of 42 plots being placed. Within each plot we recorded the species and diameter at breast height (dbh) of every woody individual ≥1 cm. Also tree height (H1), lower crown limit (H2), largest crown diameter (D1) and the diameter perpendicular to D1 (D2) were measured.

Data analysis

Vegetation data were divided by structural layers based on dbh measurements: trees (stems >6 cm), saplings (stems ≥3 and <6 cm), and seedling (stems ≥1 cm and <3 cm). A relative important value (IV200) for each species in each plot was calculated as the sum of the relative density and relative basal area. Crown volume was calculated according to the formula of an ellipsoid,

$$V = 0.167 \cdot \mathrm{D1} \cdot \mathrm{D2} \cdot (\mathrm{H1} - \mathrm{H2})$$

Species richness and three indices of diversity were calculated, the Shannon-Wiener index H, the Simpson index C, and the Equitability index E (Peet 1974):

$$H = -\sum pi^2 \, \mathrm{LOG}\, pi$$

where $pi = ni/N$; ni = number of individuals of species i, and N = total number of individuals.

$$C = \sum pi^2$$

$$E = H/Hm$$

where $Hm = {}^2\mathrm{LOG}\, S$; S = number of species.

Dominance-diversity structure was analyzed by plotting the logarithm of IV200 of the species on the ordinate against their sequence from most to least important on the abscissa (Whittaker 1972).

Community gradients were analyzed by detrended correspondence analysis (DCA, Hill 1979, Hill and Gauch 1980), derived from a species × crown volume matrix. Cluster analysis was utilized in the classification of the plots. Sum of squares agglomerative clustering (Ward 1963, Orloci 1967) was performed on the same matrix.

Size-class analysis of each vegetation type was conducted using successive 2 cm increments. Size-class distributions of species with at least 20 individuals were also analyzed. However size-class limits and number of classes were different per species. The number of classes was determined as:

$$CL = 1 + 3.3 \log N$$

Size-class curves were fitted to the negative exponential function ($y = ae^{bx}$) and negative power function ($y = ax^b$).

The data were analyzed with a computer software PRIS (Hsieh and Tang 1989). Species nomenclature follows Li *et al.* (1976–1979).

RESULTS

Vegetation characteristics

The vascular flora of the forest stand was composed of 241 species in 81 families. In terms of major growth forms, there were 70 trees, 39 shrubs, 48 climbers, 45 herbs, and 39 pteridophytes.

Composition of the secondary forest is shown in Table 1. Total density of stems ≥ 1 cm was 10,538 stems/ha. The basal area was 28.85 m^2/ha. The most important species in the tree stratum, based on IV 200, were *Myrsine sequinii, Ardisia sieboldii, Persea thunbergii, Wendlandia formosana, Gardenia jasminoides,* and *Schefflera octophylla.*

Based on species cover data, *Psychotria rubra, Lasianthus plagiophyllus, Eurya chinensis, Daemonorops margaritae,* and *Arenga engleri* dominated the shrub stratum, and *Carex baccans* and *Oplismenus undulatifolius* dominated the lowest stratum.

Ordination and classification

The results of the DCA ordination of the tree volume data is shown in Fig. 2. When the plot groups produced by cluster analysis (Fig. 3) are overlaid on the plot ordination, each of the three groups is clearly separated along axis 1 from left to right. From left to right the plots tend away from windexposed upper ridge into a small depression, then return to midslope site. An examination of the second axis revealed an less interpretable pattern. The three groups, thus identified, represent an obvious topographic segregation. Vegetation characteristics varied among the three groups (Table 2). Total density was greatest in the upper slope plots. There seemed to be no consistent differences in basal area among three groups.

Upper slope plots were dominated by *Myrsine sequinii, Ardisia sieboldii, Gardenia jasminoides,* and *Persea thunbergii.* Dominance of the depression was shared by *Ardisia sieboldii, Wendlandia formosana, Persea thunbergii,* and *Schefflera octophylla.* And the three dominant species of the midslope were *Mallotus paniculatus, Wendlandia formosana,* and *Ficus ampelas.*

Diversity

Dominance-diversity curves and their associated indices for the three vegetation types reflect changing structural conditions along the first DCA gradient is shown in Fig. 4. Species richness per plot is slightly higher in the upper slope (18 tree species per plot) than in the depression or midslope. Shannon-Wiener indices ranged from 2.99 to 3.16 (average = 3.09), Simpson indices from 0.07 to 0.09 (average = 0.08), and Equitability indices from 0.74 to 0.83 (average = 0.79). Diversity is lowest in the upper slope. E shows a highest value in the midslope suggesting the most equal distribution of individuals over species.

The dominance-diversity curve (Fig. 4A) for the 68 tree species in the secondary forest as a whole seems to conform to a lognormal species distribution with relatively few species with a high or a low importance, and many with intermediate ones. In spite of lower number of dominants, the curve of each vegetation type shows a parallel pattern (Fig. 4B–D).

Table 1. Composition and structure of the Lonlon secondary forest.

Species	Density (stems/ha)				Basal area (m/ha)	IV
	Seedling	Sapling	Tree	All		200
Myrsine sequinii	614.29	819.05	200.00	1633.33	2.26	23.33
Ardisia sieboldii	342.86	466.67	400.00	1209.52	3.09	22.20
Persea thunbergii	85.71	180.95	447.62	714.29	4.30	21.68
Wendlandia formosana	114.29	276.19	357.14	747.62	2.88	17.07
Gardenia jasminoides	266.67	366.67	157.14	790.48	1.39	12.32
Schefflera octophylla	176.19	200.00	180.95	557.14	1.57	10.74
Mallotus paniculatus	4.76	0.00	128.57	133.33	1.61	6.86
Cyclobalanopsis glauca	9.52	47.62	109.52	166.67	1.00	5.05
Itea oldhamii	147.62	133.33	47.62	328.57	0.51	4.87
Ficus ampelas	123.81	104.76	52.38	280.95	0.58	4.68
Adinandra formosana	57.14	195.24	57.14	309.52	0.49	4.63
Syzygium buxifolium	90.48	133.33	61.90	285.71	0.50	4.44
Ficus virgata	47.62	90.48	76.19	214.29	0.68	4.38
Castanopsis carlesii sessilis	38.10	66.67	95.24	200.00	0.61	4.02
Cleyera japonica	4.76	71.43	95.24	171.43	0.68	3.98
Glochidion rubrum	14.29	80.95	90.48	185.71	0.64	3.97
Styrax suberifolia	28.57	38.10	61.90	128.57	0.66	3.49
Michelia compressa	14.29	42.86	57.14	114.29	0.56	3.04
Diospyros eriantha	90.48	57.14	33.33	180.95	0.36	2.95
Decaspermum gracilentum	19.05	52.38	61.90	133.33	0.48	2.93
Elaeocarpus sylvestris	19.05	42.86	47.62	109.52	0.35	2.25
Bridelia balansae	52.38	57.14	28.57	138.10	0.25	2.17
Turpinia formosana	100.00	38.10	14.29	152.38	0.15	1.95
Ficus fistulosa	23.81	42.86	38.10	104.76	0.25	1.86
Viburnum luzonicum	152.38	14.29	0.001	66.67	0.07	1.81
Scolopia oldhamii	33.33	61.90	19.05	114.29	0.19	1.74
Sphaeropteris lepifera	0.00	0.00	19.05	19.05	0.40	1.57
Meliosma rigida	23.81	71.43	9.52	104.76	0.14	1.47
Glochidion zeylanicum	33.33	28.57	23.81	85.71	0.15	1.35
Litsea krukovii	52.38	33.33	14.29	100.00	0.11	1.34
Evodia merrillii	76.19	28.57	4.76	109.52	0.08	1.33
Glochidion lanceolatum	4.76	14.29	23.81	42.86	0.16	0.97
Symplocos cochinchinensis laurina	19.05	9.52	14.29	42.86	0.15	0.92
Randia cochinchinensis	61.90	19.05	0.00	80.95	0.04	0.89
Acacia confusa	0.00	0.00	9.52	9.52	0.23	0.89
Diospyros morrisiana	0.00	23.81	14.29	38.10	0.11	0.74
Acronychia pedunculata	4.76	14.29	9.52	28.57	0.13	0.71
Cryptocarya chinensis	14.29	0.00	14.29	28.57	0.12	0.69
Antidesma japonicum densiflorum	52.38	9.52	0.00	61.90	0.02	0.66
Ilex ficoidea	23.81	23.81	0.00	47.62	0.05	0.62
Ficus erecta beecheyana	42.86	9.52	0.00	52.38	0.02	0.58
Ilex rotunda	9.52	33.33	0.00	42.86	0.05	0.57
Ficus nervosa	4.76	4.76	19.05	28.57	0.08	0.54
Ardisia quinquegona	42.86	4.76	0.00	47.62	0.01	0.50
Styrax formosana	9.52	4.76	9.52	23.81	0.06	0.42
Ficus wightiana	0.00	0.00	4.76	4.76	0.11	0.41
Murraya paniculata	9.52	9.52	4.76	23.81	0.04	0.37
Ilex formosana	4.76	14.29	4.76	23.81	0.03	0.32
Sum	3161.90	4038.10	3119.05	10319.05	28.37	196.27

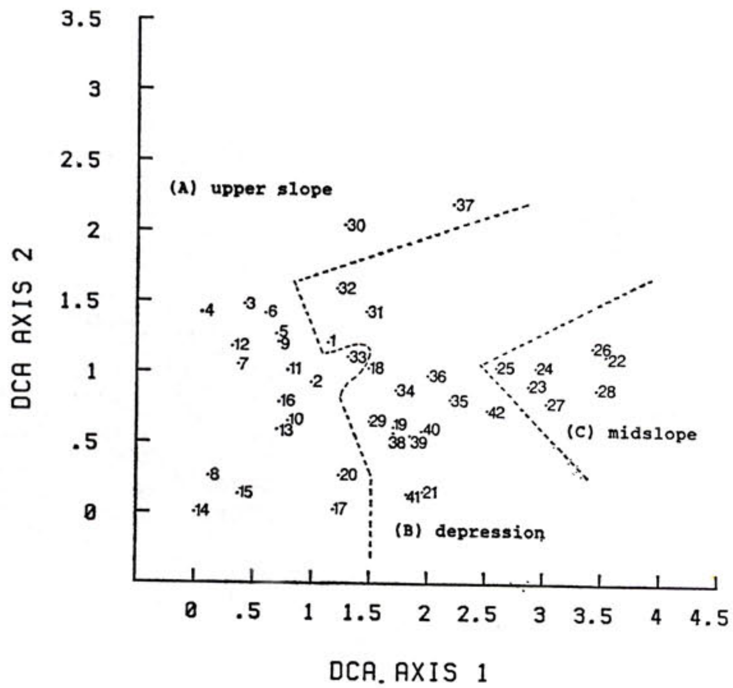

Fig. 2. Distribution of the 42 sample plots relative to the first and second axes of DCA ordination.

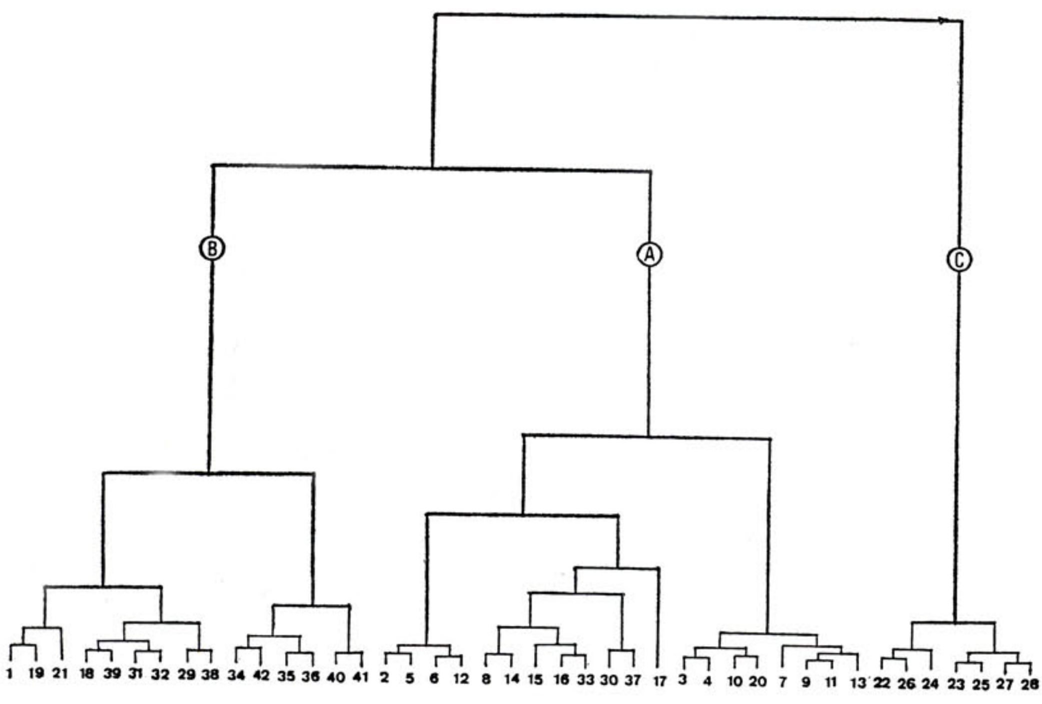

Fig. 3. Sum of squares agglomeration dendrogram of the 42 plots.

Table 2. Average composition of vegetation on plots in the three groups identified in Figs. 2 and 3. Species order is based on species scores along the first axis of DCA ordination.

Species	(A) upper slope			(B) depression			(C) midslope		
	Density (stems/ha)	BA (m/ha)	IV	Density (stems/ha)	BA (m/ha)	IV	Density (stems/ha)	BA (m/ha)	IV
Photinia beauverdiana notabilis	30.00	0.05	0.42	0.00	0.00	0.00	0.00	0.00	0.00
Castanopsis carlesii sessilis	420.00	1.28	7.00	0.00	0.00	0.00	0.00	0.00	0.00
Myrica rubra acuminata	30.00	0.10	0.59	0.00	0.00	0.00	0.00	0.00	0.00
Ilex micrococca	10.00	0.01	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Symplocos paniculata	20.00	0.01	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Myrsine sequinii	3120.00	4.30	35.78	386.67	0.55	6.48	57.14	0.08	0.89
Cryptocarya chinensis	20.00	0.13	0.66	26.67	0.15	0.72	57.14	0.02	0.68
Cleyera japonica	280.00	0.96	5.40	93.33	0.35	1.76	28.57	0.57	1.71
Podocarpus formosensis	20.00	0.02	0.21	0.00	0.00	0.00	0.00	0.00	0.00
Viburnum luzonicum	280.00	0.11	2.36	66.67	0.03	0.88	57.14	0.01	0.60
Ilex formosana	40.00	0.05	0.51	13.33	0.01	0.21	0.00	0.00	0.00
Ficus wightiana	10.00	0.22	0.90	0.00	0.00	0.00	0.00	0.00	0.00
Itea oldhamii	560.00	0.69	7.26	173.33	0.49	3.87	0.00	0.00	0.00
Glochidion rubrum	320.00	0.84	5.77	93.33	0.66	3.94	0.00	0.00	0.00
Elaeocarpus sylvestris	190.00	0.62	3.33	40.00	0.03	0.92	28.57	0.26	1.35
Scolopia oldhamii	190.00	0.30	2.14	66.67	0.13	1.16	0.00	0.00	0.00
Diospyros morrisiana	80.00	0.23	1.32	0.00	0.00	0.00	0.00	0.00	0.00
Ilex rotunda	70.00	0.08	0.99	0.00	0.00	0.00	57.14	0.05	0.77
Gardenia jasminoides	1140.00	2.15	16.42	493.33	0.90	10.83	428.57	0.26	4.60
Adinandra formosana	580.00	0.91	7.13	80.00	0.15	1.88	28.57	0.02	0.38
Styrax formosana	30.00	0.10	0.56	13.33	0.01	0.13	28.57	0.02	0.37
Ardisia sieboldii	1490.00	3.67	24.39	1266.67	3.64	32.77	285.71	0.27	3.68
Cyclobalanopsis acuta paucidentata	10.00	0.09	0.35	0.00	0.00	0.00	0.00	0.00	0.00
Glochidion rubrum	0.00	0.00	0.00	26.67	0.17	0.72	0.00	0.00	0.00
Syzygium buxifolium	360.00	0.55	4.77	280.00	0.64	6.33	85.71	0.03	0.94
Cyclobalanopsis glauca	220.00	1.09	4.89	133.33	1.31	5.04	85.71	0.10	1.29
Persea thunbergii	980.00	4.44	22.30	480.00	5.17	23.87	457.14	2.02	10.78
Ardisia quinquegona	40.00	0.01	0.34	80.00	0.03	0.99	0.00	0.00	0.00
Premna microphylla	20.00	0.03	0.27	26.67	0.06	0.45	0.00	0.00	0.00
Glochidion zeylanicum	110.00	0.19	1.85	93.33	0.18	1.91	0.00	0.00	0.00
Randia cochinchinensis	110.00	0.05	1.08	66.67	0.04	1.39	28.57	0.01	0.31
Michelia compressa	150.00	1.00	5.00	40.00	0.07	0.59	171.43	0.38	3.14
Acronychia pedunculata	20.00	0.16	0.69	26.67	0.04	0.71	57.14	0.22	1.50
Ilex ficoidea	60.00	0.09	0.74	13.33	0.01	0.20	85.71	0.03	1.01

Table 2. Average composition of vegetation on plots in the three groups identified in Figs. 2 and 3. Species order is based on species scores along the first axis of DCA ordination (continued).

Species	(A) upper slope			(B) depression			(C) midslope		
	Density (stems/ha)	BA (m/ha)	IV	Density (stems/ha)	BA (m/ha)	IV	Density (stems/ha)	BA (m/ha)	IV
Cryptocarya concinna	0.00	0.00	0.00	13.33	0.20	0.77	0.00	0.00	0.00
Mallotus philippensis	0.00	0.00	0.00	26.67	0.08	0.57	0.00	0.00	0.00
Decaspermum gracilentum	170.00	0.61	3.41	53.33	0.33	1.50	200.00	0.44	3.29
Ficus virgata	90.00	0.23	1.60	253.33	1.22	6.52	485.71	0.79	7.43
Symplocos cochinchinensis laurina	30.00	0.07	0.43	40.00	0.16	1.05	85.71	0.38	1.96
Schefflera octophylla	600.00	1.11	8.32	586.67	2.29	15.47	371.43	1.37	7.44
Litsea krukovii	80.00	0.04	0.80	93.33	0.22	1.85	171.43	0.08	1.83
Styrax suberifolia	190.00	0.77	3.87	80.00	0.62	3.34	57.14	0.40	2.20
Diospyros eriantha	100.00	0.12	1.25	333.33	0.81	6.55	85.71	0.07	1.17
Evodia lepta	10.00	0.01	0.12	13.33	0.01	0.17	0.00	0.00	0.00
Evodia merrillii	50.00	0.05	0.62	160.00	0.11	2.88	171.43	0.12	2.26
Sphaeropteris lepifera	0.00	0.00	0.00	53.33	1.12	5.12	0.00	0.00	0.00
Pithecellobium lucidum	40.00	0.01	0.34	0.00	0.00	0.00	57.14	0.01	0.73
Alniphyllum pterospermum	10.00	0.08	0.53	13.33	0.00	0.14	0.00	0.00	0.00
Antidesma japonicum densiflorum	80.00	0.03	0.59	26.67	0.00	0.31	85.71	0.02	1.03
Ficus ampelas	100.00	0.13	1.56	293.33	0.80	7.16	771.43	1.41	13.09
Persea japonica	0.00	0.00	0.00	26.67	0.11	1.04	0.00	0.00	0.00
Ficus erecta beecheyana	20.00	0.01	0.14	66.67	0.02	0.86	114.29	0.09	1.25
Ficus nervosa	10.00	0.03	0.18	53.33	0.14	0.96	28.57	0.09	0.63
Wendlandia formosana	380.00	1.03	6.73	773.33	4.07	27.85	1742.86	5.61	35.58
Glochidion lanceolatum	60.00	0.21	1.12	0.00	0.00	0.00	85.71	0.36	2.00
Meliosma rigida	60.00	0.07	0.79	66.67	0.07	1.36	314.29	0.49	4.68
Daphniphyllum glaucescens oldhamii	20.00	0.03	0.33	0.00	0.00	0.00	57.14	0.07	0.81
Bridelia balansae	30.00	0.06	0.45	133.33	0.31	2.46	457.14	0.66	7.00
Helicia formosana	0.00	0.00	0.00	0.00	0.00	0.00	57.14	0.13	0.79
Turpinia formosana	30.00	0.01	0.29	53.33	0.10	1.05	714.29	0.63	10.03
Mallotus paniculatus	0.00	0.00	0.00	0.00	0.00	0.00	800.00	9.69	45.07
Ficus fistulosa	30.00	0.04	0.51	80.00	0.35	2.72	371.43	0.64	6.80
Persea zuihoensis	10.00	0.00	0.12	0.00	0.00	0.00	85.71	0.03	1.22
Acacia confusa	0.00	0.00	0.00	0.00	0.00	0.00	57.14	1.38	5.64
Murraya paniculata	0.00	0.00	0.00	13.33	0.00	0.34	114.29	0.24	2.08
Sum	13210.00	29.28	199.83	7386.67	27.93	199.80	9571.43	29.52	200.00

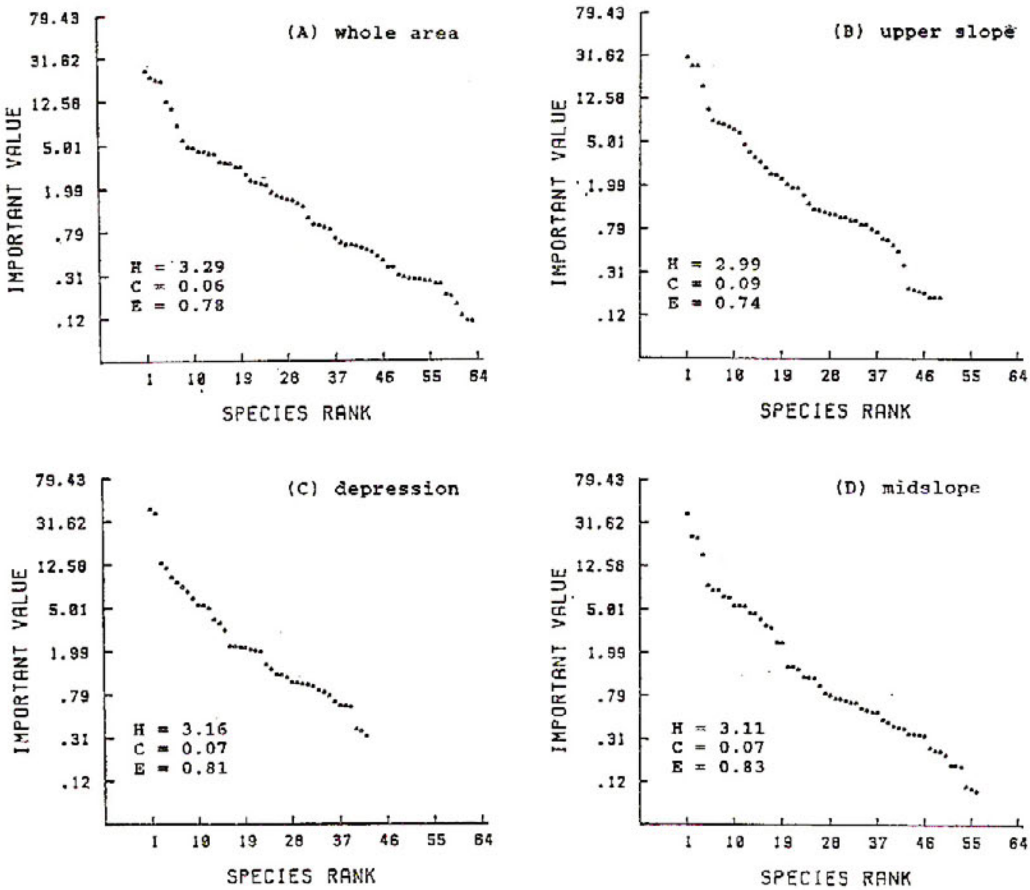

Fig. 4. Dominance-diversity curves and diversity indices for all vegetation types.

Allometry

Figure 5 shows the models fitted to the dbh-height and dbh-crown volume relation for the representative dominants in the Lonlon secondary forest. An increase in dbh is at first coupled to an increase in tree height, with a more or less constant, small crown volume. Later on, the pattern is completely reversed. For most species when individuals approach maturity, growth in crown is favoured compared to growth in height. However, the subcanopy species *Gardenia jasminoides* has relatively larger crown in smaller dbh as compared to other species.

Size-class distributions

Size-class structure of each vegetation type approximates that expected for uneven-aged forests (Fig. 6) where density decreases from smaller to larger size-classes (Schmelz and Lindsey 1965, Robertson *et al.* 1978). Size-class distributions are well described by the negative exponential function ($r^2 > 0.96$). However the slight under-representation in the smallest size-class of the upper slope vegetation type might be indicative of a minor anthropogenic disturbance.

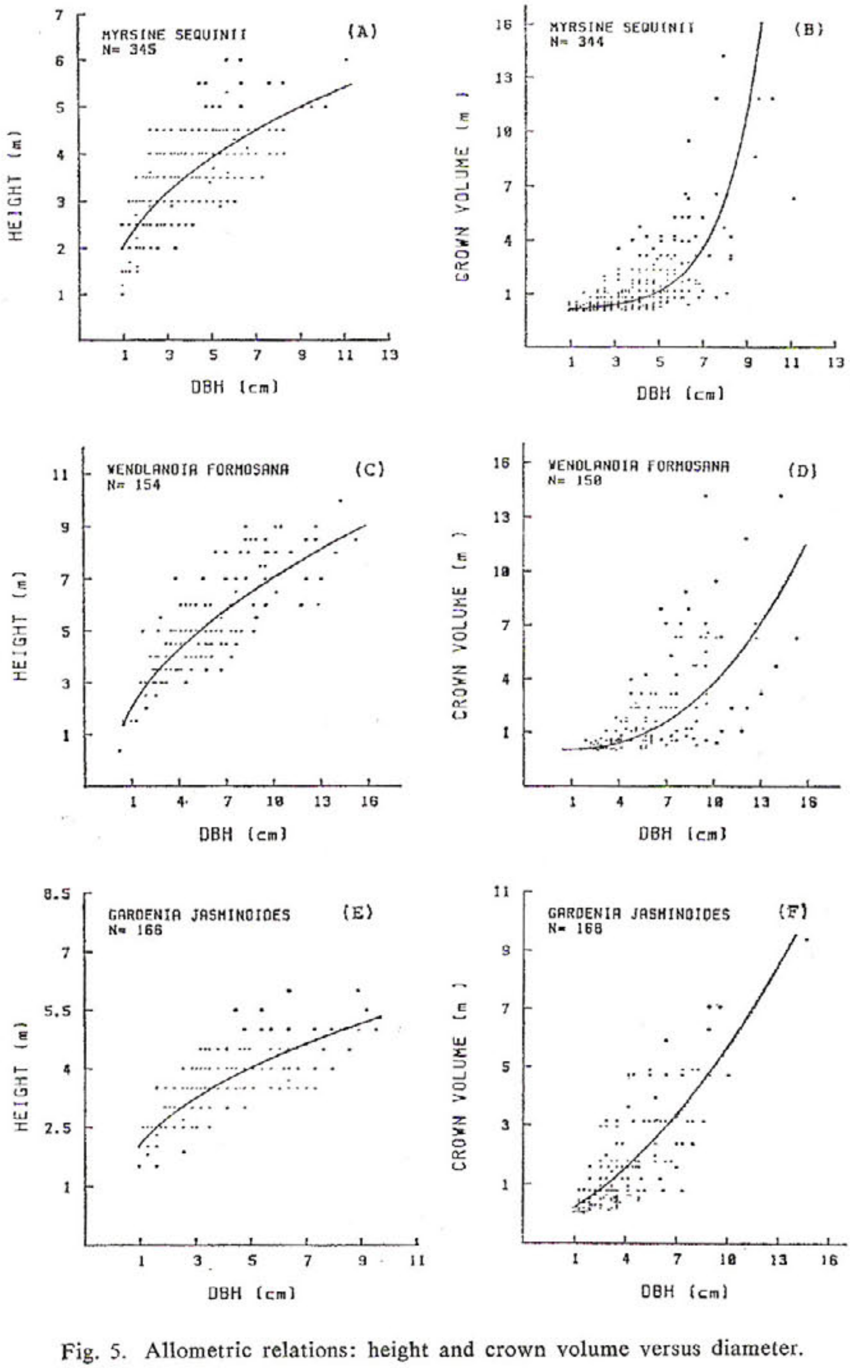

Fig. 5. Allometric relations: height and crown volume versus diameter.

(A) Height $= 1.95$ dbh $^{0.4}$ $(r^2 = 0.74)$; (B) Volume $= 0.4 - 0.25$ dbh $+ 0.1$ dbh^2 $(r^2 = 0.71)$; (C) Height $= 2$ dbh $^{0.54}$ $(r^2 = 0.84)$; (D) Volume $= 0.014$ dbh $^{2.44}$ $(r^2 = 0.77)$; (E) Height $= 2.1$ dbh $^{0.4}$ $(r^2 = 0.81)$; (F) Volume $= -1.118 + 0.3$ dbh $+ 0.03$ dbh ^{2} $(r^2 = 0.82)$.

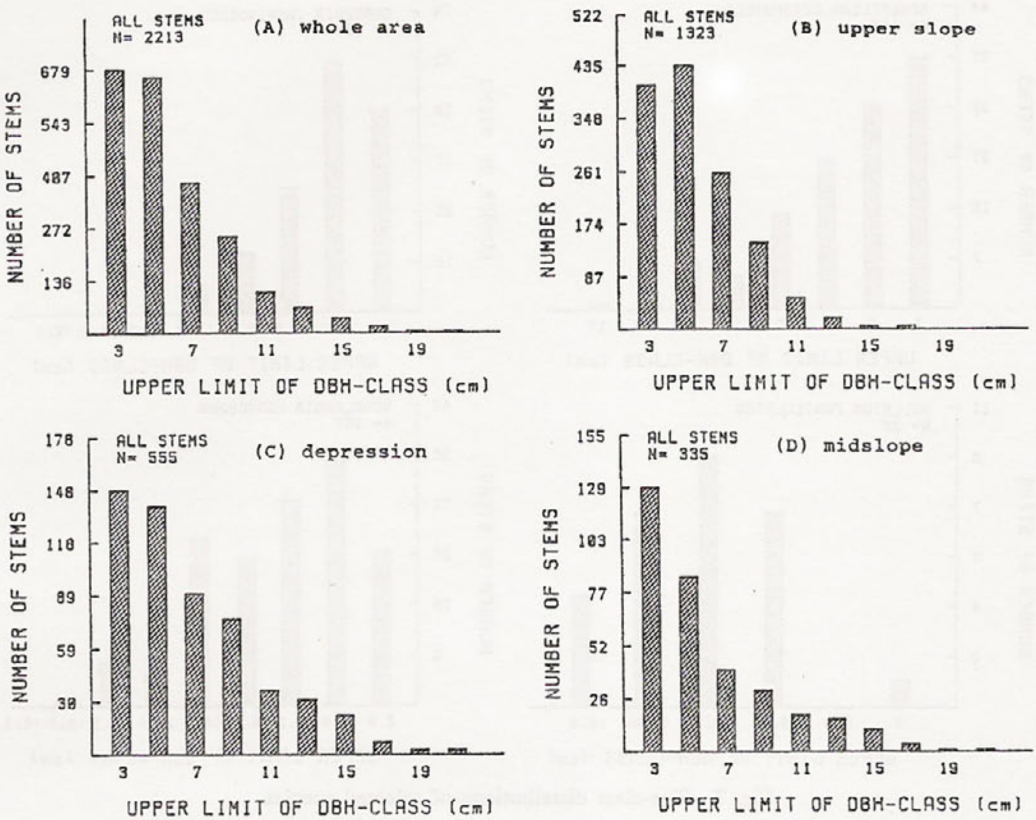

Fig. 6. Size-class distributions for all stems from each vegetation type.
(A) $y = 3071\,e^{-0.31x}$ ($r^2 = 0.98$); (B) $y = 2656\,e^{-0.38x}$ ($r^2 = 0.98$); (C) $y = 472.8\,e^{-0.24x}$ ($r^2 = 0.97$); (D) $y = 343\,e^{-0.27x}$ ($r^2 = 0.97$).

Figure 7 shows the size-class distributions of several of the more abundant species. Four general patterns could be distinguished. The first pattern (Fig. 7A) as illustrated by *Schefflera octophylla* approximates that expected for uneven-aged populations, and thereby exhibits a general fit relative to the negative exponential distribution. Other species which exhibit this pattern are *Ficus ampelas, F. virgata, Itea oldhamii, Diospyros eriantha, Evodia merrillii, Litsea krukovii,* and *Turpinia formosana.* The second pattern (Fig. 7B) has some characteristics of uneven aged distributions but is slightly underrepresented in the smallest size-classes. *Syzygium buxifolium, Ardisia sieboldii, Gardenia jasminoides, Myrsine sequinii, Castanopsis carlesii* var. *sessilis,* and *Persea thunbergii* typify this distribution. The third pattern (Fig. 7C) exhibits the normal curve form to be expected for even-aged populations (Mohler *et al.* 1978). *Mallotus paniculatus* most strongly exemplify this pattern. Species with similar distribution pattern are *Elaeocarpus sylvestris, Viburnum luzonicum,* and *Cleyera japonica.* Other species (e. g., *Wendlandia formosana, Bridelia balansae, Cyclobalanopsis glauca,* and *Ficus fistulosa*) show a distribution characterized by scattered peaks (Fig. 7D) which most likely represent periods of establishment following localized disturbance.

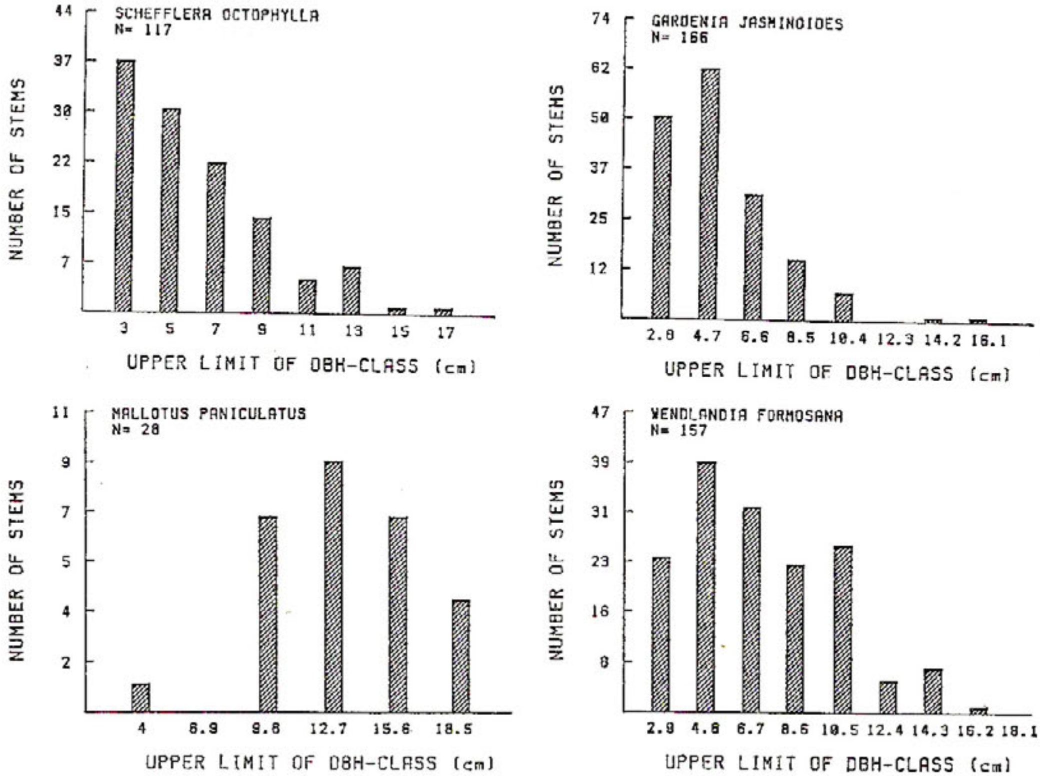

Fig. 7. Size-class distributions of selected species.

DISCUSSION

Vegetation structure, community patterns, and differential species distribution in secondary forests are affected by a broad array of complex and environmental interactions. However, former studies nearby have found that relatively few factors, including topography, moisture, and disturbance were important in determining patterns of species distribution (Hsieh *et al.* 1987). In this study, the exposed upper slope was characterized by the relative importance of *Myrsine sequinii*, *Castanopsis carlesii* var. *sessilis*, and *Adinandra formosana*. This, combined with the well represented species of *Wendlandia formosana*, *Bridelia balansae*, *Ficus virgata*, and *Sphaeropteris lepifera* in the more or less sheltered sites, suggests that topography is the most important factor for species growing on those sites.

Collectively the negative exponential distribution observed in the secondary forest is typical of the size-class distributions observed in some mature lowland forests in Taiwan (Hsu and Hsieh 1991; Sun *et al.* 1991). The little deviation of the observed values from the predicted regression (Fig. 6) in the upper slope suggested the recent occurrence of incomplete cutting under the forest. The same phenomenon could be observed among some individual species such as *Syzygium buxifolium*, *Myrsine sequinii*, *Ardisia sieboldii*, and *Adinandra formosana*. Although the size-class distribution of the community type on the midslope approximated a negative exponential function, the distribution of *Mallotus paniculatus*, one of the dominants, did not. It is always thought to be a short-lived secondary species, and occurs mainly on the sunny disturbed slopes. Structure affinity seems to be with *Alnus formosana* of the landslide sites of the middle altitudes (Hsieh *et al.* 1989a).

The density of the secondary forest studied is within the ranges reported for the mature lowland rain forests in Mt. Lopei (Hsu and Hsieh 1991) and Kenting National Park (Sun *et al.* 1991). They are all characterized by a thick individuals in the windward or exposed slopes and ridges, and seem to be similar to the elfin forests of the central America (Howard 1968; Lawton and Dryer 1980). Compared to the basal areas of the Lopei forest 38.78 (m^2/ha, dbh $\geq$ 1 cm) and Kenting forest (38.95 m^2/ha), however, the Lonlon forest shows a lower value (28.85 m^2/ha), and seems more likely to be indicative of structural immaturity.

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臺灣東北角隆隆山次生林之植被類型及結構

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摘　　要

本文在闡述臺灣東北角隆隆山次生林之組成及結構。研究區內計包含 241 種維管束植物，其中樹木 70 種、灌木 39種、蔓藤 48 種 、草本類 45 種 、蕨類 39 種 。DBH≥1 cm 樹木之歧異度爲：Shannon-Wiener index (3.09) ，Simpson index (0.08) 及 Equitability index (0.79)。優勢度—歧異度曲線近似 lognormal 分佈型 。植物社會之優勢種在樹冠層爲大明橘 (*Myrsine sequinii*)、樹杞 (*Ardisia sieboldii*)、紅楠 (*Persea thunbergii*) 及水金京 (*Wendlandia formosana*)；灌木層爲九節木 (*Psychotria rubra*) 及圓葉鷄屎樹 (*Lasianthus plagiophyllus*)。改良型對應分析及羣團分析的結果顯示三類植被型。各植被型樹木大小徑級分佈趨近負指數函數，但是在上坡稜脊處最小徑級的密度偏低，反映出人爲干擾的跡象。與其他低海拔雨林相比較，隆隆山次生林之總底面積較小，仍屬未成熟之林分。