

Floristic Composition of the Evergreen Broad-leaved Forests of Taiwan

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Abstract Evergreen broad-leaved forests are an attractive landscape feature of Taiwan. They occur from sea level to ca. 2,500 m, and cover ca. 32% of the island area. A floristic classification of the forests is presented here based on comprehensive survey data. The forests consists of 569 tree and shrub species in 234 genera and 82 families. Detrended correspondence analysis (DCA) on a data matrix of 779 plots×489 species revealed a complex pattern of both altitudinal and geographical variation in the forests. TWINSpan classification identified four major forest types corresponding to those described by Su (1984): *Ficus-Machilus*, *Machilus-Castanopsis*, Lower *Quercus*, and Upper *Quercus* forest zones. The *Ficus-Machilus* forest occurs mainly in southern Taiwan. It is dominated by Euphorbiaceae, Moraceae, and Lauraceae, and shows some tropical features such as buttresses, stilt roots, and cauliflory. The *Machilus-Castanopsis* and Lower *Quercus* forests are very rich in species. Canopy species are overwhelmingly dominated by Lauraceae and Fagaceae. The Upper *Quercus* forest is much impoverished in tree species, and is dominated by members of the Lauraceae, Theaceae, and Fagaceae. This forest is the tallest vegetation in Taiwan with some conifers reaching heights of 30–50 m. Both the Lower and Upper *Quercus* forests remain relatively intact, and are usually referred to as cloud forests.

Key words: Taiwan, evergreen broad-leaved forests, zonation, composition, classification, ordination

Taiwan Island, with its administrative subsidiary islets (Lanyu, Luta, etc.), is situated at the western edge of the Pacific Ocean at latitude 21°55'–25°20'N and longitude of 119°30'–122°00'E, and runs in a north-south direction east of mainland China, north of the Philippines, and south of the Japanese Ryukyu Islands. Extending 394 km along its longest axis and stretching 140 km at its broadest transection, Taiwan Island has an area of ca. 35,800 km². The Tropic of Cancer transects the island into almost two equal halves. Phytogeographically, Taiwan is located around the boundary between the extensive Holarctic and Paleotropical floristic kingdoms. This location, together with the topographic complexity of its high mountains supports a diverse flora of over 4,000 vascular plant species and a spectrum of seven major forest types.

Taiwan is dominated by forested moun-

tains, and almost three fourths of the island is slopeland. The Central Mountain Ridge, with the Snow Mountain on its western flank and the Eastern Schist Mountain on its eastern flank, constitute the Central Mountain Range of Taiwan. There are more than 200 peaks higher than 3,000 m. This lofty range runs basically along the N-S axis of the island. The lowlands in the central and southwestern parts of Taiwan occupy about one fourth of the island, and are densely populated.

Taiwan has a distinct oceanic subtropical climate. Tempered by winds from the sea and by frequent rains and typhoons, the climate is mild with high humidity throughout the year. However, the central mountain range with its high altitude encompasses a climatic range from subtropical to sub-arctic. Geographically, Taiwan is well within the Pacific monsoon zone. Because the N-S ex-

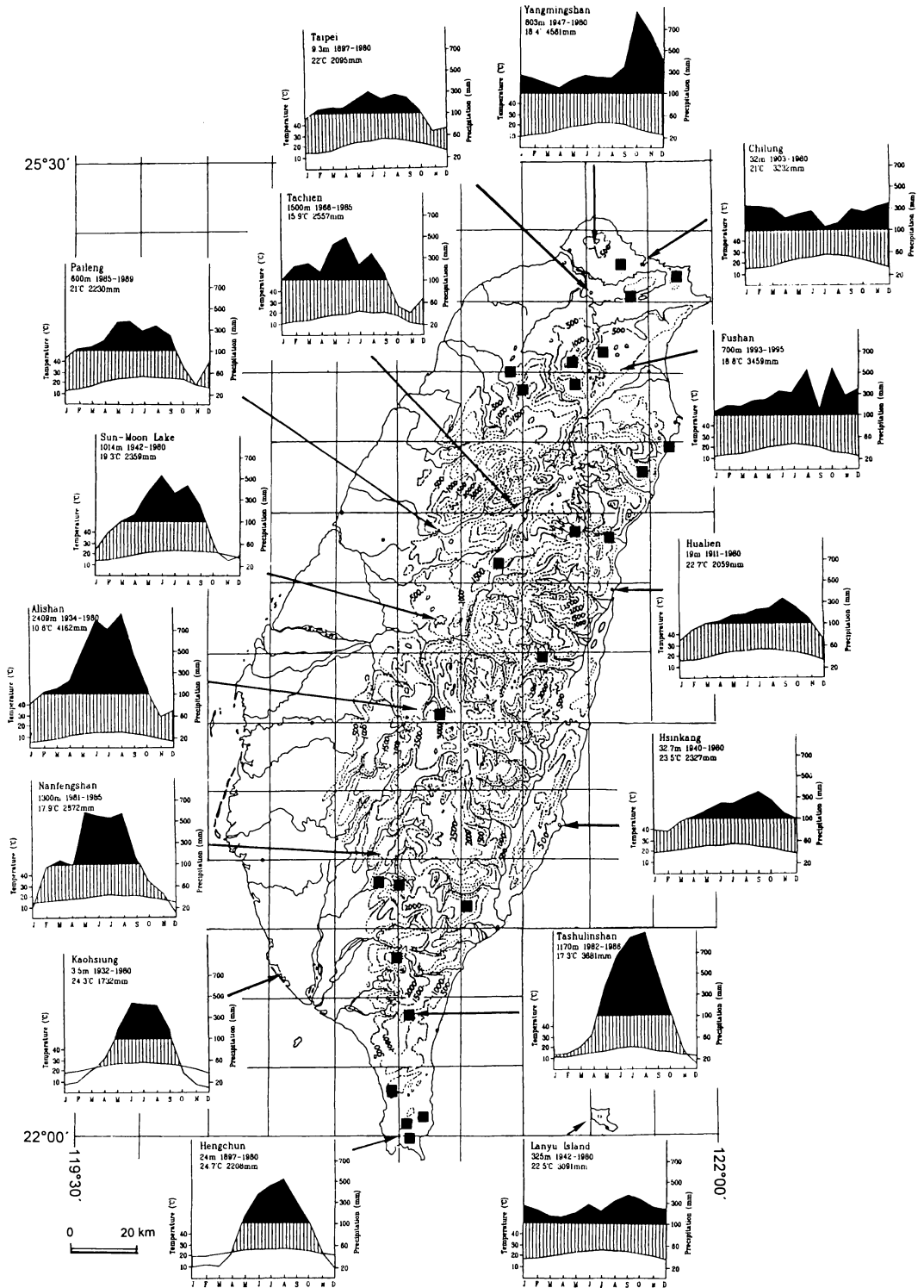


Fig. 1. Locations of study areas (■). Representative climate diagrams from 15 sites are also shown.

tending lofty ranges intersect the monsoon winds obliquely, the southwestern and northeastern parts of the island have different climates. In the winter months the rains are due mainly to the northeast monsoon winds, which bring much rain to northern, northeastern, and eastern Taiwan, but have little effect on the climate of the southern part. As a result, distinct rainy and dry seasons are present in the southwest. In summer and fall, heavy rains accompany typhoons that usually sweep over the whole island. Fig. 1 illustrates the main climatic features and the degree of climatic difference for fifteen representative areas.

Due to steepness of the slopes and the marked correlation between elevation and both temperature and moisture, the vertical zonation of the vegetation is especially impressive in the mountainous regions of Taiwan. Liu (1968) presented the first comprehensive classification of the island's vegetation. Three climax formations of broad-leaved forest were recognized: warm-temperate montane coniferous forest (1,200–2,200 m), warm-temperate rain forest (700–1,800 m in the north, 900–2,100 m in the south) and tropical rain forest (lower than 700 or 900 m). In his study of the relationships between climatic factors and forest vegetation along an altitudinal gradient, Su (1984) recognized seven vegetation zones (Table 1). Among them, four are included as members of the evergreen broad-leaved forest: *Ficus-Machilus* zone, *Machilus-Castanopsis* zone, Lower *Quercus* zone and Upper *Quercus* zone. The distribution of the evergreen broad-leaved forest and other forest types in Taiwan is shown in Plate VIII.

The evergreen broad-leaved forests of Taiwan occur from sea level to about 2,500 m asl. These forests are usually referred to as lauro-fagaceous forest (Kudo and Sasaki, 1931). The dominant tree species include many evergreen members of the Fagaceae, Lauraceae, Theaceae, Symplocaceae and other broad-leaved evergreen species. In spite of its high population density and rapid economic development, about 52% of Taiwan is still covered by forests. The evergreen broad-leaved forests cover about 34.5% (1,238,300 ha) of the island area (Liu, 1992). There has been little human exploitation of the relatively inaccessible mountain forests. By contrast, a great deal of the mixed coniferous forests at middle altitudes, especially those of commercially valuable *Chamaecyparis obtusa* var. *formosana* and *C. formosensis*, have been exploited since the beginning of this century. In low montane regions, logging has converted large expanses of virgin forest to orchards, tea gardens, and plantations of *Cryptomeria japonica*, *Cunninghamia lanceolata*, *Acacia confusa*, *Aleurites montana*, *Cinnamomum camphora*, and various bamboos. Forests that remain relatively intact are those growing in the nearly inaccessible areas of eastern Taiwan or those protected in forest reserves and national parks. In lowland areas, nearly all of the natural vegetation has been completely destroyed. The flora of Taiwan is relatively well known. However, the composition and distribution of plant communities are known only incompletely because of the complexity and diversity of the vegetation and the difficulty in gaining access to the mountain regions. The principal aim of this paper is to provide

Table 1. Temperature ranges of the altitudinal vegetation zones in central Taiwan. Tm is annual mean temperature and WI, the warmth index (Su, 1984).

Altitudinal zone	Vegetation zone	Altitude (m)	Tm (°C)	WI (°C·month)	Equivalent climate
Alpine	Alpine vegetation	>3600	<5	<12	subarctic
Subalpine	<i>Abies</i>	3100–3600	5–8	12–36	cold-temperate
Upper montane	<i>Tsuga-Picea</i>	2500–3100	8–11	36–72	cool-temperate
Montane	<i>Quercus</i> (upper)	2000–2500	11–14	72–108	temperate
	<i>Quercus</i> (lower)	1500–2000	14–17	108–144	warm-temperate
Submontane	<i>Machilus-Castanopsis</i>	500–1500	17–23	144–216	subtropical
Foothill	<i>Ficus-Machilus</i>	<500	>23	>216	tropical

a floristic classification of the evergreen broad-leaved forests of Taiwan. Major forest types are compared and described.

Methods

This paper represents a compilation of data from a series of vegetation studies (Wang, 1975; Li, 1986; Lin, 1988; Su and Wang, 1988; Hsieh, 1989; Chen, 1990; Hsieh *et al.*, 1989, 1990a, 1990b; Chen, 1991; Hsu, 1991; Lu, 1991; Yang, 1991; Wang, 1991; Chen, H. P., 1992; Chen, Y. S., 1992; Chen, 1993; Chung, 1994; Yang, 1994; Yeh, 1994; Kao, 1995; Liao, 1995; Chen, 1996; Song, 1996; Sun *et al.*, 1996; Yeh and Fan, 1996), along with other field and bibliographic information. In sum, 779 sampling plots were collected from evergreen broad-leaved forests in 24 areas (Fig. 1). The sampling sites extended from sea level to ca. 2,500 m asl. For comparison, the data for each species were transformed into a single relative importance value (percentage) for each plot. Species importance value (IV) was defined as the sum of all relative importance values of that species. Family importance value (FIV) was calculated as the sum of all species importance values within that family.

Two-way indicator species analysis as implemented in TWINSpan (Hill, 1979b) was used to classify plots into major floristic groups. Subsequently the TWINSpan groups were explored by Detrended Correspondence Analysis (DCA: Hill, 1979a) in two dimensions to determine the extent to which groups reflected discontinuity in the plot floristic data. A data matrix comprising 779 plots $\times$ 489 species was used for both analyses. Species with a total percentage of less than 0.02 were omitted. Nomenclature followed the Flora of Taiwan (Li *et al.*, 1975–1979) for consistency.

Species Composition

The woody flora of the 779 plots is composed of 569 species in 234 genera and 82 families. With lianas and vines, the flora amounts to 686 species in 303 genera and 105 families. In terms of major growth forms, there are 403 trees, 166 shrubs and 117 lianas/vines. This sample of tree and shrub species represents approximately 55%

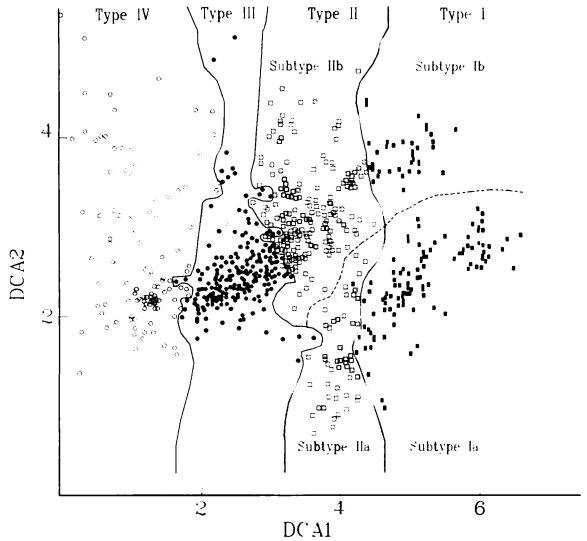


Fig. 2. Ordination of 779 sampling plots along the first two DCA axes.

of those known in Taiwan. The most important families in terms of species number are Lauraceae (48 species), Fagaceae (36), Euphorbiaceae (31), Theaceae (27), Rubiaceae (26), Ericaceae (24), Aquifoliaceae (23), Rosaceae (23), Moraceae (22) and Symplocaceae (18).

The results of the DCA are displayed in Fig. 2. The eigenvalues for the first four axes are 0.61, 0.41, 0.31 and 0.25, respectively. The gradient lengths are, respectively, 6.56, 5.34, 4.06 and 3.98. The first DCA axis clearly describes a strong altitudinal gradient. Sampling plots associated with southern lowlands are designated by high DCA1 values; conversely plots from higher altitudes are designated by low DCA1 values. This is reflected also in the highly significant correlation of DCA1 with altitude ($r^2 = -0.826$, $P < 0.0001$). When the plot groups recognized by the TWINSpan classification are overlaid on DCA ordination (Fig. 2), each of the four TWINSpan groups, labeled as Types I, II, III, and IV, are clearly separated along axis 1 from right to left. The four plot groups, thus identified, represent an obvious altitudinal segregation, and correspond, on altitudinal sequence, to the *Ficus-Machilus*, *Machilus-Castanopsis*, Lower *Quercus*, and Upper *Quercus* forest zones respectively. Along the second DCA axis, the plots within the *Ficus-Machilus* forest zone (Type I) can be

further subdivided into two subtypes. The most southerly plots (Subtype Ia) from the Hengchun Peninsula, clustered in the lower right of the ordination, are obviously quite distinct from other plots of the same type (Subtype Ib, mostly from the southwestern Taiwan). A similar trend can be observed within the *Machilus-Castanopsis* forest zone (Type II), with a cluster of the southernmost plots (Subtype IIa) in the lower half of the DCA2.

The analysis has confirmed the existence of four major types within the evergreen broad-leaved forests of Taiwan. This separation is in general accord with that from the earlier study. However, two more subtypes have been recognized here for each of the *Ficus-Machilus* and *Machilus-Castanopsis* forests, and these suggest a clear floristic dichotomy between the Hengchun Peninsula and the Island's remaining regions for both lowland and low-altitude forests.

Type I

This grouping comprises 148 lowland forest plots mainly from southernmost and southwestern Taiwan with 7 plots from the east (Hualien) and one plot from the northwest (Hsinchu). However, none of the low-altitude plots (100–300 m asl) from northern Taiwan fall into this group. Floristically, this forest is analogous to the Paratropical Rain Forest of Wolfe (1979), and is included in the *Ficus-Machilus* forest zone of Su (1984). The forest occurs at altitudes from sea level to ca. 500 m. A total of 324 woody species were found in the plots, belonging to 77 families and 195 genera. There are 213 trees, 69 shrubs and 42 lianas/vines. The most speciose families are Euphorbiaceae (28 species), Lauraceae (27), Moraceae (19), Rubiaceae (18), Leguminosae (12), Rutaceae (11) and Fagaceae (10). The size of genera represented in these forests is not large in comparison with that of tropical forests. The four that stand out are *Ficus* (16 species), *Ilex* (7), *Cinnamomum*, (6) and *Lasianthus* (6). A total of 15 families have family important values of over 2. Eight of the top families are Euphorbiaceae (FIV=12.7), Moraceae (9.5), Lauraceae (8.8), Rubiaceae (6.0), Meliaceae (5.6), Rutaceae (4.8), Lythraceae (3.7) and Urtica-

ceae (3.4). The most abundant species (Table 2) in the tree stratum are *Lagerstroemia subcostata*, *Bischofia javanica*, *Dysoxylum kuskusense*, *Laportea pterostigma*, *Machilus japonica* var. *kusanoi*, *Schefflera octophylla*, *Ardisia sieboldii*, *Diospyros eriantha*, *Champereia manillana*, *Ficus fistulosa*, *Turpinia ternata*, *Sapindus mukorossii*, *Sloanea formosana*, *Ficus irisana*, *Scolopia oldhamii*, *Gordonia axillaris*, *Acacia confusa*, *Ficus benjamina*, *Aglaia elliptifolia*, *Ficus septica*, *Drypetes hieranensis*, *Cinnamomum reticulatum*, and *Gardenia jasminoides*. The 30 most abundant tree species collectively comprises 46.6% of total IV. There are more than 69 shrub species. The dominant species are *Psychotria rubra*, *Glycosmis citrifolia*, *Murraya paniculata*, *Viburnum odoratissimum*, *Leea guineensis*, *Maytenus diversifolia*, *Lasianthus chinensis*, *Clausena excavata*, *Leucaena glauca*, *Severinia buxifolia*, *Morus australis*, *Pittosporum tobira*, *Capparis micracantha* var. *henryi*, *Pandanus odoratissimus* var. *sinensis*, *Rhaphiolepis indica* var. *hiiranensis*, and *Croton cascarilloides*.

The most diverse and least disturbed lowland evergreen broad-leaved forests are found in the Hengchun Peninsula of southernmost Taiwan (Yang, 1994; Yeh, 1994; Liao, 1995). Subtype Ia is represented by 114 plots all from this region, which occur most frequently at altitudes of less than 300 m. The forests are composed of a great number of species of trees, shrubs, climbers, lianas, and epiphytes. The upper canopy is occasionally 22 m tall but more often less than 20 m, and rather open due to frequent typhoons. Dominant species (Table 3) are *Dysoxylum kuskusense*, *Bischofia javanica*, *Psychotria rubra*, *Laportea pterostigma*, *Lagerstroemia subcostata*, *Schefflera octophylla*, *Machilus japonica* var. *kusanoi*, *Ardisia sieboldii*, *Turpinia ternata*, *Ficus fistulosa*, *Sloanea formosana*, *Scolopia oldhamii*, *Diospyros eriantha*, *Gordonia axillaris*, and *Ficus benjamina*. Trees with buttresses include *Sloanea formosana*, *Machilus japonica* var. *kusanoi*, *Castanopsis indica*, *Dysoxylum kuskusense*, *Ilex rotunda*, *Acalypha suirensiensis*, *Ficus ampelas*, and *Laportea pterostigma*. Larger lianas, especially *Derris laxiflora*, *Hiptage benghalensis*, *Ventilago elegans*, *Kadsura japonica*, *Erycibe henryi*, *Mucuna macrocarpa*, *Ficus aurantiaca* var. *parvifolia*,

Table 2. Composition of woody species in forest type I (*Ficus-Machilus* forest). IV, relative dominance; CUM, cumulative dominance. Only species with IV ≥ 0.2 are included.

Species	IV	CUM
<i>Lagerstroemia subcostata</i> (Lythraceae)	3.72	3.72
<i>Bischofia javanica</i> (Euphorbiaceae)	3.44	7.15
<i>Dysoxylum kuskusense</i> (Meliaceae)	3.41	10.56
<i>Laportea pterostigma</i> (Urticaceae)	2.85	13.41
<i>Psychotria rubra</i> (Rubiaceae)	2.73	16.14
<i>Machilus japonica</i> var. <i>kusanoi</i> (Lauraceae)	2.46	18.60
<i>Schefflera octophylla</i> (Araliaceae)	2.24	20.84
<i>Ardisia sieboldii</i> (Myrsinaceae)	1.84	22.68
<i>Diospyros eriantha</i> (Ebenaceae)	1.78	24.46
<i>Glycosmis citrifolia</i> (Rutaceae)	1.56	26.01
<i>Champeria manillana</i> (Santalaceae)	1.50	27.51
<i>Ficus fistulosa</i> (Moraceae)	1.48	29.00
<i>Murraya paniculata</i> (Rutaceae)	1.46	30.46
<i>Turpinia ternata</i> (Staphyleaceae)	1.39	31.85
<i>Sapindus mukorossii</i> (Sapindaceae)	1.30	33.15
<i>Sloanea formosana</i> (Elaeocarpaceae)	1.28	34.44
<i>Ficus irisana</i> (Moraceae)	1.27	35.71
<i>Scolopia oldhamii</i> (Flacourtiaceae)	1.24	36.95
<i>Gordonia axillaris</i> (Theaceae)	1.18	38.12
<i>Acacia confusa</i> (Leguminosae)	1.16	39.28
<i>Ficus benjamina</i> (Moraceae)	1.16	40.44
<i>Aglaia elliptifolia</i> (Meliaceae)	1.14	41.59
<i>Ficus septica</i> (Moraceae)	1.13	42.72
<i>Drypetes hieranensis</i> (Euphorbiaceae)	1.12	43.84
<i>Cinnamomum reticulatum</i> (Lauraceae)	1.06	44.90
<i>Gardenia jasminoides</i> (Rubiaceae)	1.04	45.95
<i>Macaranga tanarius</i> (Euphorbiaceae)	0.99	46.94
<i>Castanopsis indica</i> (Fagaceae)	0.97	47.91
<i>Glochidion rubrum</i> (Euphorbiaceae)	0.94	48.85
<i>Vitex negundo</i> (Verbenaceae)	0.94	49.79
<i>Aglaia formosana</i> (Meliaceae)	0.91	50.69
<i>Litsea kruckovii</i> (Lauraceae)	0.86	51.55
<i>Mallotus philippensis</i> (Euphorbiaceae)	0.83	52.38
<i>Ilex rotunda</i> (Aquifoliaceae)	0.81	53.20
<i>Cryptocarya concinna</i> (Lauraceae)	0.81	54.00
<i>Michelia compressa</i> (Magnoliaceae)	0.80	54.80
<i>Schima superba</i> var. <i>kankoensis</i> (Theaceae)	0.76	55.56
<i>Pouteria obovata</i> (Sapotaceae)	0.76	56.32
<i>Syzygium formosanum</i> (Myrtaceae)	0.75	57.07
<i>Beilschmiedia erythrophloia</i> (Lauraceae)	0.75	57.82
<i>Ficus microcarpa</i> (Moraceae)	0.74	58.56
<i>Ficus ampelas</i> (Moraceae)	0.73	59.29
<i>Mallotus paniculatus</i> (Euphorbiaceae)	0.68	59.97
<i>Ficus virgata</i> (Moraceae)	0.68	60.65
<i>Melanolepis multiglandulosa</i> (Euphorbiaceae)	0.65	61.30
<i>Trema orientalis</i> (Ulmaceae)	0.63	61.94
<i>Kleinhovia hospita</i> (Sterculiaceae)	0.63	62.57
<i>Daphniphyllum glaucescens</i> ssp. <i>oldhamii</i> (Daphniphyllaceae)	0.62	63.18
<i>Viburnum odoratissimum</i> (Caprifoliaceae)	0.62	63.80
<i>Leea guineensis</i> (Leeaceae)	0.61	64.41
<i>Glochidion philippicum</i> (Euphorbiaceae)	0.60	65.02
<i>Maytenus diversifolia</i> (Celastraceae)	0.60	65.62
<i>Ilex uraiensis</i> (Aquifoliaceae)	0.60	66.21
<i>Celtis formosana</i> (Ulmaceae)	0.57	66.78
<i>Fraxinus formosana</i> (Oleaceae)	0.56	67.34
<i>Bridelia balansae</i> (Euphorbiaceae)	0.52	67.86
<i>Ficus wightiana</i> (Moraceae)	0.51	68.37
<i>Aphananthe aspera</i> (Ulmaceae)	0.50	68.87
<i>Lindera akoensis</i> (Lauraceae)	0.50	69.37
<i>Ilex cochinchinensis</i> (Aquifoliaceae)	0.49	69.86
<i>Lasianthus chinensis</i> (Rubiaceae)	0.49	70.35
<i>Glochidion zeylanicum</i> (Euphorbiaceae)	0.49	70.84
<i>Clauseria excavata</i> (Rutaceae)	0.48	71.33
<i>Leucaena glauca</i> (Leguminosae)	0.47	71.80
<i>Euodia merrillii</i> (Rutaceae)	0.47	72.27
<i>Neonauclea reticulata</i> (Rubiaceae)	0.47	72.74
<i>Radermachia sinica</i> (Bignoniaceae)	0.47	73.21
<i>Severinia buxifolia</i> (Rutaceae)	0.46	73.66
<i>Morus australis</i> (Moraceae)	0.44	74.10
<i>Schefflera actinophylla</i> (Araliaceae)	0.42	74.53
<i>Ehretia thyrsoflora</i> (Boraginaceae)	0.42	74.94
<i>Decaspermum gracilentum</i> (Myrtaceae)	0.41	75.35
<i>Distylium racemosum</i> (Hamamelidaceae)	0.40	75.75
<i>Diospyros discolor</i> (Ebenaceae)	0.39	76.14
<i>Ficus nervosa</i> (Moraceae)	0.38	76.52
<i>Pittosporum tobira</i> (Pittosporaceae)	0.38	76.89
<i>Eurya hayatai</i> (Theaceae)	0.37	77.26
<i>Helicia formosana</i> (Proteaceae)	0.35	77.62
<i>Gelonium aequoreum</i> (Euphorbiaceae)	0.35	77.97
<i>Capparis micrantha</i> var. <i>henryi</i> (Capparidaceae)	0.34	78.31
<i>Pandanus odoratissimus</i> var. <i>sinensis</i> (Pandanaaceae)	0.34	78.65
<i>Styrax suberifolia</i> (Styracaceae)	0.34	78.99
<i>Eriobotrya deflexa</i> (Rosaceae)	0.33	79.32
<i>Acer alboburpurascens</i> (Aceraceae)	0.33	79.65
<i>Reevesia formosana</i> (Sterculiaceae)	0.32	79.97
<i>Rhaphiolepis indica</i> var. <i>hiiranensis</i> (Rosaceae)	0.32	80.29
<i>Machilus zuihoensis</i> (Lauraceae)	0.32	80.61
<i>Croton cascarilloides</i> (Euphorbiaceae)	0.32	80.92
<i>Litsea akoensis</i> (Lauraceae)	0.31	81.23
<i>Bridelia tomentosa</i> (Euphorbiaceae)	0.31	81.54
<i>Turpinia formosana</i> (Staphyleaceae)	0.30	81.85
<i>Wendlandia formosana</i> (Rubiaceae)	0.30	82.15
<i>Randia sinensis</i> (Rubiaceae)	0.30	82.45
<i>Drypetes littoralis</i> (Euphorbiaceae)	0.29	82.74
<i>Wendlandia uvariifolia</i> (Rubiaceae)	0.28	83.03
<i>Palaquium formosanum</i> (Sapotaceae)	0.28	83.31
<i>Mallotus japonicus</i> (Euphorbiaceae)	0.28	83.59
<i>Broussonetia papyrifera</i> (Moraceae)	0.27	83.87
<i>Koeleruteria henryi</i> (Sapindaceae)	0.27	84.14
<i>Machilus thunbergii</i> (Lauraceae)	0.26	84.40
<i>Callicarpa remotiserrulata</i> (Verbenaceae)	0.26	84.65
<i>Rhus semialata</i> var. <i>roxburghiana</i> (Anacardiaceae)	0.26	84.91
<i>Diospyros maritima</i> (Ebenaceae)	0.24	85.15
<i>Syzygium euphlebiu</i> (Myrtaceae)	0.24	85.40
<i>Ardisia quinqueгона</i> (Myrsinaceae)	0.24	85.64
<i>Photinia lucida</i> (Rosaceae)	0.24	85.88
<i>Antidesma pentandrum</i> var. <i>barbatum</i> (Euphorbiaceae)	0.24	86.11
<i>Villebrunea pedunculata</i> (Urticaceae)	0.23	86.34
<i>Sphaeropteris lepifera</i> (Cyatheaceae)	0.22	86.57
<i>Machilus obovatifolia</i> (Lauraceae)	0.22	86.79
<i>Sapium discolor</i> (Euphorbiaceae)	0.22	87.01
<i>Symplocos modesta</i> (Symplocaceae)	0.22	87.24
<i>Murraya euchrestifolia</i> (Rutaceae)	0.22	87.46
<i>Castanopsis stellato-spina</i> (Fagaceae)	0.22	87.67
<i>Terminalis catappa</i> (Combretaceae)	0.21	87.89
<i>Boehmeria zollingeriana</i> (Urticaceae)	0.21	88.10
<i>Myrica adenophora</i> var. <i>kusanoi</i> (Myricaceae)	0.21	88.31
<i>Celtis sinensis</i> (Ulmaceae)	0.21	88.52
<i>Elaeocarpus sylvestris</i> (Elaeocarpaceae)	0.21	88.73
<i>Neolitsea parvigena</i> (Lauraceae)	0.21	88.94
<i>Syzygium kuskusense</i> (Myrtaceae)	0.20	89.14
<i>Maesa japonica</i> (Myrsinaceae)	0.20	89.34
<i>Eurya chinensis</i> (Theaceae)	0.20	89.53

Table 3. Composition of woody species in forest type Ia (*Ficus-Machilus* forest of the Hengchun Peninsula in the southernmost Taiwan). IV, relative dominance; CUM, cumulative dominance. Only species with IV ≥ 0.2 are included.

Species	IV	CUM
<i>Dysoxylum kuskusense</i> (Meliaceae)	4.43	4.43
<i>Bischofia javanica</i> (Euphorbiaceae)	4.10	8.53
<i>Psychotria rubra</i> (Rubiaceae)	3.37	11.90
<i>Laportea pterostigma</i> (Urticaceae)	3.31	15.21
<i>Lagerstroemia subcostata</i> (Lythraceae)	3.19	18.40
<i>Schefflera octophylla</i> (Araliaceae)	2.46	20.86
<i>Machilus japonica</i> var. <i>kusanoi</i> (Lauraceae)	2.24	23.10
<i>Ardisia sieboldii</i> (Myrsinaceae)	2.12	25.22
<i>Turpinia ternata</i> (Staphyleaceae)	1.81	27.02
<i>Ficus fistulosa</i> (Moraceae)	1.71	28.73
<i>Sloanea formosana</i> (Elaeocarpaceae)	1.67	30.40
<i>Scolopia oldhamii</i> (Flacourtiaceae)	1.60	32.00
<i>Diospyros eriantha</i> (Ebenaceae)	1.53	33.53
<i>Gordonia axillaris</i> (Theaceae)	1.53	35.06
<i>Ficus benjamina</i> (Moraceae)	1.50	36.56
<i>Acacia confusa</i> (Leguminosae)	1.50	38.06
<i>Aglaiella elliptifolia</i> (Meliaceae)	1.49	39.55
<i>Drypetes hieranensis</i> (Euphorbiaceae)	1.45	41.00
<i>Glycosmis citrifolia</i> (Rutaceae)	1.44	42.44
<i>Ginnomomum reticulatum</i> (Lauraceae)	1.38	43.82
<i>Champereia manillana</i> (Santalaceae)	1.37	45.19
<i>Castanopsis indica</i> (Fagaceae)	1.26	46.45
<i>Murraya paniculata</i> (Rutaceae)	1.25	47.70
<i>Aglaiella formosana</i> (Meliaceae)	1.18	48.88
<i>Vitex negundo</i> (Verbenaceae)	1.17	50.06
<i>Ficus septica</i> (Moraceae)	1.12	51.18
<i>Ilex rotunda</i> (Aquifoliaceae)	1.05	52.23
<i>Cryptocarya concinna</i> (Lauraceae)	1.05	53.28
<i>Michelia compressa</i> (Magnoliaceae)	1.04	54.32
<i>Schima superba</i> var. <i>kankensis</i> (Theaceae)	0.99	55.30
<i>Pouteria obovata</i> (Sapotaceae)	0.98	56.29
<i>Glochidion rubrum</i> (Euphorbiaceae)	0.95	57.24
<i>Ficus irisana</i> (Moraceae)	0.94	58.18
<i>Sapindus mukorossii</i> (Sapindaceae)	0.91	59.09
<i>Gardenia jasminoides</i> (Rubiaceae)	0.91	60.00
<i>Ficus microcarpa</i> (Moraceae)	0.90	60.90
<i>Beilschmiedia erythrophloia</i> (Lauraceae)	0.87	61.77
<i>Ficus ampelae</i> (Moraceae)	0.84	62.61
<i>Viburnum odoratissimum</i> (Caprifoliaceae)	0.80	63.41
<i>Ilex uraiensis</i> (Aquifoliaceae)	0.77	64.18
<i>Macaranga tanarius</i> (Euphorbiaceae)	0.77	64.95
<i>Melanolepis multiglandulosa</i> (Euphorbiaceae)	0.76	65.71
<i>Daphniphyllum glaucescens</i> ssp. <i>oldhamii</i> (Daphniphyllaceae)	0.73	66.44
<i>Leea guineensis</i> (Leeaceae)	0.73	67.18
<i>Bridelia balansae</i> (Euphorbiaceae)	0.68	67.85
<i>Ilex cochinchinensis</i> (Aquifoliaceae)	0.64	68.50
<i>Lasianthus chinensis</i> (Rubiaceae)	0.64	69.13
<i>Clausena excavata</i> (Rutaceae)	0.63	69.76
<i>Maytenus diversifolia</i> (Celastraceae)	0.62	70.38
<i>Lindera akoensis</i> (Lauraceae)	0.62	71.00
<i>Glochidion philippicum</i> (Euphorbiaceae)	0.61	71.61
<i>Syzygium formosanum</i> (Myrtaceae)	0.60	72.20
<i>Saverinia buxifolia</i> (Rutaceae)	0.59	72.80
<i>Neonauclea reticulata</i> (Rubiaceae)	0.58	73.37
<i>Euodia merrillii</i> (Rutaceae)	0.57	73.94
<i>Ficus wightiana</i> (Moraceae)	0.56	74.50
<i>Schefflera actinophylla</i> (Araliaceae)	0.55	75.05
<i>Fraxinus formosana</i> (Oleaceae)	0.54	75.60
<i>Decaspermum gracilentum</i> (Myrtaceae)	0.53	76.13
<i>Ficus virgata</i> (Moraceae)	0.52	76.65
<i>Distylium racemosum</i> (Hamamelidaceae)	0.52	77.16
<i>Diospyros discolor</i> (Ebenaceae)	0.51	77.67
<i>Leucaena glauca</i> (Leguminosae)	0.50	78.17
<i>Trema orientalis</i> (Ulmaceae)	0.50	78.68
<i>Mallotus paniculatus</i> (Euphorbiaceae)	0.49	79.16
<i>Pittosporum tobira</i> (Pittosporaceae)	0.49	79.65
<i>Eurya hayatai</i> (Theaceae)	0.48	80.13
<i>Helicia formosana</i> (Proteaceae)	0.46	80.59
<i>Gelonium aequoreum</i> (Euphorbiaceae)	0.46	81.04
<i>Capparis micrantha</i> var. <i>henryi</i> (Capparidaceae)	0.44	81.49
<i>Pandanus odoratissimus</i> var. <i>sinensis</i> (Pandanaceae)	0.44	81.93
<i>Reevesia formosana</i> (Sterculiaceae)	0.42	82.35
<i>Raphiolepis indica</i> var. <i>hiiranensis</i> (Rosaceae)	0.42	82.76
<i>Mallotus philippensis</i> (Euphorbiaceae)	0.40	83.17
<i>Wendlandia formosana</i> (Rubiaceae)	0.39	83.56
<i>Litsea kruckovii</i> (Lauraceae)	0.38	83.94
<i>Drypetes littoralis</i> (Euphorbiaceae)	0.38	84.32
<i>Palaquium formosanum</i> (Sapotaceae)	0.37	84.69
<i>Radermachia sinica</i> (Bignoniaceae)	0.36	85.05
<i>Machilus zuihoensis</i> (Lauraceae)	0.35	85.40
<i>Callicarpa remotiserrulata</i> (Verbenaceae)	0.33	85.73
<i>Ficus nervosa</i> (Moraceae)	0.33	86.06
<i>Diospyros maritima</i> (Ebenaceae)	0.32	86.38
<i>Syzygium euphlebiu</i> (Myrtaceae)	0.32	86.69
<i>Ardisia quinquegona</i> (Myrsinaceae)	0.31	87.01
<i>Photinia lucida</i> (Rosaceae)	0.31	87.32
<i>Kleinhovia hospita</i> (Sterculiaceae)	0.30	87.62
<i>Ehretia thyrsoiflora</i> (Boraginaceae)	0.29	87.91
<i>Sphaeropteris lepifera</i> (Cyatheaceae)	0.29	88.20
<i>Machilus obovatifolia</i> (Lauraceae)	0.29	88.49
<i>Symplocos modesta</i> (Symplocaceae)	0.29	88.78
<i>Castanopsis stellato-spina</i> (Fagaceae)	0.28	89.06
<i>Terminalia catappa</i> (Combretaceae)	0.28	89.34
<i>Machilus thunbergii</i> (Lauraceae)	0.27	89.62
<i>Myrica adenophora</i> var. <i>kusanoi</i> (Myricaceae)	0.27	89.89
<i>Syzygium kuskusense</i> (Myrtaceae)	0.26	90.15
<i>Eurya chinensis</i> (Theaceae)	0.26	90.41
<i>Osmanthus marginatus</i> (Oleaceae)	0.25	90.66
<i>Antidesma pentandrum</i> var. <i>barbatum</i> (Euphorbiaceae)	0.24	90.90
<i>Acer alboburpurascens</i> (Aceraceae)	0.21	91.11
<i>Pisonia umbellifera</i> (Nyctaginaceae)	0.21	91.32
<i>Neolitsea parvigemma</i> (Lauraceae)	0.20	91.52
<i>Celtis formosana</i> (Ulmaceae)	0.20	91.72
<i>Astronia ferruginea</i> (Melastomataceae)	0.20	91.93

and *Fissistigma glaucescens*, are common.

Subtype Ib comprises 34 plots occurring mostly in the foothill region of southwestern Taiwan. It contains many species common to the forests of the Hengchun Peninsula. However, the families Meliaceae, Theaceae, Aquifoliaceae, and Fagaceae are much less abundant, while Ulmaceae, Sapindaceae, and Sterculiaceae are fairly common. The most abundant tree species in these forests are *Lagerstroemia subcostata*, *Machilus japonica* var. *kusanoi*, *Diospyros eriantha*, *Sapindus mukor-*

ossii, *Ardisia quinquegona*, *Photinia lucida*, *Kleinhovia hospita*, *Ehretia thyrsoiflora*, *Sphaeropteris lepifera*, *Machilus obovatifolia*, *Symplocos modesta*, *Castanopsis stellato-spina*, *Terminalia catappa*, *Machilus thunbergii*, *Myrica adenophora* var. *kusanoi*, *Syzygium kuskusense*, *Eurya chinensis*, *Osmanthus marginatus*, *Antidesma pentandrum* var. *barbatum*, *Acer alboburpurascens*, *Pisonia umbellifera*, *Neolitsea parvigemma*, *Celtis formosana*, and *Astronia ferruginea*.

Table 4. Composition of woody species in the forests of the Lanyu Island (*Ficus-Machilus* forest). IV, relative dominance; CUM, cumulative dominance. Only species with IV $\geq$ 0.1 are included (Liu and Lin, 1978).

Species	IV	CUM
<i>Ficus benjamina</i> (Moraceae)	13.32	13.32
<i>Garcinia linii</i> (Guttiferae)	7.71	21.03
<i>Bischofia javanica</i> (Euphorbiaceae)	7.06	28.09
<i>Ardisia sieboldii</i> (Myrsinaceae)	4.34	32.43
<i>Schefflera octophylla</i> (Araliaceae)	4.30	36.73
<i>Timonius arboreus</i> (Rubiaceae)	3.96	40.69
<i>Astronia ferruginea</i> (Melastomataceae)	3.70	44.39
<i>Planchonella obovata</i> (Sapotaceae)	3.19	47.58
<i>Syzygium densinervium</i> var. <i>insulare</i> (Myrtaceae)	3.00	50.58
<i>Machilus thunbergii</i> (Lauraceae)	2.90	53.48
<i>Boerlagiodendron pectinatum</i> (Araliaceae)	2.61	56.09
<i>Ficus microcarpa</i> (Moraceae)	1.95	58.04
<i>Michelia compressa</i> (Magnoliaceae)	1.93	59.97
<i>Elaeocarpus argenteus</i> (Elaeocarpaceae)	1.85	61.82
<i>Acmena acuminatissima</i> (Myrtaceae)	1.84	63.66
<i>Ficus nervosa</i> (Moraceae)	1.74	65.40
<i>Litsea garciae</i> (Lauraceae)	1.72	67.12
<i>Ficus fistulosa</i> (Moraceae)	1.44	68.56
<i>Planchonella duclitan</i> (Sapotaceae)	1.10	69.66
<i>Elaeocarpus sphaericus</i> var. <i>hayatae</i> (Elaeocarpaceae)	1.07	70.73
<i>Ficus virgata</i> (Moraceae)	0.98	71.71
<i>Syzygium triplinatum</i> (Myrtaceae)	0.96	72.67
<i>Elaeocarpus multiflorus</i> (Elaeocarpaceae)	0.92	73.59
<i>Ficus ampelas</i> (Moraceae)	0.90	74.49
<i>Excoecaria kawakamii</i> (Euphorbiaceae)	0.89	75.38
<i>Pinanga bavensis</i> (Palmae)	0.89	76.27
<i>Wendlandia luzoniensis</i> (Rubiaceae)	0.88	77.15
<i>Calophyllum inophyllum</i> (Guttiferae)	0.83	77.98
<i>Garcinia subelliptica</i> (Guttiferae)	0.81	78.79
<i>Alsophila fenicis</i> (Cyatheaceae)	0.77	79.56
<i>Styrax japonica</i> var. <i>kotoensis</i> (Styracaceae)	0.76	80.32
<i>Linociera ramiflora</i> (Oleaceae)	0.76	81.08
<i>Laportea batanensis</i> (Urticaceae)	0.75	81.83
<i>Flacourtia rukam</i> (Flacourtiaceae)	0.73	82.56
<i>Syzygium claviflorum</i> (Myrtaceae)	0.72	83.28
<i>Sphaeropteris lepifera</i> (Cyatheaceae)	0.70	83.98
<i>Antidesma hontausshanensis</i> (Euphorbiaceae)	0.68	84.66
<i>Symplocos cochinchinensis</i> var. <i>philippinensis</i> (Symplocaceae)	0.61	85.27
<i>Palaquium formosanum</i> (Sapotaceae)	0.58	85.85
<i>Myristica cagayanensis</i> (Myristicaceae)	0.57	86.42
<i>Laportea pterostigma</i> var. <i>subglabra</i> (Urticaceae)	0.55	86.97
<i>Leea philippinensis</i> (Leeaceae)	0.54	87.51
<i>Daphniphyllum glaucescens</i> ssp. <i>oldhamii</i> (Daphniphyllaceae)	0.53	88.04
<i>Pterospermum niveum</i> (Sterculiaceae)	0.51	88.55
<i>Diospyros maritima</i> (Ebenaceae)	0.50	89.05
<i>Ficus wightiana</i> (Moraceae)	0.50	89.55
<i>Linociera coriacea</i> (Oleaceae)	0.48	90.03
<i>Artocarpus lanceolata</i> (Moraceae)	0.46	90.49
<i>Distylium racemosum</i> (Hamamelidaceae)	0.45	90.94
<i>Sterculia ceramica</i> (Sterculiaceae)	0.44	91.38
<i>Turpinia ternata</i> (Staphyleaceae)	0.42	91.80
<i>Leucosyke quadrinervia</i> (Urticaceae)	0.41	92.21
<i>Myristica simarum</i> (Myristicaceae)	0.40	92.61
<i>Randia wallichii</i> (Rubiaceae)	0.39	93.00
<i>Chisocheton kanehirai</i> (Meliaceae)	0.37	93.37
<i>Endiandra coriacea</i> (Lauraceae)	0.34	93.71
<i>Nothapodytes foetida</i> (Icacinaeae)	0.34	94.05
<i>Rhus succedanea</i> (Anacardiaceae)	0.34	94.39
<i>Dysoxylum cumingianum</i> (Meliaceae)	0.31	94.70
<i>Ilex kusanoi</i> (Aquifoliaceae)	0.30	95.00
<i>Clausena brevistylia</i> (Rutaceae)	0.28	95.28
<i>Ficus caudato-longifolia</i> (Moraceae)	0.27	95.55
<i>Turpinia ovalifolia</i> (Staphyleaceae)	0.25	95.80
<i>Meliosma rhoifolia</i> (Sabiaceae)	0.23	96.03
<i>Prunus grisea</i> (Rosaceae)	0.20	96.23
<i>Geniostema glabra</i> (Loganiaceae)	0.19	96.42
<i>Ficus irisana</i> (Moraceae)	0.19	96.61
<i>Aglia tetrapetala</i> (Meliaceae)	0.19	96.80
<i>Samocarpus cuneiformis</i> (Anacardiaceae)	0.17	96.97
<i>Ilex integra</i> (Aquifoliaceae)	0.16	97.13
<i>Podocarpus macrophyllus</i> (Podocarpaceae)	0.15	97.28
<i>Glochidion zeylanicum</i> (Euphorbiaceae)	0.15	97.43
<i>Dendropanax trifidus</i> (Araliaceae)	0.13	97.56
<i>Stemonurus luzoniensis</i> (Icacinaeae)	0.12	97.68
<i>Idesia polycarpa</i> (Flacourtiaceae)	0.11	97.79
<i>Samocarpus gigantifolia</i> (Anacardiaceae)	0.11	97.90
<i>Pisonia umbellifera</i> (Nyctaginaceae)	0.10	98.00
<i>Osmanthus marginatus</i> (Oleaceae)	0.10	98.10
<i>Aglia elliptifolia</i> (Meliaceae)	0.10	98.20

ossii, *Litsea krukovii*, *Ficus irisana*, *Mallotus philippensis*, *Aphananthe aspera*, *Murraya paniculata*, *Glycosmis citrifolia*, *Champereia manillana*, *Celtis formosana*, *Macaranga tanarius*, and *Kleinhovia hospita*.

Despite the closeness of Lanyu Island (ca. 47 km² in size) to the southeastern shore of Taiwan, its flora is closely related to the Mallesian Region, especially the Philippinean Province of the Paleotropical Kingdom. The most speciose families contain Moraceae (25 species), Rubiaceae (23), Euphorbiaceae (22), and Lauraceae (10). However, the family Fagaceae is not represented in this district at all. Compared with tropical rain forests, the Lanyu forests have a lower canopy (9 to 20

m) due to persistent high monsoon winds. However, there are 32 species producing buttresses, about 18 species showing stilt roots, and more than 14 species with cauliflory. The most dominant species (Table 4) in the forests are *Ficus benjamina*, *Garcinia linii*, and *Bischofia javanica*. Other prominent trees are *Ardisia sieboldii*, *Schefflera octophylla*, *Timonius arboreus*, *Astronia ferruginea*, *Planchonella obovata*, *Syzygium densinervium* var. *insulare*, *Machilus thunbergii*, and *Boerlagiodendron pectinatum*.

Type II

This type comprises 238 plots throughout the whole island. It is equivalent to the *Ma-*

Table 5. Composition of woody species in forest type II (*Machilus-Castanopsis* forest). IV, relative dominance; CUM, cumulative dominance. Only species with IV ≥ 0.2 are included.

Species	IV	CUM		
<i>Schefflera octophylla</i> (Araliaceae)	3.97	3.97	<i>Machilus konishii</i> (Lauraceae)	0.45 65.20
<i>Machilus thunbergii</i> (Lauraceae)	3.05	7.02	<i>Bridelia balansae</i> (Euphorbiaceae)	0.45 65.64
<i>Ardisia sieboldii</i> (Myrsinaceae)	2.62	9.64	<i>Lithocarpus amygdalifolius</i> (Fagaceae)	0.44 66.09
<i>Turpinia formosana</i> (Staphyleaceae)	2.21	11.85	<i>Castanopsis indica</i> (Fagaceae)	0.44 66.53
<i>Psychotria rubra</i> (Rubiaceae)	2.08	13.93	<i>Syzygium buxifolium</i> (Myrtaceae)	0.43 66.96
<i>Beilschmiedia erythrophloia</i> (Lauraceae)	1.85	15.79	<i>Osmanthus marginatus</i> (Oleaceae)	0.42 67.38
<i>Lagerstroemia subcostata</i> (Lythraceae)	1.82	17.61	<i>Celtis formosana</i> (Ulmaceae)	0.41 67.79
<i>Machilus japonica</i> var. <i>kusanoi</i> (Lauraceae)	1.54	19.14	<i>Fraxinus formosana</i> (Oleaceae)	0.41 68.20
<i>Daphniphyllum glaucescens</i> ssp. <i>oldhamii</i> (Daphniphyllaceae)	1.45	20.60	<i>Elaeocarpus japonicus</i> (Elaeocarpaceae)	0.40 68.60
<i>Villebrunea pedunculata</i> (Urticaceae)	1.41	22.01	<i>Osmanthus matsumuranus</i> (Oleaceae)	0.39 68.99
<i>Litsea acuminata</i> (Lauraceae)	1.40	23.41	<i>Neolitsea parvigeoma</i> (Lauraceae)	0.38 69.37
<i>Helicia formosana</i> (Proteaceae)	1.31	24.72	<i>Viburnum odoratissimum</i> (Caprifoliaceae)	0.38 69.74
<i>Engelhardtia roxburghiana</i> (Juglandaceae)	1.27	25.99	<i>Mallotus philippensis</i> (Euphorbiaceae)	0.37 70.11
<i>Mallotus paniculatus</i> (Euphorbiaceae)	1.24	27.23	<i>Maesa tenara</i> (Myrsinaceae)	0.37 70.48
<i>Cyclobalanopsis glauca</i> (Fagaceae)	1.22	28.45	<i>Drypetes hieranensis</i> (Euphorbiaceae)	0.36 70.85
<i>Elaeocarpus sylvestris</i> (Elaeocarpaceae)	1.18	29.63	<i>Symplocos cochinchinensis</i> ssp. <i>laurina</i> (Symplocaceae)	0.36 71.21
<i>Wendlandia formosana</i> (Rubiaceae)	1.17	30.80	<i>Mallotus japonicus</i> (Euphorbiaceae)	0.36 71.57
<i>Glochidion rubrum</i> (Euphorbiaceae)	1.08	31.89	<i>Alsophila spinulosa</i> (Cyatheaceae)	0.35 71.91
<i>Styrax suberifolia</i> (Styracaceae)	1.01	32.90	<i>Callicarpa formosana</i> (Verbenaceae)	0.35 72.26
<i>Tricalysia dubia</i> (Rubiaceae)	0.94	33.84	<i>Pittosporum illicioides</i> (Pittosporaceae)	0.35 72.61
<i>Michelia compressa</i> (Magnoliaceae)	0.92	34.76	<i>Ficus formosana</i> (Moraceae)	0.34 72.95
<i>Ficus erecta</i> var. <i>beecheana</i> (Moraceae)	0.90	35.66	<i>Maesa japonica</i> (Myrsinaceae)	0.34 73.29
<i>Diospyros eriantha</i> (Ebenaceae)	0.87	36.53	<i>Pasania konishii</i> (Fagaceae)	0.33 73.62
<i>Gordonia axillaris</i> (Theaceae)	0.77	37.30	<i>Phoebe formosana</i> (Lauraceae)	0.32 73.94
<i>Glycosmis citrifolia</i> (Rutaceae)	0.75	38.05	<i>Viburnum luzonicum</i> var. <i>formosanum</i> (Caprifoliaceae)	0.32 74.26
<i>Machilus zuihoensis</i> (Lauraceae)	0.71	38.76	<i>Litsea akoensis</i> (Lauraceae)	0.32 74.58
<i>Saurauia oldhamii</i> (Actinidiaceae)	0.71	39.48	<i>Blastus cochinchinensis</i> (Melastomataceae)	0.31 74.89
<i>Gardenia jasminoides</i> (Rubiaceae)	0.71	40.18	<i>Carpinus kawakamii</i> (Betulaceae)	0.31 75.20
<i>Ficus fistulosa</i> (Moraceae)	0.70	40.88	<i>Lindera megaphylla</i> (Lauraceae)	0.30 75.50
<i>Cleyera japonica</i> (Theaceae)	0.66	41.55	<i>Symplocos modesta</i> (Symplocaceae)	0.30 75.81
<i>Schima superba</i> var. <i>kankensis</i> (Theaceae)	0.65	42.20	<i>Itea oldhamii</i> (Saxifragaceae)	0.30 76.11
<i>Neolitsea konishii</i> (Lauraceae)	0.65	42.85	<i>Sapindus mukorossi</i> (Sapindaceae)	0.30 76.41
<i>Sloanea formosana</i> (Elaeocarpaceae)	0.65	43.49	<i>Adinandra formosana</i> (Theaceae)	0.30 76.71
<i>Castanopsis stellato-spina</i> (Fagaceae)	0.64	44.14	<i>Cryptocarya concinna</i> (Lauraceae)	0.30 77.00
<i>Pasania kawakamii</i> (Fagaceae)	0.64	44.78	<i>Ilex uraiensis</i> (Aquifoliaceae)	0.29 77.29
<i>Sphaeropteris lepifera</i> (Cyatheaceae)	0.64	45.42	<i>Ilex formosana</i> (Aquifoliaceae)	0.28 77.58
<i>Eriobotrya deflexa</i> (Rosaceae)	0.62	46.04	<i>Wendlandia uvariifolia</i> (Rubiaceae)	0.28 77.85
<i>Litsea nakaii</i> (Lauraceae)	0.62	46.66	<i>Ilex triflora</i> var. <i>kanehirai</i> (Aquifoliaceae)	0.28 78.13
<i>Cleyera japonica</i> var. <i>morii</i> (Theaceae)	0.62	47.28	<i>Cinnamomum camphora</i> (Lauraceae)	0.27 78.41
<i>Syzygium formosanum</i> (Myrtaceae)	0.62	47.89	<i>Eurya acuminata</i> (Theaceae)	0.27 78.67
<i>Machilus japonica</i> (Lauraceae)	0.61	48.51	<i>Randia cochinchinensis</i> (Rubiaceae)	0.26 78.94
<i>Litsea kruckovii</i> (Lauraceae)	0.61	49.12	<i>Bischofia javanica</i> (Euphorbiaceae)	0.25 79.19
<i>Castanopsis carlesii</i> (Fagaceae)	0.59	49.71	<i>Ardisia virens</i> (Myrsinaceae)	0.25 79.44
<i>Castanopsis formosana</i> (Fagaceae)	0.59	50.30	<i>Pithecellobium lucidum</i> (Leguminosae)	0.25 79.69
<i>Cryptocarya chinensis</i> (Lauraceae)	0.58	50.88	<i>Acacia confusa</i> (Leguminosae)	0.24 79.93
<i>Pasania ternaticupula</i> (Fagaceae)	0.58	51.45	<i>Trema orientalis</i> (Ulmaceae)	0.24 80.17
<i>Pasania brevicaudata</i> (Fagaceae)	0.58	52.03	<i>Hydrangea angustipetala</i> (Saxifragaceae)	0.24 80.41
<i>Cinnamomum insularimontanum</i> (Lauraceae)	0.57	52.60	<i>Helicia cochinchinensis</i> (Proteaceae)	0.24 80.64
<i>Ardisia quinquegona</i> (Myrsinaceae)	0.56	53.17	<i>Cyclobalanopsis stenophylla</i> var. <i>stenophylloides</i> (Fagaceae)	0.24 80.88
<i>Rhus succedanea</i> (Anacardiaceae)	0.56	53.73	<i>Cinnamomum osmophloeum</i> (Lauraceae)	0.23 81.11
<i>Machilus obovatifolia</i> (Lauraceae)	0.55	54.28	<i>Vitex quinata</i> (Verbenaceae)	0.23 81.34
<i>Ilex cochinchinensis</i> (Aquifoliaceae)	0.55	54.82	<i>Sapindus discolor</i> (Euphorbiaceae)	0.23 81.57
<i>Illicium arborescens</i> (Illiciaceae)	0.55	55.37	<i>Eurya chinensis</i> (Theaceae)	0.22 81.79
<i>Diospyros morrisiana</i> (Ebenaceae)	0.54	55.91	<i>Eurya hayatai</i> (Theaceae)	0.22 82.01
<i>Acer albobuppurascens</i> (Aceraceae)	0.54	56.45	<i>Lithocarpus lepidocarpus</i> (Fagaceae)	0.22 82.24
<i>Acer serrulatum</i> (Aceraceae)	0.53	56.98	<i>Helicia rengetiensis</i> (Proteaceae)	0.22 82.45
<i>Syzygium euphlebiu</i> (Myrtaceae)	0.52	57.49	<i>Syzygium kusukusense</i> (Myrtaceae)	0.22 82.67
<i>Myrsine sequinii</i> (Myrsinaceae)	0.51	58.01	<i>Symplocos glomerata</i> ssp. <i>congesta</i> (Symplocaceae)	0.22 82.89
<i>Zelkova serrata</i> (Ulmaceae)	0.50	58.51	<i>Ilex ficoidea</i> (Aquifoliaceae)	0.21 83.10
<i>Lindera communis</i> (Lauraceae)	0.50	59.01	<i>Aucuba chinensis</i> (Cornaceae)	0.20 83.30
<i>Turpinia ternata</i> (Staphyleaceae)	0.50	59.51	<i>Adinandra formosana</i> var. <i>hypochlora</i> (Theaceae)	0.20 83.51
<i>Hydrangea chinensis</i> (Saxifragaceae)	0.50	60.01	<i>Quercus tarokoensis</i> (Fagaceae)	0.20 83.71
<i>Prunus phaeosticta</i> (Rosaceae)	0.50	60.51	<i>Styrax formosana</i> (Styracaceae)	0.20 83.91
<i>Itea parviflora</i> (Saxifragaceae)	0.50	61.00	<i>Cinnamomum randaiense</i> (Lauraceae)	0.20 84.11
<i>Cyclobalanopsis championii</i> (Fagaceae)	0.48	61.49	<i>Ficus septica</i> (Moraceae)	0.20 84.31
<i>Cyclobalanopsis longinux</i> (Fagaceae)	0.48	61.97	<i>Lasianthus plagiophyllus</i> (Rubiaceae)	0.20 84.50
<i>Eurya japonica</i> (Theaceae)	0.48	62.44	<i>Morus australis</i> (Moraceae)	0.20 84.70
<i>Astronia ferruginea</i> (Melastomataceae)	0.48	62.92		
<i>Ardisia cornudentata</i> (Myrsinaceae)	0.46	63.38		
<i>Ficus virgata</i> (Moraceae)	0.46	63.84		
<i>Ficus nervosa</i> (Moraceae)	0.46	64.30		
<i>Arenga engleri</i> (Palmae)	0.45	64.75		

chilus-Castanopsis forest type described in the earlier study (Su, 1984). This type of forest occurs in narrow bands in the northernmost (110–400 m asl) and southernmost parts (300–700 m asl) of Taiwan. However, it occurs in rather wider bands in central (500–1,500 m) and eastern Taiwan (400–1,100 m asl). Forests of this type are usually susceptible to frequent human disturbance. Relatively intact or unaltered forests are largely restricted to the eastern part of the island. Floristically and physiognomically the forests are greatly modified by topographic position, aspect, position relative to moisture gradients, and disturbances.

This type is the most species-rich of all the evergreen broad-leaved forests in Taiwan. The woody flora (including stranglers) of the 238 sampling plots is composed of 496 species in 246 genera and 92 families. There are about 303 trees, 110 shrubs, and 83 lianas/vines. The most important families in terms of species number are Lauraceae (43 species), Fagaceae (25), and Moraceae (25), followed by Rubiaceae (24), Euphorbiaceae (22), Theaceae (20), Rosaceae (17), Aquifoliaceae (16), Rutaceae (15), Symplocaceae (14), Araliaceae (11), Leguminosae (11), Myrsinaceae (11), Verbenaceae (11), and Saxifragaceae (10). The most speciose genera include *Ficus* (20 species), *Ilex* (16), *Symplocos* (14), *Cinnamomum* (10), *Litsea* (10), *Machilus* (8), and *Cyclobalanopsis* (8). A total of 12 families have family IV of over 2. Eight of the top families are Lauraceae (FIV = 17.7), Fagaceae (8.6), Rubiaceae (6.1), Euphorbiaceae (5.3), Myrsinaceae (5.2), Theaceae (4.8), Araliaceae (4.6), and Moraceae (4.2). The principal tree species (Table 5) in order are *Schefflera octophylla*, *Machilus thunbergii*, *Ardisia sieboldii*, *Turpinia formosana*, *Beilschmiedia erythrophloia*, *Lagerstroemia subcostata*, *Machilus japonica* var. *kusanoi*, *Daphniphyllum glaucescens* ssp. *oldhamii*, *Villebrunea pedunculata*, *Litsea acuminata*, *Helicia formosana*, *Engelhardtia roxburghiana*, *Mallotus paniculatus*, *Cyclobalanopsis glauca*, *Elaeocarpus sylvestris*, *Wendlandia formosana*, *Glochidion rubrum*, *Styrax suberifolia* and *Tricalysia dubia*. The 30 most abundant tree species collectively comprise 40% of total IV. The most dominant shrub species include *Psychotria rubra*,

Glycosmis citrifolia, *Hydrangea chinensis*, *Ardisia cornudentata*, *Arenga engleri*, *Viburnum odoratissimum*, *Maesa tenera*, *Callicarpa formosana*, *Pittosporum illiciodes*, *Ficus formosana*, *Maesa japonica*, and *Blastus cochinchinensis*. Large lianas are frequent, represented mainly by *Bauhinia championii*, *Demonorops margaritae*, *Mussaenda parviflora*, *Hiptage benghalensis*, *Mucuna macrocarpa*, *Fissistigma oldhamii*, *Erycibe henryi*, *Elaeagnus thunbergii*, *Ficus sarmentosa* var. *henryi*, *Stauntonia hexaphylla*, *Schefflera odorata*, and *Pileostegia viburnoides*.

In the DCA diagram (Fig. 2), the plots (Subtype IIa) from the Hengchun Peninsula are obviously quite distinct from other plots (Subtype IIb) of the same forest type. Many species better represented in the forests of the Hengchun Peninsula become rare or completely absent northwards. Examples are *Schima superba* var. *kankoensis*, *Castanopsis stellato-spina*, *Machilus obovatifolia*, *Syzygium euphlebioides*, *Illicium arborescens*, *Ilex cochinchinensis*, *Cyclobalanopsis championii*, etc. In contrast, species attaining much dominance in the northern plots include *Machilus thunbergii*, *Turpinia formosana*, *Lagerstroemia subcostata*, *Cyclobalanopsis glauca*, *Ficus erecta* var. *beecheana*, *Villebrunea pedunculata*, and *Styrax suberifolia*.

Type III

A total of 277 plots are included as members of this type. It is comparable to that described in the earlier study (Su, 1984) as the lower *Quercus* forest. The forests are relatively undisturbed, and usually form a continuous tract along the western and eastern fringes of the Central Mountain Range. They are prevalent in areas of lower to middle altitudes, usually occurring at 1,400–1,700 m in central Taiwan, but at 300–700 m in the northernmost and 700–1,000 m in the southernmost part. In eastern Taiwan it occurs between 1,000 and 1,600 m. A large number of tree species appear in these montane broad-leaved forests. The lower and upper *Quercus* forests experience heavy cloud cover and frequent fog, and are often called cloud forests in Taiwan. The height of the canopy may reach 30–40 m. The stratification is characteristically three or four layers.

Table 6. Composition of woody species in forest type III (Lower *Quercus* forest). IV, relative dominance; CUM, cumulative dominance. Only species with IV ≥ 0.2 are included.

Species	IV	CUM		
<i>Machilus thunbergii</i> (Lauraceae)	5.48	5.48	<i>Schima superba</i> (Theaceae)	0.52 68.69
<i>Myrsine seguinii</i> (Myrsinaceae)	3.34	8.82	<i>Osmanthus matsumuranus</i> (Oleaceae)	0.51 69.20
<i>Cyclobalanopsis longinux</i> (Fagaceae)	2.79	11.61	<i>Lasianthus fordii</i> (Rubiaceae)	0.50 69.71
<i>Litsea acuminata</i> (Lauraceae)	2.61	14.23	<i>Ilex goshiensis</i> (Aquifoliaceae)	0.49 70.20
<i>Engelhardtia roxburghiana</i> (Juglandaceae)	2.61	16.83	<i>Cyclobalanopsis myrsinaefolia</i> (Fagaceae)	0.48 70.68
<i>Elaeocarpus japonicus</i> (Elaeocarpaceae)	2.43	19.27	<i>Pithecellobium lucidum</i> (Leguminosae)	0.47 71.15
<i>Diospyros morrisiana</i> (Ebenaceae)	2.14	21.40	<i>Eriobotrya deflexa</i> (Rosaceae)	0.46 71.61
<i>Castanopsis carlesii</i> (Fagaceae)	2.07	23.47	<i>Helicia cochinchinensis</i> (Proteaceae)	0.46 72.07
<i>Syzygium buxifolium</i> (Myrtaceae)	1.95	25.42	<i>Symplocos glauca</i> (Symplocaceae)	0.46 72.53
<i>Daphniphyllum glaucescens</i> ssp. <i>oldhamii</i> (Daphniphyllaceae)	1.79	27.21	<i>Lithocarpus amygdalifolius</i> (Fagaceae)	0.45 72.98
<i>Illicium arborescens</i> (Illiciaceae)	1.66	28.88	<i>Symplocos glomerata</i> ssp. <i>congesta</i> (Symplocaceae)	0.44 73.42
<i>Schefflera octophylla</i> (Araliaceae)	1.65	30.52	<i>Turpinia formosana</i> (Staphyleaceae)	0.43 73.85
<i>Adinandra formosana</i> (Theaceae)	1.47	32.00	<i>Cyclobalanopsis stenophylla</i> var. <i>stenophylloides</i> (Fagaceae)	0.43 74.29
<i>Eurya japonica</i> (Theaceae)	1.46	33.45	<i>Litsea coreana</i> (Lauraceae)	0.40 74.69
<i>Ardisia sieboldii</i> (Myrsinaceae)	1.45	34.90	<i>Hydrangea angustipetala</i> (Saxifragaceae)	0.40 75.09
<i>Prunus phaeosticta</i> (Rosaceae)	1.42	36.33	<i>Trochodendron aralioides</i> (Trochodendraceae)	0.38 75.47
<i>Cyclobalanopsis acuta</i> var. <i>paucidentata</i> (Fagaceae)	1.38	37.71	<i>Blastus cochinchinensis</i> (Melastomataceae)	0.38 75.85
<i>Ilex formosana</i> (Aquifoliaceae)	1.37	39.08	<i>Machilus zuihoensis</i> (Lauraceae)	0.37 76.21
<i>Elaeocarpus sylvestris</i> (Elaeocarpaceae)	1.26	40.34	<i>Gardenia jasminoides</i> (Rubiaceae)	0.37 76.58
<i>Helicia formosana</i> (Proteaceae)	1.25	41.59	<i>Ardisia cornudentata</i> (Myrsinaceae)	0.36 76.94
<i>Tricalysia dubia</i> (Rubiaceae)	1.24	42.83	<i>Photinia parvifolia</i> (Rosaceae)	0.32 77.26
<i>Meliosma squamulata</i> (Sabiaceae)	1.21	44.05	<i>Lindera communis</i> (Lauraceae)	0.31 77.57
<i>Eurya acuminata</i> (Theaceae)	1.21	45.26	<i>Ficus erecta beecheyana</i> (Moraceae)	0.30 77.87
<i>Michelia compressa</i> (Magnoliaceae)	1.13	46.39	<i>Lagerstroemia subcostata</i> (Lythraceae)	0.29 78.16
<i>Castanopsis carlesii</i> var. <i>sessilis</i> (Fagaceae)	1.11	47.50	<i>Machilus konishii</i> (Lauraceae)	0.29 78.44
<i>Pasania brevicaudata</i> (Fagaceae)	1.04	48.55	<i>Pasania rhombocarpa</i> (Fagaceae)	0.29 78.73
<i>Beilschmiedia erythrophloia</i> (Lauraceae)	1.02	49.57	<i>Litsea lili</i> (Lauraceae)	0.29 79.02
<i>Pyrenaria shinkoensis</i> (Theaceae)	0.96	50.53	<i>Hydrangea chinensis</i> (Saxifragaceae)	0.29 79.30
<i>Dendropanax pellicoidpunctata</i> (Araliaceae)	0.94	51.46	<i>Ilex asprella</i> (Aquifoliaceae)	0.28 79.58
<i>Psychotria rubra</i> (Rubiaceae)	0.93	52.40	<i>Cleyera japonica</i> (Theaceae)	0.27 79.86
<i>Itea parviflora</i> (Saxifragaceae)	0.92	53.32	<i>Helicia rengetiensis</i> (Proteaceae)	0.27 80.13
<i>Cinnamomum randaiense</i> (Lauraceae)	0.89	54.21	<i>Ilex ficoidea</i> (Aquifoliaceae)	0.27 80.40
<i>Randia cochinchinensis</i> (Rubiaceae)	0.88	55.09	<i>Pasania kawakamii</i> (Fagaceae)	0.27 80.67
<i>Rhododendron ellipticum</i> (Ericaceae)	0.87	55.96	<i>Rhododendron formosanum</i> (Ericaceae)	0.27 80.94
<i>Limlia uraiana</i> (Fagaceae)	0.86	56.81	<i>Cinnamomum camphora</i> (Lauraceae)	0.26 81.20
<i>Gordonia axillaris</i> (Theaceae)	0.86	57.67	<i>Rhododendron oldhamii</i> (Ericaceae)	0.26 81.45
<i>Myrica rubra</i> var. <i>acuminata</i> (Myricaceae)	0.76	58.43	<i>Pasania ternaticupula</i> (Fagaceae)	0.26 81.71
<i>Ardisia quinqueгона</i> (Myrsinaceae)	0.75	59.18	<i>Villebrunea pedunculata</i> (Urticaceae)	0.26 81.96
<i>Wendlandia formosana</i> (Rubiaceae)	0.72	59.90	<i>Vaccinium wrightii</i> (Ericaceae)	0.25 82.22
<i>Itea oldhamii</i> (Saxifragaceae)	0.71	60.61	<i>Cinnamomum osmophloeum</i> (Lauraceae)	0.25 82.47
<i>Neolitsea variabilis</i> (Lauraceae)	0.71	61.32	<i>Euonymus laxiflorus</i> (Celastraceae)	0.25 82.72
<i>Machilus japonica</i> (Lauraceae)	0.65	61.97	<i>Sloanea formosana</i> (Elaeocarpaceae)	0.24 82.96
<i>Camellia tenuifolia</i> (Theaceae)	0.62	62.59	<i>Ilex hayataiana</i> (Aquifoliaceae)	0.23 83.19
<i>Cyclobalanopsis glauca</i> (Fagaceae)	0.61	63.20	<i>Alnus formosana</i> (Betulaceae)	0.23 83.42
<i>Cleyera japonica</i> var. <i>morii</i> (Theaceae)	0.59	63.79	<i>Neolitsea acutotrinervia</i> (Lauraceae)	0.23 83.65
<i>Antidesma japonicum</i> var. <i>densiflorum</i> (Euphorbiaceae)	0.58	64.36	<i>Glochidion rubrum</i> (Euphorbiaceae)	0.23 83.88
<i>Litsea nakaii</i> (Lauraceae)	0.57	64.94	<i>Glochidion acuminatum</i> (Euphorbiaceae)	0.23 84.11
<i>Ternstroemia gymnanthera</i> (Theaceae)	0.57	65.50	<i>Ligustrum japonicum</i> (Oleaceae)	0.23 84.33
<i>Symplocos anomala</i> (Symplocaceae)	0.55	66.06	<i>Euscaphis japonica</i> (Staphyleaceae)	0.23 84.56
<i>Symplocos cochinchinensis</i> ssp. <i>laurina</i> (Symplocaceae)	0.53	66.59	<i>Syzygium formosanum</i> (Myrtaceae)	0.22 84.78
<i>Pasania konishii</i> (Fagaceae)	0.53	67.12	<i>Ilex rotunda</i> (Aquifoliaceae)	0.22 85.01
<i>Symplocos lucida</i> (Symplocaceae)	0.53	67.65	<i>Camellia transsarisanensis</i> (Theaceae)	0.22 85.23
<i>Cryptocarya chinensis</i> (Lauraceae)	0.52	68.18	<i>Castanopsis indica</i> (Fagaceae)	0.22 85.44
			<i>Alsophila podophylla</i> (Cyatheaceae)	0.21 85.66
			<i>Eurya chinensis</i> (Theaceae)	0.20 85.86
			<i>Cinnamomum insularimontanum</i> (Lauraceae)	0.20 86.06

A total of 457 woody species, representing 202 genera and 86 families, are recorded in the 277 plots. There are about 276 trees, 109 shrubs, and 72 lianas/vines. The largest two

families are Lauraceae (43 species) and Fagaceae (27), followed by Theaceae (23), Rubiaceae (21), Aquifoliaceae (20), Rosaceae (20), Ericaceae (17), Symplocaceae (15), Moraceae

(14), Euphorbiaceae (13), Caprifoliaceae (12), Myrsinaceae (12), Oleaceae (11), Saxifragaceae (11), Verbenaceae (11), Rutaceae (10), and Araliaceae (10). The most speciose genera are *Ilex* (20 species), *Symplocos* (15), *Ficus* (12), *Cyclobalanopsis* (evergreen oak) and *Quercus* (11), *Litsea* (11), *Eurya* (10), *Cinnamomum* (10), *Rhododendron* (9), and *Viburnum* (9). The most important families in terms of species abundance are Lauraceae (FIV = 16.6), Fagaceae (13.7), Theaceae (9.5), Myrsinaceae (6.2), Rubiaceae (5.2), Elaeocarpaceae (3.9), Aquifoliaceae (3.6), Symplocaceae (3.5), Rosaceae (2.8), Araliaceae (2.8), Juglandaceae (2.6), Saxifragaceae (2.5), and Ericaceae (2.4). The major canopy or subcanopy tree species (Table 6) in order of importance value are *Machilus thunbergii*, *Myrsine seguinii*, *Cyclobalanopsis longinux*, *Litsea acuminata*, *Engelhardtia roxburghiana*, *Elaeocarpus japonicus*, *Diospyros morrisiana*, *Castanopsis carlesii*, *Syzygium buxifolium*, *Daphniphyllum glaucescens* ssp. *oldhamii*, *Illicium arborescens*, *Schefflera octophylla*, *Adinandra formosana*, *Eurya japonica*, *Ardisia sieboldii*, *Prunus phaeosticta*, and *Cyclobalanopsis acuta* var. *paucidentata*. The 30 most abundant tree species collectively comprises 52.1% of total IV. *Eurya acuminata* usually dominates the shrub stratum. The secondary shrubs are *Psychotria rubra*, *Antidesma japonicum* var. *densiflorum*, *Lasianthus fordii*, *Hydrangea angustipetala*, *Blastus cochinchinensis*, *Ardisia cornudentata*, *Hydrangea chinensis*, and *Ilex asprella*.

Type IV

This grouping comprises 116 plots, and is comparable to the upper *Quercus* forest described in the earlier study (Su, 1984). In the mountains of mid-altitude (1,300–2,100 m in the north, 1,600–2,350 m in the east, 1,700–2,500 m in the central and south), the broad-leaved forests usually give way to some conifers, and thus form a zone of mixed montane forests. Here bryophytes develop luxuriantly; they may swathe tree boles and crowns in great festoons along with lichens. It has been assumed that these forests represent a penultimate stage in a succession from coniferous pioneer stages toward a climax of exclusively broad-leaved trees, the upper *Quercus* forest. Logging of the highly prized

Chamaecyparis formosensis during 1900–1980 has greatly reduced the area of the virgin stands of this forest type. These forests consist primarily of evergreen broad-leaved trees with conspicuous emergent conifers including *Chamaecyparis formosensis*, *C. obtusa* var. *formosana*, *Taiwania cryptomerioides*, *Cunninghamia konishii*, *Pinus armandii* var. *masteriana*, *P. taiwanensis* and *Picea morrisonicola*. These conifers often grow to a height of 30–50 m, with stems 100–200 cm in dbh.

The upper *Quercus* forest is much impoverished in tree species compared to the lower-altitude forests. A total of 263 species were recorded in the 116 plots, belonging to 131 genera and 59 families. There are about 178 trees, 64 shrubs, and 21 lianas/vines. Families with more than 10 species include Lauraceae (24 species), Fagaceae (20), Rosaceae (18), Ericaceae (17), Theaceae (17), Aquifoliaceae (14), and Symplocaceae (13). The largest genera are *Ilex* (14 species), *Symplocos* (13), *Litsea* (10), *Viburnum* (9), *Cyclobalanopsis* and *Quercus* (8), *Eurya* (8), and *Rhododendron* (8). The most important families in terms of species abundance are Lauraceae (FIV = 16.1), Theaceae (14.2), Fagaceae (14.1), Ericaceae (5.8), Araliaceae (4.5), Symplocaceae (4.3), Rosaceae (3.2), Aquifoliaceae (3.0), Caprifoliaceae (2.6), Saxifragaceae (2.6), Aceraceae (2.4), and Cupressaceae (2.4).

This forest shares many species with the Lower *Quercus* forest. Species continuing to be important components of the canopy (Table 7) include *Machilus thunbergii*, *Cyclobalanopsis acuta* var. *paucidentata*, *Cyclobalanopsis longinux*, *Litsea acuminata*, *Daphniphyllum glaucescens* spp. *oldhamii*, *Machilus japonica*, *Elaeocarpus japonicus*, *Prunus phaeosticta*, *Adinandra formosana*, *Michelia compressa*, etc. However, trees becoming more abundant or represented exclusively in this forest include *Castanopsis carlesii*, *Neolitsea acuminatissima*, *Rhododendron ellipticum*, *Cleyera japonica*, *Chamaecyparis formosensis*, *Dendropanax pellucidopunctata*, *Trochodendron aralioides*, *Cinnamomum randaiense*, *Schima superba*, *Ternstroemia gymnanthera*, *Acer morrisonense*, and *Lithocarpus lepidocarpus*. The 30 most abundant tree species collectively comprise 53% of total IV. The dominant

Table 7. Composition of woody species in forest type IV (Upper *Quercus* forest). IV, relative dominance; CUM, cumulative dominance. Only species with IV ≥ 0.2 are included.

Species	IV	CUM		
<i>Castanopsis carlesii</i> (Fagaceae)	4.23	4.23	<i>Viburnum foetidum</i> var. <i>rectangulatum</i>	
<i>Neolitsea acuminatissima</i> (Lauraceae)	3.25	7.48	(Caprifoliaceae)	0.65 71.42
<i>Machilus thunbergii</i> (Lauraceae)	2.92	10.40	<i>Ilex pedunculosa</i> (Aquifoliaceae)	0.60 72.02
<i>Rhododendron ellipticum</i> (Ericaceae)	2.52	12.92	<i>Litsea morrisonensis</i> (Lauraceae)	0.59 72.61
<i>Chamaecyparis formosensis</i>			<i>Aralia bipinnata</i> (Araliaceae)	0.57 73.18
(Cupressaceae)	2.26	15.17	<i>Schefflera taiwaniana</i> (Araliaceae)	0.56 73.74
<i>Cleyera japonica</i> (Theaceae)	2.24	17.42	<i>Hydrangea angustipetala</i> (Saxifragaceae)	0.56 74.29
<i>Dendropanax pelloidopunctata</i>			<i>Lyonia ovalifolia</i> (Ericaceae)	0.53 74.83
(Araliaceae)	2.16	19.58	<i>Cinnamomum insularimontanum</i> (Lauraceae)	0.53 75.36
<i>Trochodendron aralioides</i>			<i>Symplocos anomala</i> (Symplocaceae)	0.51 75.86
(Trochodendraceae)	2.11	21.68	<i>Rhododendron formosanum</i> (Ericaceae)	0.51 76.37
<i>Cinnamomum randaiense</i> (Lauraceae)	2.10	23.78	<i>Photinia parvifolia</i> (Rosaceae)	0.50 76.87
<i>Schima superba</i> (Theaceae)	2.04	25.83	<i>Vaccinium bracteatum</i> (Ericaceae)	0.50 77.38
<i>Ternstroemia gymnanthera</i> (Theaceae)	1.99	27.82	<i>Pasania kawakamii</i> (Fagaceae)	0.49 77.86
<i>Alnus formosana</i> (Betulaceae)	1.83	29.65	<i>Gordonia axillaris</i> (Theaceae)	0.47 78.33
<i>Eurya acuminata</i> (Theaceae)	1.69	31.34	<i>Hydrangea chinensis</i> (Saxifragaceae)	0.43 78.76
<i>Acer morrisonense</i> (Aceraceae)	1.61	32.96	<i>Eriobotrya deflexa</i> (Rosaceae)	0.42 79.19
<i>Cyclobalanopsis acuta</i> var. <i>paucidentata</i>			<i>Hydrangea integrifolia</i> (Saxifragaceae)	0.42 79.60
(Fagaceae)	1.58	34.53	<i>Eurya japonica</i> (Theaceae)	0.41 80.01
<i>Litsea acuminata</i> (Lauraceae)	1.53	36.06	<i>Pinus taiwanensis</i> (Pinaceae)	0.41 80.42
<i>Barthea formosana</i> (Melastomataceae)	1.52	37.58	<i>Itea parviflora</i> (Saxifragaceae)	0.40 80.82
<i>Cyclobalanopsis longinax</i> (Fagaceae)	1.52	39.10	<i>Cephalotaxus wilsoniana</i>	
<i>Lithocarpus lepidocarpus</i> (Fagaceae)	1.48	40.58	(Cephalotaxaceae)	0.39 81.21
<i>Illicium philippinense</i> (Illiciaceae)	1.37	41.95	<i>Acer kawakamii</i> (Aceraceae)	0.39 81.60
<i>Symplocos sumuntia</i> (Symplocaceae)	1.35	43.30	<i>Symplocos lancifolia</i> (Symplocaceae)	0.38 81.97
<i>Elaeocarpus japonicus</i> (Elaeocarpaceae)	1.34	44.64	<i>Pasania ternaticupula</i> (Fagaceae)	0.36 82.34
<i>Fagus hayatae</i> (Fagaceae)	1.33	45.97	<i>Carpinus kawakamii</i> (Betulaceae)	0.35 82.69
<i>Eurya leptophylla</i> (Theaceae)	1.33	47.30	<i>Ulmus uyematsui</i> (Ulmaceae)	0.35 83.04
<i>Cyclobalanopsis stenophylla</i> var.			<i>Symplocos modesta</i> (Symplocaceae)	0.34 83.38
<i>stenophylloides</i> (Fagaceae)	1.31	48.61	<i>Vaccinium randaiense</i> (Ericaceae)	0.33 83.71
<i>Cinnamomum reticulatum</i> (Lauraceae)	1.29	49.90	<i>Eurya strigillosa</i> (Theaceae)	0.33 84.03
<i>Ilex hayataiana</i> (Aquifoliaceae)	1.29	51.19	<i>Symplocos lucida</i> (Symplocaceae)	0.32 84.36
<i>Machilus japonica</i> (Lauraceae)	1.13	52.32	<i>Stranvaesia niitakayamensis</i> (Rosaceae)	0.32 84.68
<i>Daphniphyllum glaucescens</i> ssp. <i>oldhamii</i>			<i>Taxus mairei</i> (Taxaceae)	0.31 84.99
(Daphniphyllaceae)	1.10	53.42	<i>Symplocos stellaris</i> (Symplocaceae)	0.30 85.29
<i>Neolitsea variabilissima</i> (Lauraceae)	1.09	54.51	<i>Cleyera japonica</i> var. <i>morii</i> (Theaceae)	0.29 85.58
<i>Eurya glaberrima</i> (Theaceae)	1.03	55.54	<i>Ligustrum japonicum</i> (Oleaceae)	0.29 85.87
<i>Pittosporum illicioides</i>			<i>Stachyurus himalaicus</i> (Stachyuraceae)	0.27 86.14
(Pittosporaceae)	1.03	56.57	<i>Quercus spinosa</i> var. <i>miyabei</i> (Fagaceae)	0.27 86.41
<i>Osmanthus heterophyllus</i> var. <i>bibracteatus</i>			<i>Viburnum odoratissimum</i> (Caprifoliaceae)	0.26 86.67
(Oleaceae)	1.02	57.59	<i>Vaccinium dunalianum</i> var. <i>caudatifolium</i>	
<i>Camellia brevistyla</i> (Theaceae)	0.97	58.56	(Ericaceae)	0.26 86.93
<i>Meliosma callicarpaefolia</i> (Sabiaceae)	0.97	59.52	<i>Blastus cochinchinensis</i>	
<i>Prunus phaeosticta</i> (Rosaceae)	0.95	60.47	(Melastomataceae)	0.25 87.18
<i>Tsuga chinensis</i> var. <i>formosana</i> (Pinaceae)	0.92	61.39	<i>Illicium arborescens</i> (Illiciaceae)	0.25 87.43
<i>Viburnum taiwanianum</i> (Caprifoliaceae)	0.88	62.28	<i>Pieris taiwanensis</i> (Ericaceae)	0.25 87.68
<i>Fatsia polycarpa</i> (Araliaceae)	0.88	63.15	<i>Viburnum integrifolium</i> (Caprifoliaceae)	0.24 87.92
<i>Microtropis fukienensis</i> (Celastraceae)	0.86	64.01	<i>Osmanthus matsumuranus</i> (Oleaceae)	0.24 88.16
<i>Cyclobalanopsis morii</i> (Fagaceae)	0.80	64.81	<i>Villebrunea pedunculata</i> (Urticaceae)	0.24 88.40
<i>Picea morrisonicola</i> (Pinaceae)	0.79	65.61	<i>Eurya hayatai</i> (Theaceae)	0.23 88.63
<i>Daphniphyllum himalaense</i> ssp. <i>macropodum</i>			<i>Prunus campanulata</i> (Rosaceae)	0.23 88.86
(Daphniphyllaceae)	0.78	66.39	<i>Ligustrum microcarpum</i> (Oleaceae)	0.23 89.08
<i>Deutzia pulchra</i> (Saxifragaceae)	0.76	67.15	<i>Callicarpa randaiensis</i> (Verbenaceae)	0.22 89.30
<i>Michelia compressa</i> (Magnoliaceae)	0.75	67.90	<i>Sinopanax formosana</i> (Araliaceae)	0.22 89.52
<i>Litsea musheensis</i> (Lauraceae)	0.75	68.65	<i>Eurya gnaphalocarpa</i> (Theaceae)	0.22 89.73
<i>Adinandra formosana</i> (Theaceae)	0.75	69.40	<i>Ilex ficoidea</i> (Aquifoliaceae)	0.21 89.94
<i>Salix fulvopubescens</i> (Salicaceae)	0.69	70.09	<i>Mahonia oiwakensis</i> (Berberidaceae)	0.20 90.15
<i>Symplocos heishanensis</i> (Symplocaceae)	0.68	70.76	<i>Acer serrulatum</i> (Aceraceae)	0.20 90.35
			<i>Pasania brevicaudata</i> (Fagaceae)	0.20 90.55

shrubs are *Eurya acuminata*, *Barthea formosana*, *Eurya leptophylla*, *Pittosporum illicioides*, *Viburnum taiwanianum*, *Vaccinium bracteatum*, *Viburnum integrifolium*, and *Skimmia reevesiana*.

Conclusions

Taiwan is a small island with a broad range of environments. Despite large-scale clearing for agriculture and urban develop-

ment in lowland areas, the evergreen broad-leaved forests continue to cover 34.5% of the island. The forests, extending to ca. 2,500 m asl, have a wide species diversity, and are structurally very complex. TWINSpan classification and complementary DCA analysis of a data set comprising 779 plots $\times$ 489 taxa yielded four forest types which were comparable to the *Ficus-Machilus*, *Machilus-Castanopsis*, Lower *Quercus*, and Upper *Quercus* zones described in the earlier study (Su, 1984). The dominant tree species include evergreen members of Lauraceae, Fagaceae, Theaceae, Rubiaceae, and Myrsinaceae in montane areas. However, the members of the Euphorbiaceae and Moraceae attain their highest dominance in the lower-altitude and lowland forests of southern Taiwan. Species richness is highest in the *Machilus-Castanopsis* forest, with at least 303 tree species, and lowest in the Upper *Quercus* forest with at least 178 species. The relatively low species diversity of the *Ficus-Machilus* forest can be attributed to intensive human influence.

The evergreen broad-leaved forests of Taiwan are unique biological treasures worthy of protection. For the past fifteen years, five of the most magnificent natural areas of Taiwan have been established as national parks, and thirty-five or more preserves and reserves have been established. Together they occupy nearly 12% of the total land area of Taiwan, and the broad-leaved forest lands cover most of them. Other than designating areas for habitat protection, an overall policy of forest resource conservation has been implemented. This includes the management and protection of forests; the prevention of forest fires; moratorium on harvesting of any natural forests, etc. These offer the best opportunities for protecting large intact tracts of forest. Because of the limited scientific resources available in Taiwan, our knowledge of these forests is still very scanty. The rational management of the forests will depend on more comprehensive research of the structure, function and dynamics of the different evergreen broad-leaved forest ecosystems.

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台湾の常緑広葉樹林の種組成

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常緑広葉樹林は台湾の魅力的な景観を特徴づける森林で、海拔 0–2500 m の範囲に見られ、国土の 32% をおおっている。本報では、台湾全域から得られた 779 調査区のデータをもとに、台湾の常緑広葉樹林を種組成の面から分類した。全体で 82 科、234 属に属する 569 種の高木および低木が出現した。779 調査区×489 種のデータ行列を DCA 解析した結果、常緑広葉樹林の種組成は複雑な垂直的・地理的变化を示すこ

とが明らかとなった。さらに、TWINSPAN により分類したところ、台湾の常緑広葉樹林には、種組成的に 4 つのタイプが認められた。各タイプは Su (1984) が示した 4 つの植生帯、すなわち *Ficus-Machilus* 帯、*Machilus-Castanopsis* 帯、下部 *Quercus* 帯および上部 *Quercus* 帯にほぼ対応している。*Ficus-Machilus* 型の森林は主に台湾南部に見られ、トウダイグサ科やクワ科、クスノキ科の植物が優占し、板根や支柱根、幹生花などの熱帯的な特徴を示すことがある。*Machilus-Castanopsis* 帯と下部 *Quercus* 帯は種が非常に豊富で、林冠構成種の中ではブナ科とクスノキ科の種が圧倒的に優勢である。上部 *Quercus* 帯は高木種の数の点でやや貧化し、クスノキ科やツバキ科、ブナ科の種が優占している。上部 *Quercus* 帯の森林は、樹高 30–50 m に達する針葉樹を混じえ、台湾の森林の中では最も森林高が高い。上部・下部 *Quercus* 帯は比較的、損なわれることなく残されており、雲霧林として扱われることが多い。