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Comparative Studies on Floristic Composition of the Lucidophyll Forests in Southern Kyushu, Ryukyu and Taiwan

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Abstract Floristic compositions of the lucidophyll forests in southern Kyushu, Ryukyu Islands and Taiwan were compared in relation to topographic gradient. A total of eight plots encompassing the whole slope from the valley bottom to the ridge were established at Kitago in Miyazaki, Kinsakubaru in Amami Island, Mikyo in Tokunoshima Island, Yona in Okinawa Island, Ohtomi in Iriomote Island, Lopeishan and Pinglin in northern Taiwan, and Nanjenshan in southern Taiwan. Full species composition including understorey plants was recorded for every 5 m×5 m subplot into which the whole area of each plot was divided. Floristic compositions of the forest varied both among the plots and along the topographic gradient within a plot, showing the following patterns. In every plot, changes of floristic composition along the topographic gradient from valley to ridge were caused by a stepwise replacement of four integrated types of species: species mostly confined to the valley bottom, species distributed from the valley bottom to the lower or middle part of the slope, species confined to the ridge and the upper part of the slope, species distributed from the ridge to the middle or lower part of the slope. The former two consisted largely of herbaceous plants including many ferns, whereas the latter two consisted mostly of trees and shrubs. From a geographical point of view, there are major gaps in floristic composition between mainland Japan and the Ryukyu Islands, and between the Ryukyu Islands and Taiwan. Lucidophyll forests in the Ryukyu Islands seem to have a closer relation to those in the lowland of northern Taiwan than to mainland Japan, sharing about one-third of the component species in common with the former. Within the Ryukyu Islands, floristic compositions of the forests were relatively homogeneous, with half or two-thirds of species in common. Species richness of the forests in the Ryukyu Islands was generally lower than in Taiwan or mainland Japan. Additionally, there is another significant connection in floristic composition between mainland Japan and the mountains of northern Taiwan, although the species in common are not abundant. The pattern of floristic composition among the areas differed between the two contrasting topographic positions. On the upper part of the slope and the ridge, the difference in floristic composition was conspicuous between Japan (including the Ryukyu Islands) and Taiwan, whereas on the valley bottom, the difference in floristic composition seemed to lie between warm-temperate areas (mainland Japan and montane Taiwan) and subtropical areas (Ryukyu Islands and lowland Taiwan).

Key words: southern Kyushu, Ryukyu Islands, Taiwan, lucidophyll forest, floristic composition, topographic gradient, species richness.

Lucidophyll forest dominated mainly by *Castanopsis*, *Quercus* (*Cyclobalanopsis*) and *Machilus* is widely distributed over lowland southwestern Japan and Taiwan. It is ecologically important to know what are the similarities, differences and patterns of change in floristic composition of this forest among the areas and within a certain area.

Variations in species composition of forests are generally caused by two major factors, climatic and floristic differences between areas, and habitat variety within an area. In this region, many large and small islands range linearly like stepping stones from Taiwan to Kyushu, forming a sort of geographical gradient. With respect to habitat differences within an area, topographic conditions from valley bottom to ridge are known to be the most important factor, especially in well-preserved hilly and mountain-

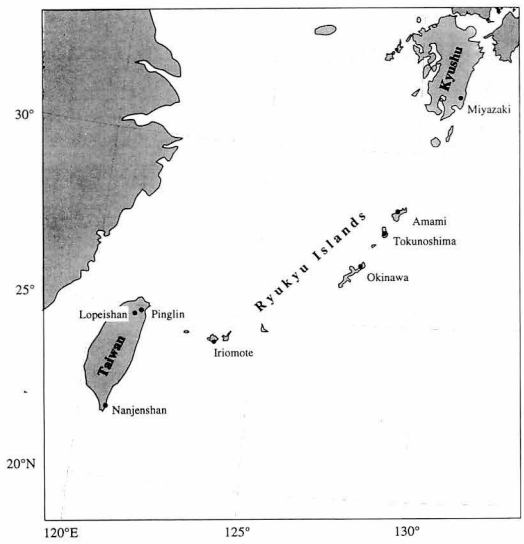


Fig. 1. Map showing location of plots studied.

ous forests (Whittaker, 1956; Kikuchi and Miura, 1993; Sakai and Ohsawa, 1994; Hara *et al.*, 1996 a,b). Therefore, it is important to examine the variations of floristic composition of forests in terms of both geographic and topographic gradient. However, there have apparently been no studies from such a point of view.

Previous studies on the floristic composition of lucidophyll forests in this region can roughly be divided into two categories. The first is a phytosociological classification of plant communities. Many types of plant community with different floristic composition have been classified with some descriptions of the habitat or the area in which they occur (*e.g.* Suzuki, 1979; Miyawaki, 1989). There are some phytosociological systematizations of the floristic composition of lucidophyll forests in Japan (Fujiwara, 1981–86) as well as many local studies (*e.g.* Yamanaka, 1957; Niiro *et al.*, 1974; Hattori and Miyagi, 1987; Miyagi *et al.*, 1989). However, few phytosociological studies have been made on how the floristic composition changes along the topographic gradient from valley to ridge, because the sampling has been confined to homogeneous stands and dispersed in an arbitrary manner over a wide area. Patterns of floristic change that have nothing to do with syntaxonomic classification are also scarcely discussed in phytosociology. Besides, there are very few phytosociological comparisons between Japan and Taiwan except some early preliminary studies (Suzuki, 1953). The second category of previous work is an analysis of stand structure by tree census. Compositional variations of woody species are discussed in relation to topography (Liu and Su, 1976; Hara *et al.*, 1996a, b) or other habitat conditions such as disturbance and wind stress (Tanouchi and Yamamoto, 1995; Hsieh, 1989; Hsieh *et al.*, 1989,1990; Sun *et al.*, 1996). In these studies, however, little has been described about the understorey flora, which often comprises a major portion of the species richness of the community. Comparisons of species composition among areas are also few.

It is evident that there has been no detailed study on floristic composition including the understorey flora between Japan and Taiwan, nor analysis of transition patterns along the topographic gradient. The main purpose of this study is to make such comparative studies for eight lucidophyll forests from Taiwan to Kyushu, together with the geographic and topographic changes.

Study Sites

From southern Kyushu to Taiwan through the Ryukyu Islands, we selected eight sites for study (Fig. 1). These were selected because well-developed lucidophyll forests occurring on similar geological conditions still remain. These are Inohae, Kitago-machi in Miyazaki Prefecture (hereafter Miyazaki), Kinsakubaru in Amami-ohshima Island (Amami), Mikyo in Tokunoshima Island (Tokunoshima), Yona, Kunigami in Okinawa Island (Okinawa), Ohtomi in Iriomote-jima Island (Iriomote); Lopeishan, Sanhsia in Taipei County (Lopeishan), Pifu, Pinglin in Taipei County (Pinglin), Nanjenshan, Kenting National Park in Pingtung County (Nanjenshan). Latitude, longitude and elevation of the sites are shown in Table 1. Seven are located on mountains below 500 m a.s.l., whereas Lopeishan is located at over 1100 m.

The climate of the sites is generally warm and humid. As shown in Table 1, an estimated annual mean temperature of the sites ranges from 16.0℃ in Miyazaki to

Table 1. Outline of the plots studied.

Locality	Taiwan			Ryukyu Islands				Southern Kyushu
Abbreviation	Nanjenshan **N**	Pinglin **P**	Lopeishan **L**	Iriomote **I**	Okinawa **O**	Tokunoshima **T**	Amami **A**	Miyazaki **M**
Latitude (° N)	22° 03′	24° 52′	24° 50′	24° 18′	26° 44′	27° 45′	28° 20′	31° 45′
Longitude (° E)	120° 51′	121° 44′	121° 28′	123° 51′	128° 14′	128° 58′	129° 27′	131° 23′
Altitude (m)	320	470	1150	140	280	180	320	290
Annual mean temperature (℃)	21.8*1	18.5*1	16.7*1	22.5*2	20.0*2	20.2*2	19.4*2	16.0*2
Annual precipitation (mm)	2691*1	4070*1	3071*1	2343*3	2265*3	1920*3	2871*3	2597*3
Plot area (m^2)	1100	950	1025	1188	885	2375	1475	2000
Slope direction	NW	SSE	W	SSE	S	NW	SE	NNW
Canopy dominant	*Astronia formosana* *Lithocarpus amygdalifolius* *Castanopsis carlesii*	*Castanopsis carlesii* var. *sessilis* *Cryptocarya chinensis* *Schefflera octophylla*	*Quercus longinux* *Machilus thunbergii* *Quercus sessilifolia*	*Quercus miyagii* *Castanopsis sieboldii* ssp. *lutchuensis* *Ilex goshiensis*	*Castanopsis siedboldii* ssp. *lutchuensis* *Distylium racemosum* *Schima wallichii*	*Quercus miyagii* *Castanopsis sieboldii* ssp. *lutchuensis*	*Castanopsis sieboldii* ssp. *lutchuensis* *Schima wallichii*	*Quercus gilva* *Distylium racemosum* *Machilus thunbergii*

*1, cited from Hara *et al.* (1997). *2, estimated value with lapse rate (0.6℃/100m) based on observations at the nearest meteorological station (Japan Meteorological Agency, 1991). *3, observation at the nearest meteorological station (Japan Meteorological Agency, 1991).

Table 2. Density classes for recording abundance of the species.

Density class	Number of individuals per subplot (25 m^2)
0	1
1	2–9
2	10–99
3	100–999

22.5℃ in Iriomote. Annual rainfall at the nearest meteorological station to each site ranges from 1920 to 4070 mm. There is no distinct dry season at any sites. Because the area is often attacked by typhoon in summer and autumn, the forests are sometimes damaged by heavy rain and violent wind. Topographies of these sites are generally steep, dissected by many deep valleys. The geology is in each case clastic sedimentary rocks of Mesozoic or Tertiary origin such as sandstone, mudstone, shale and slate.

Castanopsis spp. usually dominate the primary forest of the areas except in Lopeishan where *Quercus* spp. predominate. These are *Castanopsis sieboldii* and *C. cuspidata* in Miyazaki, *C. sieboldii* ssp. *lutchuensis* in the Ryukyu Islands, and *C. carlesii* in Taiwan. These *Castanopsis*-dominated forests phytosociologically belong to Maeso-Castanopsion sieboldii in Miyazaki and Psychotrio-Castanopsion sieboldii in Ryukyu Islands (Fujiwara, 1981). In Taiwan, the Lopeishan plot is situated in the *Quercus* zone, Pinglin in *Machilus-Castanopsis* zone and Nanjenshan at the boundary between *Machilus-Castanopsis* and *Ficus-Machilus* zone (Su, 1984; Hsieh *et al.*, 1997). Many different trees share the dominance with *Castanopsis*, such as *Quercus gilva* and *Distylium racemosum* in Kyushu (Miyawaki, 1981), *Quercus miyagii* and *Schima wallichii* in Ryukyu Islands (Miyawaki, 1989).

Methods

Field study

At each of the eight study sites, we selected a place for the plot so as to fulfill three conditions to make the habitat conditions of the plots comparable. First, the slope should be covered by well-developed lucidophyll forest. Second, the length of the slope from valley bottom to ridge top should be 50 to 100 m. Third, the valley should be large enough to have at leat some water flow except in the driest season, but small enough to be overshadowed by trees on the side slope. At the selected stand a long belt-like plot was established, with its longer side along the direction of the slope so as to cover the whole slope from the valley bottom to the ridge top. In Okinawa and Iriomote, where the valley portion of the plot was small and with little waterflow, the plot was extended downstream along the valley bottom to reach the major waterflow. All the plots were further divided into subplots of 5 m×5 m.

Table 1 shows plot area as well as slope direction and canopy dominants. The area of plots ranged from 885 m^2 in Okinawa to 2375 m^2 in Tokunoshima mainly depending on the slope length.

In every subplot, the name and density class (Table 2) were recorded for all vascular plant species. The distribution of microlandform elements (such as small cliff *etc.*) was also recorded.

Data treatment

In order to detect how the floristic composition was differentiated within a plot, we classified the subplots of each plot into groups with similar floristic compositions. Hereafter, these groups will be called *subplot group*. The classification of subplots was carried out by the phytosociological method (Mueller-Dombois and Ellenberg, 1974) as follows. First, a group of mutually associated species that occurred together in a few or more subplots was recognized by scanning the primary table in which every species present was arranged in the row and the subplots in the column. A second group of species exclusive to the first species group was similarly recognized by searching. Then, the subplots can be divided into two, one with the first species group and the other with the second species group. By using a combination of presence and absence of the species groups thus obtained, whole subplots of a plot were divided into a few or several groups. Likewise, species were also divided into several groups in which the members had a similar occurrence pattern among the

subplots. Finally, a binomial test was applied to determine whether any particular species belongs to the species group.

Sørensen's index (*IS*) was calculated to estimate the floristic similarities among the plots by the following formula:

$$IS=2c/(a+b)$$

Where a and b are total number of species in plot A and B, respectively, and c is number of species common to both plots.

In order to compare the habitat preference of species among plots, we calculated a score for each species, that represents its relative position along the gradient from valley to ridge as below. We call this score *habitat score* (*H*). First, a score (s_i) for subplot groups i was defined as -1 to the lowest subplot group that included valley bottom, 1 to the uppermost subplot group that included ridge, and an intermediate value to the other subplot groups in-between according to the position relative to the extremes. For example, if the plot consisted of four subplot groups, scores of -1, -0.33, 0.33, 1 were given to each of the subplot groups according to their relative territories along the gradient. Second, frequency (F_i) of each species in subplot group i was calculated by the formula, F_i=(number of subplot of the subplot group i in which the species occurred)/(total number of subplot of the subplot group i). An associated weighting value (c_i) to F_i in subplot group i was given as follows: $c_i=0.5$ when $0<F_i\leqq 0.05$, $c_i=1$ when $0.05<F_i\leqq 0.1$, $c_i=2$ when $0.1<F_i\leqq 0.25$, $c_i=3$ when $0.25<F_i\leqq 0.5$, $c_i=4$ when $0.5<F_i\leqq 0.75$, and $c_i=5$ when $0.75<F_i\leqq 1$. Finally, for each species, a weighted average (habitat score, H) of s_i of all the subplot groups in a plot was calculated by:

$$H=\Sigma s_i c_i/\Sigma c_i$$

If the habitat score H is 1 or -1, then the species is confined to the ridge or valley bottom, respectively. Likewise, smaller values of H indicate that the species prefers a more mesic habitat, and larger H indicates a more xeric habitat.

Floristic Composition of the Plots

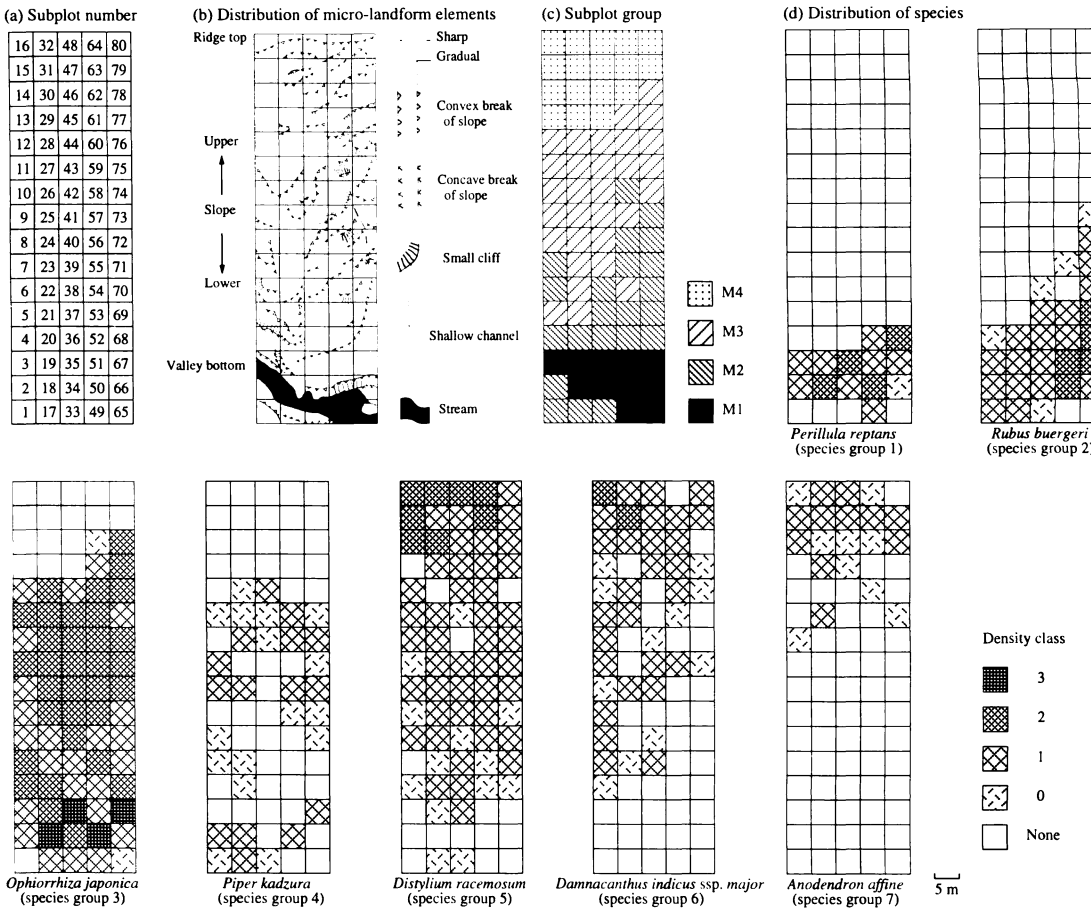
Miyazaki

The plot includes a ridge top in the uppermost part and a valley bottom with a small stream in the lowest part (Fig. 2b). A transversally convex slope runs from the ridge on the left side of Fig. 2b, and a transversally concave slope with indistinct shallow channel is on the right side. There are many small cliffs in the lower part of the slope and in the middle part of the concave slope. The forest canopy of the plot is dominated mainly by *Quercus gilva*, *Distylium racemosum* and *Machilus thunbergii*.

A total of 173 taxa (species, subsp. and var.) occurred and 172 taxa were identified in the plot. The composition varied greatly among subplots and such variation in species composition is shown in Table 3. Seven species groups were extracted, and four subplot groups (M1 to M4) were distinguished by the presence or absence of these species groups. M1, M2, M3 and M4 are characterized by the occurrence of species groups 1 to 3, 2 to 5, 3 to 6 and 5 to 7, respectively (Table 3).

The distribution of each subplot group is shown in Fig. 2c. These subplot groups were arranged in sequence from valley bottom to ridge and were related to the slope as follows: M1 was on the valley bottom and the lowest part of slope, M2 on the lower part of slope, M3 on the middle part of slope and M4 on the upper part of slope and ridge. In addition, M3 and M4 both descended downward along the convex slope on the left, and M2 ascended upward along the concave slope with shallow channel on the right (Fig 2b). Therefore, topographic conditions seem to be the most important factor controlling the floristic composition of the plot. In other words, the layout of subplot groups can be regarded as a partitioning of the topographic gradient between plant assemblages, in each of which conditions for plant growth are similar.

The distribution of representatives of each species group within the plot is shown in Fig 2. Species group 1 (19 spp.) *e.g. Perillula reptans* and *Oplismenus undulatifolius* was confined to the valley bottom. Species group 2 (11 spp.) *e.g. Rubus buergeri* and *Ardisia pusilla* stretched from the valley to the lower part of slope. Species group 3 (7 spp.) *e.g. Ophiorrhiza japonica* and *Stegnogramme pozoi* ssp. *mollissima* were widely distributed from the valley bottom to the middle part of slope.



16	32	48	64	80
15	31	47	63	79
14	30	46	62	78
13	29	45	61	77
12	28	44	60	76
11	27	43	59	75
10	26	42	58	74
9	25	41	57	73
8	24	40	56	72
7	23	39	55	71
6	22	38	54	70
5	21	37	53	69
4	20	36	52	68
3	19	35	51	67
2	18	34	50	66
1	17	33	49	65

Fig. 2. Subplot number (a), distribution of micro-landform elements (b), layout of subplot groups (c), and distributional patterns of some representative species (d) in the plot of Miyazaki. Subplot number (a) corresponds to that in Table 3. For the density classes and subplot groups, refer to Table 2 and Table 3, respectively.

Species group 4 (4 spp.) *e.g. Piper kadzura* and *Crepidomanes auriculatum* occurred mainly on the middle part of slope. Species group 5 (6 spp.) *e.g. Distylium racemosum* and *Trachelospermum asiaticum* covered the whole slope except for the valley bottom, although *Distylium racemosum* was denser on the upper part of the slope. Species group 6 *e.g. Damnacanthus indicus* ssp. *major* and *Lindsaea chienii* were most abundant (21 spp.) and were distributed from the middle part of slope to the ridge. Species group 7 (12 spp.) *e.g. Anodendron affine* and *Symplocos theophrastiifolia* occurred mainly on the upper part of the slope and on the ridge. As for the other species, no topographic preference was detected due to their constant occurrence over the whole area or being too rare.

Phytosociologically, the plot seems to be a transitional stand of two associations, Symploco glaucae-Castanopsietum sieboldii and Lasiantho-Quercetum gilvae (Fujiwara, 1981), since the character- and differential-species of the former association and its upper unit such as *Symplocos glauca*, *Meliosma rigida*, *Randia cochinchinensis* and others were intermingled with those of the latter association and its upper unit such as *Quercus gilva*, *Lasianthus japonicus*, *Symplocos theophrastiifolia* and others in the plot.

Amami

The plot includes a ridge top in the uppermost part and a valley bottom with small waterflow in the lowest part (Fig. 3b). A transversally convex slope runs from the

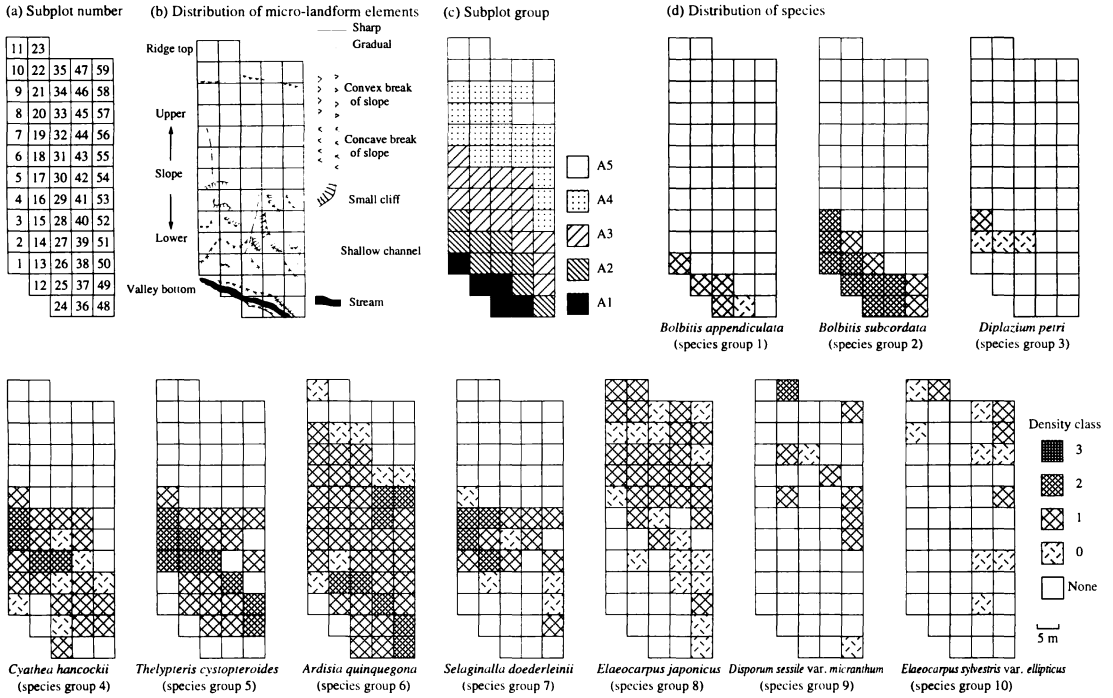


Fig. 3. Subplot number (a), distribution of micro-landform elements (b), layout of subplot groups (c), and distributional patterns of some representative species (d) in the plot of Amami. Subplot number (a) corresponds to that in Table 4. For the density classes and the subplot groups, refer to Table 2 and Table 4, respectively.

ridge on the right side of Fig. 3b. There are many small cliffs in the middle to lower part of the slope where the inclination is generally the steepest. A small gentle slope develops in the lowest slope besides the stream. The contour map, layout of micro-landform units and stand structure of this plot have already been reported in a previous paper (Hara *et al.*, 1996b). The forest canopy is dominated by *Castanopsis sieboldii* ssp. *lutchuensis* and *Schima wallichii* (Hara *et al.*, 1996b).

A total of 118 taxa (species, subsp. and var.) occurred and 116 taxa were identified in the plot. The variation of species composition among the subplots is shown in Table 4. Ten species groups and five subplot groups (A1 to A5) were distinguished. A1 is characterized by joint occurrence of species group 1, 2, 4 and 6 (Table 4). Similarly, A2, A3, A4 and A5 are characterized by the combination of species group 2 to 6, 4 to 8, 6 to 9 (except 7) and 8 to 10, respectively.

The distribution of each subplot groups is shown in Fig. 3c. Subplot groups A1 to A5 were distributed along the slope from the valley bottom to the ridge in this order, and were closely associated with the relative position of slope: A1 was on the valley bottom and its adjacent area, A2 mainly on the lower part of slope with gentle inclination, A3 on the steep middle slope, A4 on the upper part of the slope and A5 on the uppermost slope and ridge. Such a layout of the subplot group roughly agrees with the arrangement of micro-landform units classified by Hara *et al.* (1996b), *i.e.* A1 on the bottomland in their sense, A2 on the foot slope, A3 on the lower side slope, A4 on the upper side slope and A5 on the crest slope.

The distribution of representatives of each species group within the plot is also shown in Fig 3. Species group 1 (3 spp.) consisted of *Bolbitis appendiculata*, *Hymenophyllum riukiuense* and *Diplazium dilatatum* and was confined to the valley bottom. The first two species in particular were restricted to the wet stones in the stream. Species group 2 (8 spp.) *e.g. Bolbitis subcordata* and *Ardisia sie-*

Table 3. Floristic composition of the plot in Miyazaki. Numerals (0–3) represent the density class. Subplot groups enclosed by thick or thin lines indicate that the frequency of the species are significantly (at $P<0.01$ or $P<0.05$ respectively) higher than in the rest of the subplot groups.

Subplot group	M1	M2	M3	M4
Subplot no.	01133455666 38945901567	00000123333555556677777 12467703678235688901 23	00011122222222344444555667777 58901212345678901234479014 5678	11112333444466678 34569012567823490
Species group 1				
Oplismenus undulatifolius	··110120·10	0·····0····0···2·····	····0·····	·1··········0···
Perillula reptans	12112121·01	·1·····1···2·····	·····	·····
Microsorium buergerianum	00···01·10·	··0···00·····0····	·····0·····	·····
Adenostemma lavenia	·010·1100·1	·····1·0··0·····	·····	·····
Trichosanthes multiloba	·0100·1·10·	0····0·····	····0·····	·····
Antenoron filiforme	·0011·11·0·	·····1····	·····	·····
Diplazium wichurae	·1·1··2·11·	·1·····	·····	·····
Elatostema umbellatum	12010·····	····0·····	·····	·····
Dryopteris commixta	0····11·1··	·····1·····	·····	·····
Clerodendron trichitomum	···11··0··1	·····0····	·····	·····
Polystichum tagawanum	0····00···0	·····	·····	·····
Athyrium otophorum	1·····00	·····	·····1···	·····
Colysis pothifolia	···0·0··1··	····1·····	·····	·····
Actinidia polygama	····10····0	····0·····	·····	·····
Boehmeria spicata	·0·0·····0	·····	·····	·····
Sedum subtile	·····12··1·	·····	·····	·····
Schizophragma hydrangeoides	·000·01·1·0	·0··0·····0·0·····	·0··1·····0··0·0··0··111·	1···1·····0····
Rubus palmatus	···01·10···	····0·1·····	·····0·····0····	·····
Platycrater arguta	·····0··1··	·····	·····	·····
Species group 2				
Machilus japonica	11111··10·1	10000111111111111011111	1···1·1··0···000····110·0·····	0·····0····
Ardisia pusilla	101121·20·1	21011111··00·0002·011·	····1··0·····1·	22···0·····112
Rubus buergeri	11111·22·12	110··110110110··221110	·····	·····
Scutellaria indica	·1·1····1··	·1···1·····1··	·····	·····
Pellionia radicans	·····1···	··1·····2····11·0··	1·····	·····
Mallotus japonicus	····1·····	0····0·0·····0·····	·····	·····
Gynostemma pentaphyllum	·····1·0	·····0···10····	·····	·····
Crepidomanes latealatum	···1·····	·11··1	·····	·····
Quercus sessilifolia	··0·····	0·····0···0·····	·····	·····
Arisaema tashiroi	····0···0··	·····1·0·	·····	·····
Swida controversa	····00·····	·····0·····0····	·····	·····
Species group 3				
Ophiorrhiza japonica	13223131013	·121112111212222211122	2121211122222222222112221212222	·····0····
Stegnogramme pozoi ssp. mollissima	11110110·21	·01··11000···101···010	1·21·10020110·11101·1011111·21	·····
Plagiogyria euphlebia	·001··00·01	11·1011010·11110001111	0·0··111111····11···1··1·00·1·	·····0·····
Diplazium subsinuatum	·0·0·111112	·112·1·2··2··112···212	2021··122221··12221··21·2·2·2·	·····
Plagiogyria adnata	000·01···10	·0011011110111011111	1111011112311111111112111111	·0···10··10···1····
Dumasia truncata	····1··0··0	·····0··1·00···001·	·····00·····00·	·····
Crepidomanes birmanicum	·0·1··1·1··	·02···1·····0·0·	1·····1·0·····0····	·····
Species group 4				
Piper kadzura	·1····1···1	01·0·100·····011··0010	011·0·0··1·100···001··1··10···	·····
Crepidomanes auriculatum	·····	·····1···0··101··0·10	·0·1··0·1000··11·0·0·0···010··	·····1·····
Litsea acuminata	·····	·10····0··01····0··0··	····0·1··0·00·0·····0····	·····
Adina pilulifera	·····	·····1···01·	·0·····00····1···01···	·····
Species group 5				
Trachelospermum asiaticum	·0·0···0···	00·1101011100111111011	01111211122202·111111210111111	22222222112111111
Distylium racemosum	··0·1·····	··0100101100011101 1011	·101110111111·111·011111111·11	·2221212111212211
Lasianthus japonicus	·····	11·00····0··1··1100·00	·1001···000····0··0··1···11··11	··0···0··0100··1·
Meliosma rigida	····10·····	1·0·11···000·0001110 10	··0100000··1·1010110000000000·	001100·1001111·10
Hydrangea luteo-venosa	····0···1·	·0111011····0111··1111	·1110111·111010110·1·111111111	101·211·100·11·1·
Cleyera japonica	···0·····0·	··011·0···000····001·00	·11011·1·11101·00010·1101110·1	010111··1·001111·
Species group 6				
Damnacanthus indicus ssp. major	·····	··011····10·····0	1011100··1···11·110···1011··00·	0112·121111111·11
Elaeocarpus japonicus	··0·····0	·0·····0··1···0····	0··1101·0·1111·0···000··1···10	1101011111111111
Lindsaea chienii	·····	·····11·····	·01211·11121·0011111·111110·10	12···12···10···1····
Camellia japonica	·····	··0·····00·····0	·00·00·····110·0·111··000·0·10	111111·1·111111·0
Plagiogyria japonica	·····	···1·····00·0···0·	··10110··1001··0·111··0111··11	110·01··00··10·0·
Myrsine seguinii	·····	···0·····0	·10·10···0·01···1····0110···0·	11111100111110010
Abies firma	·····	·····0····	·0··00····0··1·00··1·····0··	10011··1·0·0··0·0
Lycopodium serratum var. longipetiolatum	·····	·····1·····	·····0···01··1·1000··0··01·0·1	0·0··1····0·00···
Quercus salicina	····0·····	···0·····	···0·····1·00·0··0·····0·00·	1···1100·001·····
Lithocarpus edulis	·····	·····	0··10·····1·0··00·0·····	·····00···0·····0
Castanopsis cuspidata	0·····0·	···11·····0··111···111	111211·01101110111111·111101112	2212221212112111
Goodyera velutina	·····1···	··1·0··0·1·····1····	·01111·00211110111··1·0····0	10··0··01··1····
Cheiropleuria bicuspis	·····	·····	···1·····3·1··22··2·1····2	·····21··1····
Ilex integra	·····	·····	··0·0·0·····0·····0···	·01··010·····0··
Dryopteris erythrosora	·····	·····	···0·····110·····0···0000··0·····	
Eurya japonica	·1000·0··00	0·01··1····1001···001	0·11110·1111·1·11001·011111111	112111111110111111
Ficus nipponica	·····	···00·····0·00····10	·1··1···10···10··1010010111111	10·····10··1··11
Daphniphyllum teijsmannii	··0·····	····0·····0····00	··00·0·····01····010···000···0	·111·1·01·000·1··
Randia cochinchinensis	·····	·····0···0·····	··0·····1·····010···1000···1	·····10·20
Liparis nervosa	·····1	·····	·····0·····10·····1·····11	0·····0···0·····
Ardisia crenata	·····	·····	·····0·····0··0·0	·····00·····
Species group 7				
Symplocos theophrastiifolia	·0····0····	····1·····00·····	·····0·11···01···01·1·1100	1110·110110·0··10
Castanopsis sieboldii	·····0·····	·····0·····0···	··1101·····11····10·0·0···0·	11101011·1·1····0
Symplocos glauca	····1·····	·····0···000·0···	···0·0·····0····010·0···0····	1·110101··010···0

Table 3. (Continued)

Anodendron affine	·····0·····1·····0··0··1	·1101011001101 01·			
Cinnamomum japonicum	·00····· ····1···1·····00·····00	1001···0··0101000			
Ilex goshiensis	··0·····110·····0···0·0···11	···00111·00111··0			
Ternstroemia gymnanthera	·····0·····0 ··0·····0	01·100010·00···00			
Symplocos prunifolia	····0·····0···0	000·00100·0··0···			
Ligustrum japonicum	·····0···0··0··0·0·····	···00001·00··0···			
Helicia cochinchinensis	····0···· ····1·····0·10·····	000···0··00···0··			
Cymbidium lancifolium	·····	··00···1·0·0·····			
Wisteria floribunda	·····0··· ·····0	··01·····0···1			
Other species					
Maesa japonica	0111·011001 101101101111111111112	111112121212111111111111121112	11111111111011121		
Arachniodes sporadosora	121111131·2 22·22212122112121122212	2221112111·22112122222122212221	01110111·11221122		
Machilus thunbergii	21202110001 1020101·122111010·1001	11112212·22022111111111001·0112	22223222111201112		
Alpinia japonica	·1011·11001 11011010111111111111111	01111211222111111111111111111112	1100111·110·00·1·		
Damnacanthus indicus	101·01·1··0 11111121·····11110211·	11121212111221011211111122122	21221222·1221·221		
Aucuba japonica	11111001··1 111··1111010·0··121111	1··0010···11110·1110111··00011	111110··000····10		
Kadsura japonica	·011··10··1 11·00··01·01·0·00011··	0····01·0·01011··001010··1··1·	11101·1000011·000		
Quercus gilva	···00·000·0 00·1010·00··0111·01000	··0·010·10·1100···1·00····0·0·	01011111000··0··0		
Lemmaphyllum microphyllum	01110·011·0 0001·00000·01···000100	·0101···1201···1··1100···111··	··10·····0101·101		
Ficus erecta	0·01010·21· ·00···0····0111·0·00·	0000··01·100··0110···00101·111	····0·1·0···1··0·		
Paederia scandens	001110·0··· 00···0·10··01····00·0·	···0·1··0110·0····1·····0··0·1	10·1·01000···1·1·		
Sarcandra glabra	1··0····· ·00·1·····10·1·11·	·0····10·1·1····11···0·1·11···	·····1··0·····0		
Ilex buergeri	00··00····· ·0·1·····0·00···0··	·····0·0·00··0·0	···000···00····0·		
Ficus thunbergii	·····0···· ·0·2·····0·····	···001·····0·1··00··1···0101	2·····0·0····		
Callicarpa mollis	·····11·01 ····1·····0···00	····0·····0·0··1···010··0··	···0·····		
Cephalotaxus harringtonia	·····0 ····0·····00·····	·000110··0··1··0·····	·0·1···0·····		
Diospyros morrisiana	····· 0·····0·····0	·0·····0·0·1·0·0···1	··01··10···0·0···		
Prunus spinulosa	····· ·····0···0·0·0	···0·····0·····0·0·0····	·0·1102··0·····		
Daphniphyllum macropodum	·····0···1 00····0···1·····0·	·····01····0···00····	····0·····		
Microlepia marginata	0··0····· ·010··1·····	0····00·1·0·····0·····	·····		
Elaeagnus glabra	····0····0 ·····0·····0	···0····0··0··0·····0·	····0·····0····		
Dioscorea japonica	·····0···· 10···1·····	····00·····0·0·0···	·····0···0···		
Celastrus orbiculatus	·0···10··· ·····1·0···	·····0·····	·····10·0·····		
Rubus palmatus	···01·10··· ·····0·1·····	·····0·····0·····	·····		
Lepisorus thunbergianus	···0··0···0 ·····0·····	·····0·····1··	·····1···0·····		
Pyrrosia lingua	·····0···· ····0·····0·····0·	·····0···0·····0··	·····		
Smilax china	····· ····0·····	·····0·····0·····0·····	·0·····0·····		
Stauntonia hexaphylla	····· ·····00···	·····0·····	···1···0···0····		
Litsea coreana	·····0·· ·····0·····0····	·····0·····	·····00···		
Asplenium wrightii	1·1····· ··1···1·····	1·····	·····		
Dryopteris sparsa	····· ··01·····	0·····0···0·····	·····		
Asplenium wilfordii	····· ···1·····0·····	·····0·····0·····1··	·····		
Cymbidium goeringii	····· ·····	····0·····0·····	···0····0····0··		
Ilex rotunda	···0····· 00·····	·····0·····	0·····		
Gleichenia japonica	····0····· ·····	·····1·····21·····	·0·····		
Podocarpus macrophyllus	····· ·····	·0·····0·	·····0·0·····0		
Uncaria rynchophylla	····· 10·····0·····	·····0·····	·····		
Vittaria flexuosa	····· ··11·····	·····0·····0·····	·····		
Diplazium mettenianum	····· ···0·····11·····	·····1·····	·····		
Phyllanthus flexuosus	····· ···0·····	·····1·····0···0	·····		
Dryopteris fuscipes	····· ·····	····0·····0·····	·····01·····		
Parthenocissus tricuspidata	·····1···· ·····1·····	·····	···1·····0·····		
Dendropanax trifidus	····· ·····	·····00··	····1·1·····		
Thelypteris glanduligera	····· ·····	····1·····1·1·····	·····		
Sambucus racemosa ssp. sieboldiana	···0··0···· ·····0·····	·····	·····		
Pieris japonica	····· ·····	·····1	·····0·····0···		
Prunus pendula	····00····· ·····	·····	·····0·····		
Selaginella involvens	·····11···· ·····0·····	·····	·····		
Pteris dispar	····· ·····	·····00··0·····	·····		
Daphne kiusiana	····· ·····	·····00·····	·····0····		
Styrax japonicus	·····0·· ·····0·····	·····0··	·····		
Bulbophyllum japonicum	0····· ···0·····0·····	·····	·····		
Fatsia japonica	····· ·····	····0·····	·····0·····		
Hedera rhombea	····· ·····	·····0·····	··0·····		
Psilotum nudum	····· ·····	·····0··	···0·····		
Viburnum odoratissimum var. awabuki	····· ·····00·····	·····	·····		
Heterotropa hexaloba var. perfecta	····· ·····	·····1·····1·····	·····		
Carpesium faberi	·····1···· ·····	·····0·····	·····		
Crassocephalum crepidioides	····· ·····	·····1·····	·····1·····		
Pteris laurisilvicola	·····1···· ·····0·····	·····	·····		
Millettia japonica	····· ·····0·····	·····0·····	·····		
Lonicera hypoglauca	·····0·· ·····0·····	·····	·····		
Syzygium buxifolium	····· ·····	·····0	·····0··		
Ilex latifolia	·····0·· ·····0·····	·····	·····		
Microtropis japonica	····· ·····	·····	00·····		

Species occurring in one subplot. No. 1; Salvia ranzaniana, 1; Camellia sasanqua, 1; Quercus hondae, 1. No. 2; Lophatherum gracile, 0. No. 5; Arachniodes rhomboidea, 1. No. 15; Lonicera japonica, 0. No. 16; Rhus succedanea, 0. No. 26; Rubus sieboldii, 0. No. 32; Skimmia japonica, 0. No. 34; Hymenophyllum riukiuense, 2; Ehretia dicksonii, 0; Sapindus mukurossi, 0. No. 36; Diospyros japonica, 0. No. 48; Ardisia japonica, 0. No. 49; Sapium japonicum, 0. No. 50; Pellionia minima, 0; Quercus glauca, 0; Acer palmatum, 0. No. 51; Duchesnea chrysantha, 1. No. 52; Morus australis, 0; Selaginella remotifolia, 0. No. 54; Davallia mariesii, 0. No. 62; Orchidaceae sp., 0. No. 67; Pteris excelsa, 0. No. 74; Ainsliaea apiculata, 1. No. 75; Loxogramme salicifolia, 0. No. 76; Crepidomanes minutum, 2. No. 77; Neolitsea sericea, 0. No. 78; Symplocos lancifolia, 0.

Table 4. Floristic composition of the plot in Amami. Numerals (0–3) represent the density class. Subplot groups enclosed by thick or thin lines indicate that the frequency of the species is significantly (at $P<0.01$ or $P<0.05$ respectively) higher than in the rest of the subplot groups.

Subplot group	A1	A2	A3	A4	A5
Subplot no.	01223 12546	001122334 324376878	0001113224443554 6547650982109109	0002211333344455555 9871098432164365432	1122344555 1032575987
Species group 1					
Bolbitis appendiculata	11110	·····	·····	·····	·····
Hymenophyllum riukiuense	·2·21	·····	·····	·····	·····
Diplazium dilatatum	1·00·	·····	·····	·····	·····
Species group 2					
Bolbitis subcordata	22222	2212·1·21	·····1	·····	·····
Kadsura japonica	100··	011111100	·····0··1·····	·····	·····
Ardisia sieboldii	11111	111111111	··1··0··0·····	·····0···	·····
Piper kadzura	111·0	···1·1·11	·····	·····	·····
Diplazium incomptum	1·110	·211·1·1·	·····0·····	·····	·····
Arachniodes sporadosora	··111	1·····10	····0·····0····	·····	·····
Heterotropa fudsinoi	··0··	11110····	·····	·····	·····
Ctenitis subglandulosa	0····	00·0·0···	·····	·····	·····
Species group 3					
Diplazium petri	·····	100·0····	·····	·····	·····
Species group 4					
Alpinia intermedia	1·110	111111·11	0·1·0···0·0···01	·····0·····0····	·····
Heterotropa lutchuensis	0··00	111111111	··1···1111·0··011	·····	·····
Blastus cochinchinensis	11·10	1121·110·	012122·10···1···	·····	·····
Lasianthus fordii	1·0··	10101····	·11·0····0·000··	·····0·····00··	·····
Pileostegia viburnoides	00··0	01·····00	··1101·····0···	·····	·····
Cyathea hancockii	0·01·	111·0111·	122112021101011	·····	·····
Damnacanthus indicus f. microphylla	···21	1·221210·	01010·11122·0011	··0···1·····1··	·····
Machilus japonica	··0··	·01·10···	··00··0····1···	·····0···0··	·····
Anodendron affine	·0···	···1·0···	0··0····0····0	·····	·0·····
Arachniodes yakusimensis	1····	110·····	·11·····	·····	·····
Diplazium subsinuatum	1···0	·····	·11··1·····	·····	·····
Species group 5					
Dryopteris koidzumiana	···0·	··1·00·00	00···0000·1····1	··0·····0····	·····
Sarcandra glabra	···0·	1000·111·	·1···0011011··011	·00··1·····1····1	·····1···
Thelypteris cystopteroides	··1··	2·111111·	12212211211·2·22	·····1·1	·····
Plagiogyria adnata	·····	11·110101	02101111111101111	··1··0·0·00·····0·	·····
Wendlandia formosana	··0··	010·10··1	00··01·11·011·01	·····0·····0·	·····
Glochidion acuminatum	·····	·0··11000	·00··1·10···1·00	·····0···0···0···	··0·····
Cheiropleuria bicuspis	·····	····1·1·1	·11·11··11112100	·····	·····
Symplocos microcalyx	0····	11111101	11111111111111121	00··101·110·1···000	··0··10···
Tylophora japonica	·····	·000011··	1111··11101···00	··1···1·10···1·111·	1·1····1··
Trachelospermum gracilipes	·····	1··1·0···	01001···1···0···	··1·····0·1·····	·····
Styrax japonicus	·····	·····0·0	·1·····10··10·	·····0····	·····
Blechnum orientale	·····	1····00··	····0·····0···	·····	·····
Eurya osimensis	·····	····0·0··	·0·····0···	·····	·····
Itea oldhamii	·····	····0····	····0·····1·1·	·····	·····
Cymbidium lancifolium	·····	··0·····0	····0·····1····	·····	·····
Species group 6					
Ardisia quinquegona	··111	102121212	11111011121111112	11101110111·0202111	0·····
Dryopteris sordidipes	·0000	100011011	11110111101110111	·0··0110101001··00·	·····1
Distylium racemosum	111·0	111102111	·10111101111111·	10110010·1··1····011	·····0···
Psychotria rubra	10111	0··101001	0··0111111101101	1·11·01·101001·1·1·	··1···0···
Species group 7					
Selaginella doederleinii	·····	1·0·····	02221210111··001	·····1·1	·····
Ilex goshiensis	·····	·····	···0·1··0··10···	·····	·····
Tainia laxiflora	·····	·····	····1····1··0···	·····	·····
Species group 8					
Elaeocarpus japonicus	·····	·····0	0··1·001··000010	01101110111111111·0	1111011010
Illicium anisatum	·····	··0····0	·1·1·011·101·1·0	0···010100000110·11	·00·0·001·
Cinnamomum doederleinii	·····	·····	01·····0···0·0·1	···0·1·11101001101 1	1·0··11111
Ternstroemia gymnanthera	·····	1·····1	11·1·0·1··011110	0·10011·11·0·11·1··	1011101001
Symplocos prunifolia	·····	·····0	1····10·0111···0	00·0010101···011111	1·2·00·11·
Schima wallichii	·····	·····	·0·····00···01·	·····0··0·0101101	2·3·111211
Rhaphiolepis indica var. umbellata	·····	·····	···0··0···010·0·	·····0·100·1···1·00	·0····1·11
Podocarpus macrophyllus	··0··	0···0··0	1·0·0··101110·00	111111·11101111111	2111211121
Machilus thunbergii	·····	1·····	100·10·10··10···	·00·1·1·····1·000··	0·10·1·110
Syzygium buxifolium	···1·	··1111001	1101112212211211	2112221222222222222	2232222222
Rhododendron tashiroi	0····	0···1·0·1	11111111·0110010	1111001111111101··1	···0111111
Neolitsea aciculata	·····	0··0·0·0·	·0·0101001···011	1101111011·101111·1	1011011111
Ilex liukiuensis	·····	···111··0	10011·100111110·	01···1·01·1·1·111·1	1121101001
Species group 9					
Disporum sessile var. micranthum	·····	·····0	·····	····1·1·0···1··111·	··2····1··
Species group 10					
Elaeocarpus sylvestris var. ellipticus	·····	·····0··	·····0····	0·····1··0	0·1··00110
Vaccinium wrightii	·····	·····	·····0·	·····0··1···0·1·	0·10·10011
Myrica rubra	·····	·····	·····	····1·····1·····	····10·01·
Quercus salicina	·····	·····	···1·····	0···0·····010···1	·10·100111
Other species					
Psychotria serpens	11011	111121112	1122121111112221	1111111100122222222	2122221112
Castanopsis sieboldii ssp. lutchuensis	1·00·	221121212	2222222122222211	1111212211222222222	1111112222
Myrsine seguinii	··10·	101·11·12	2211101102221211	2221122211221122222	2231222222
Lindsaea chienii	··1··	111121111	1212222212221221	1111111121112122212	··11111112

Table 4. (Continued)

Diospyros morrisiana	···0·	··000000·	·1·0001111110111	110·111111111010001	0110111110
Ardisia crenata	·01··	·00····11	00010·0001110··1	··0·000·001001·0101	··110010·0
Antidesma japonicum	1·100	·0001···1	·00·001001110··0	10010·1111001211111	1·2·001121
Daphniphyllum teijsmannii	·0··0	···0·0··0	1··1··10·11·111·	11010·011··101111·1	112012111·
Morinda umbellata	···0·	·0011000·	·0·1010·111111··	·····0·0·0·1110211	0·1001···0
Camellia sasanqua	··11·	11·111·11	00···0·1010·1101	00·0···00···0··0·00	0·10·1··1·
Ilex maximowicziana var. kanehirae	·0···	101·10···	····0·1110·00··0	·01··1···1010·11···	1·1··01111
Damnacanthus biflorus	·····	0···1·0·0	··0···011111011·	10··011001·0···1·1	·0·····0·
Tricalysia dubia	···0·	·0···0·1	0·····111010·	0····01····1·111111	1·1·1·0·10
Symplocos glauca	···0·	0··01···0	0·····0··1·000·	·0··00·····100·10·1	0·1···1·00
Podocarpus nagi	·····	·····10·	····1·0·010·0··0	01·10··0··000·1····	101··00·0·
Smilax nervo-marginata	·····	0·····0·0	·1010··0·11··00·	0·1···1····01··00·0	····0····0
Cleyera japonica	·····	····1·1·0	·0·····00··0··	1··0000····0·····	·100···0·1
Symplocos confusa	·····	····0····	··0·····00·0··0	····0··1·····0·0·	··2··010·1
Lemmaphyllum microphyllum var. obovatum	·0···	·····0	·····1··0···	·0·····1·····1·0·	··0·01·1··
Eurya japonica	·····	·····	10·0·····1·0··	··0·····00·	·····
Microtropis japonica	·····	1·····	···0····0····1·	00·····0····	··0·····
Lasianthus curtisii	·····	·····0·	·1··0·0··0·····	··0·····	·····
Listera japonica	···0·	···201···	·····0·····	·····1·····	·····
Hoya carnosa	·····	·1·0····	·····0	·····	·····
Ardisia pusilla	·····	··0··1···	····1·····	·····	·····
Gardenia jasminoides	·····	·····	·····0·····	·0·····0·	·····
Ilex integra	·····	·····	·····0·····	·····0·····	·····0·
Cephalomanes obscurum	·····	·····	·01·····	·····	·····
Ficus thunbergii	···1·	·····	·····0·····	·····	·····
Cyathea metteniana	····0	·····	··0·····	·····	·····
Mitrastemon yamamotoi	·····	22·····	·····	·····	·····
Angiopteris lygodiifolia	1····	·1·····	·····	·····	·····
Dendropanax trifidus	·····	·····	·····	·····0·	··1·····
Ophiorrhiza pumila	·····	····0····	·····0·····	·····	·····
Ficus erecta	···1·	·····	·····0·····	·····	·····
unknown liana	·····	·0·····	····0·····	·····	·····
Smilax bracteata	·····	·····	·0·····0·····	·····	·····

Species occurring in one subplot. No. 1; Crepidomanes auriculatum, 0; Schefflera octophylla, 0. No. 3; Viburnum odoratissimum var. awabuki, 0. No. 6; Prunus zippeliana, 0. No. 13; Hetaeria cristata, 1. No. 17; Viburnum tashiroi?, 0. No. 19; Croomia japonica, 0. No. 23; Rhus succedanea, 0; Trachelospermum jasminoides var. pubescens, 0. No. 25; Diplazium pullingeri, 0. No. 30; Calanthe gracilis var. venusta, 0. No. 35; Diplazium hachijoense, 1. No. 39; Thrixspermum pricei, 1. No. 44; Camellia japonica, 0. No. 45; Eurya emarginata, 1.

boldii grew on the valley bottom and the lower part of the slope. Species group 3, represented only by *Diplazium petri*, was restricted to the lower part of the slope. Species group 4 (11 spp.) *e.g. Cyathea hancockii* and *Heterotropa lutchuensis* occurred from the valley bottom to the middle part of slope. Species group 5 (15 spp.) *e.g. Thelypteris cystopteroides* and *Plagiogyria adnata* grew mainly on the lower and the middle part of the slope. Species group 6 (4 spp.) *e.g. Ardisia quinquegona* and *Dryopteris sordidipes* was distributed widely from the valley bottom to the upper part of the slope, except for the ridge. Species group 7 (3 spp.) *e.g. Selaginella doederleinii* and *Ilex goshiensis* was confined mostly to the middle part of slope, the steepest portion of the plot. Species group 8 (13 spp.) *e.g. Elaeocarpus japonicus* and *Illicium anisatum* covered the area from the middle part of the slope to the ridge. Species group 9, represented only by *Disporum sessile* var. *micranthum*, occurred sporadically on the upper part of the slope. Species group 10 (4 spp.) *e.g. Elaeocarpus sylvestris* var. *ellipticus* and *Vaccinium wrightii* occurred on the uppermost part of the slope and on the ridge. Other species such as *Psychotria serpens* and *Castanopsis sieboldii* ssp. *lutchuensis* occurred widely, irrespective of topographic position, or occurred too rarely to detect any topographic preference.

Phytosociologically, the overall stand of the plot can be identified as the association, Lasiantho-Castanopsietum sieboldii, by its character- and differential-species as *Podocarpus nagi*, *Diospyros morrisiana*, *Blastus cochinchinensis*, *Damnacanthus biflorus* and *Disporum sessile* var. *micranthum* (Miyawaki, 1989).

Tokunoshima

A distinct ridge runs across the uppermost part of the plot, and a stream in the lowest part (Fig. 4b). A transversally convex slope runs from the ridge on the left side of Fig. 4b. Also, a concave slope with an indistinct shallow channel that terminates in a small cliff near the ridge is on the right (Fig. 4b). There is a small gentle slope developed on the lowest part of slope besides the stream. Canopy dominance of the plot is mostly shared by *Quercus miyagii* and *Castanopsis sieboldii* ssp. *lutchuensis* (Hara *et al.*, un-

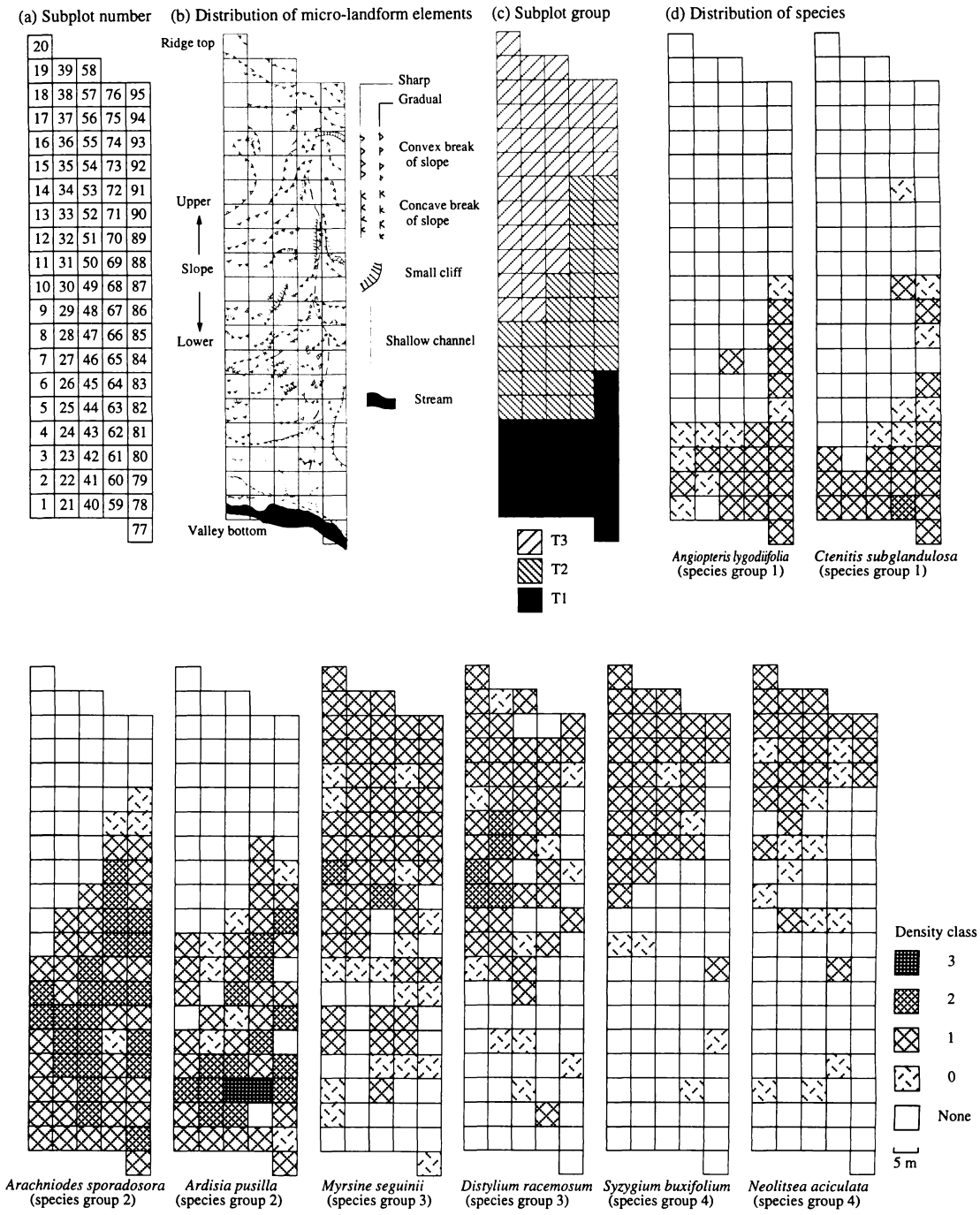


Fig. 4. Subplot number (a), distribution of micro-landform elements (b), layout of subplot groups (c), and distributional patterns of some representative species (d) in the plot of Tokunoshima. Subplot number (a) corresponds to that in Table 5. For the density classes and the subplot groups, refer to Table 2 and Table 5, respectively.

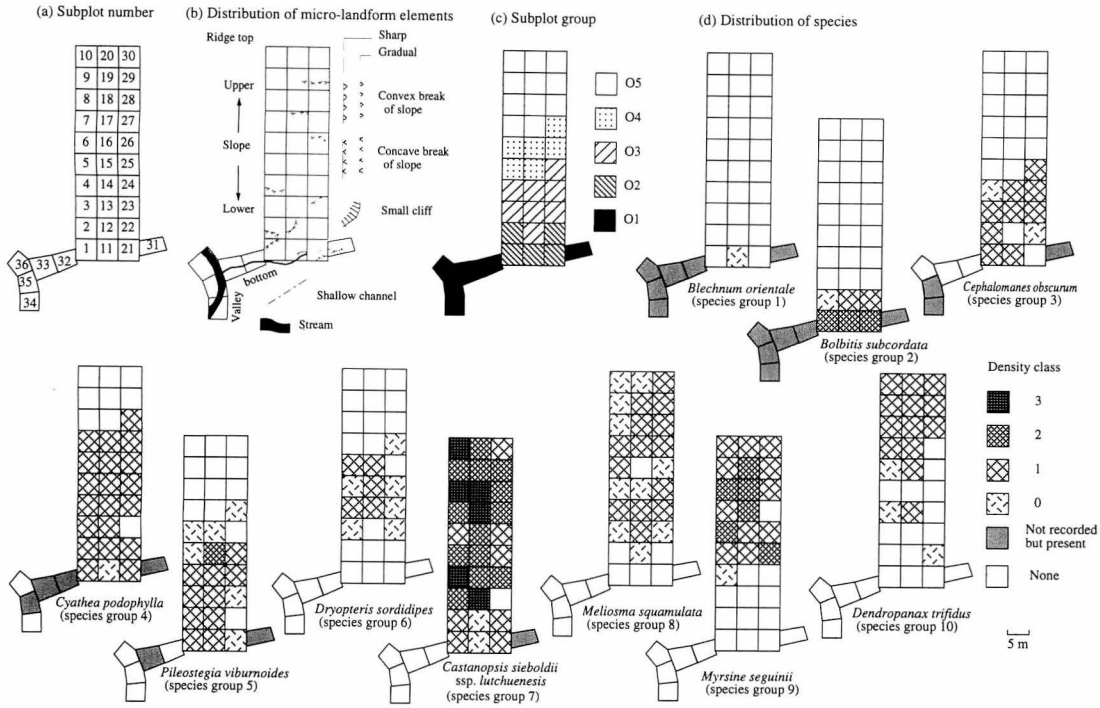


Fig. 5. Subplot number (a), distribution of micro-landform elements (b), layout of subplot groups (c), and distributional patterns of some representative species (d) in the plot of Okinawa. Subplot number (a) corresponds to that in Table 6. For the density classes and the subplot groups, refer to Table 2 and Table 6, respectively.

published).

A total of 134 taxa (species, subsp. and var.) occurred and 131 taxa were identified in the plot. The variation in species composition among the subplots was sorted out as in Table 5. Four species groups and three subplot groups (T1 to T3) were distinguished. T1, T2 and T3 were characterized by joint occurrence of species group 1 to 2, 2 to 3 and 3 to 4, respectively (Table 5).

The distribution of each subplot groups is shown in Fig. 4c. These subplot groups, T1, T2 and T3, were distributed in sequence along the slope from valley bottom to ridge. T1 was on the valley bottom and the adjacent lower part of slope, T2 on the middle part of slope and T3 on the upper part of slope and ridge. In addition, T3 ranged downward along the convex slope on the left, and T2 ascended upward along the concave slope on the right (Fig 4b).

The distribution of representatives of the species groups within the plot is also shown in Fig 4. Species group 1 (18 spp.) *e.g. Angiopteris lygodiifolia* and *Ctenitis subglandulosa* grew on the valley bottom and the gentle lower part of the slope. Species group 2 (24 spp.) *e.g. Arachniodes sporadosora* and *Ardisia pusilla* was distributed from the valley bottom to the middle part of slope. Species group 3 (12 spp.) *e.g. Myrsine seguinii* and *Distylium racemosum* occurred from the middle part of slope to the ridge, but the density and frequency tend to be higher on the upper part of slope. Species group 4 (16 spp.) *e.g. Syzygium buxifolium* and *Neolitsea aciculata* grew mainly on the upper part of slope and ridge. Other species such as *Ardisia quinquegona* and *Castanopsis sieboldii* ssp. *lutchuensis* occurred widely, irrespective of topographic position, or occurred too rarely to detect any topographic preference.

Phytosociologically, the overall stand of the plot was identified as the association of Lasiantho-Castanopsietum sieboldii by its character- and differential-species such as *Podocarpus nagi, Lasianthus fordii* var. *pubescens*, *Damnacanthus biflorus* and *Disporum*

Table 5. Floristic composition of the plot in Tokunoshima. Numerals (0–3) represent the density class. Subplot groups enclosed by thick or thin lines indicate that the frequency of the species is significantly (at $P<0.01$ or $P<0.05$ respectively) higher than in the rest of the subplot groups.

Subplot group	T1	T2	T3
Subplot no.	000022222444456667778888 123412340123901278901 23	000022224444446666666777888888899 567856784567893456789012456789 01	011111111112233333333335555555557779999 901234567890901234567890123456783456 2345
Species group 1			
Angiopteris lygodiifolia	0100·0101110111111111101	·····1·····1110····	·····
Ctenitis subglandulosa	111·11··111021101111101	·····0···1···0·010····	·····
Kadsura japonica	0····10··010·00001100··	0··0·····0·····001·····	0·····00·····0·····
Bolbitis subcordata	·1··01·111·121·02222101	·····	·····
Dryopteris sparsa	·0·····1101·1101···1100	·····0·····00·····	·····
Piper kadzura	100·1···11···111·12200··	·····0·····	·····
Crepidomanes auriculatum	····001··0··1···111110·	·····00·····	·····
Diplazium donianum	··11··12·111··0···21···	····1···1·····	·····
Codonacanthus pauciflorus	10···0···11·0····1·····	·····	·····
Turpinia ternata	011···1·····0·0·1000··	·····0···0·····00····	·····
Diplazium dilatatum	·····0···1··0···11·····	·····	·····
Sarcandra glabra	·1201100·0010111·111111	··11····00·010····1····0·000·0·0	100···100·····0····0···10·····1·····
Smilax bracteata	0···0···0··010·000····	·····0···0·····00·····	·····0·0·····0·····0
Maesa tenera	·····1···00·····0··	·····	·····
Cyathea metteniana	··0····0·····0···	····0·····	·····
Ophiorrhiza pumila	·····11···1····	·····0·····	·····
Rhynchotechum discolor	·····10····0····	·····	·····
Lepisorus thunbergianus	·····0····00···	·····	·····
Species group 2			
Arachniodes sporadosora	11111112122211111211221	12212211222211012122221021221110	·····11·····1·····0···
Quercus miyagii	022··011··12·1111111023	1110·12122100·2322·01···22100110	1···01·····0·0·····0·00·····
Ardisia pusilla	1121122212321·3110122·2	1·1101·0102110211221111·1·1210··	1·····0·····
Ardisia sieboldii	1111·1111101010011101	10·0000·11····111012·00111111··1	0·····1···1···
Machilus japonica	10010010010·0101·0111·0	·0···1·10···1···1·1101···0·00···0·	0·····0·····
Colysis wrightii	211011101111111022201 1·	····110021111·0·0·0·····1·····	·····
Thelypteris triphylla	1·21·0···1·11020·122111	·0·0··011001··1111111··1·11····	·····1·····
Thelypteris cystopteroides	·····111··121···1·111	·····210···11111021110101	·····1·····1·1·····11····1··
Lasianthus wallichii	1·0···100·0·00···0110··	·01·00·000·100·0·0·1···00···0····	·····
Lasianthus fordii	··00·1·1···1···0···00011·	·····1·00·0···0110···00·1·0·0·	·····0·····
Calanthe sp.	·00·····0···0···00·0·1011	····01···10·0···1···0····11·····	·····
Blechnum orientale	·····00··0011···0·10	·····110···010·000···00	·····
Diplazium subsinuatum	·····1·0·12001··1101	·····1·····101···1021····	·····
Trachelospermum gracilipes	·····0·····000·	····0·00000···000···000···10010···	·····0·····0·····
Wendlandia formosana	·····1001·····00····	··0·····0·····0·1·····	·····
Mussaenda parviflora	····0····0000·····0··	·····0·····0····0·	·····
Dryopteris koidzumiana	···1·0···11·0·····10··	01·0·····0·····	·····
Schefflera octophylla	·00100000·010001·100110	1·1·000010···0011·10···0·1111·1···	·10·10110···0·····1·0·0·····0··1··10·0
Lasianthus fordii var. pubescens	011101111111101·111111	1111101111111101111111·10010·01·	10···0100···1100··0·0···100·0···011··0···
Asplenium nidus	·····0···000·····0··1··	0···01·····01·····	·····0·····0·····
Hoya carnosa	0··0·····0·····	·01···1·00·0·00·····	·1·····1·····
Damnacanthus indicus	·····01··	·0·····011·····1·····1100··	·····1·····
Cyathea podophylla	·····0·····0·0001	···1·····111·····1·····	·····0·····
Selaginella doederleinii	·····11··0·····0····	·····11·····1···0·00····	·····1·····
Species group 3			
Myrsine seguinii	·00·····10···00···0··	11·0···011·0···110101101101·0·111	11121100111111111111111211111111101111111
Anodendron affine	··1·0··0·000·····0·0·	01110·001000·0·00010···11·0···0111	·000011·11101····01100100010111111110111
Distylium racemosum	·····0··1·····0··	···00···10·110·····1·1101···1·0··	11221101111111212211101·11111·1111···011
Ilex goshiensis	·····	···0·011···0·0·····0·11·····01·	11011·010···00011··0·00101110000111·111·0
Ilex liukiuensis	··00·····0·····	·0·10··1···010·····1···1···000·11·	1101110110011·0·11·010001110011·010·111
Lindsaea chienii	·····10····0···0···	··11···00·1001000···1111·000001··	1·1···0···10·1·1···01·1·111·0···00110·····
Rhododendron tashiroi	·····0···0·····	··10···10·····0····01···10·1·00111	1110·00·0···10001·00·0·111··11···111·2211
Coptosapelta diffusa	·····	·····0·····0·····0110····0001	··1111111···00···1···10·011101·0·01···1···
Camellia japonica	·····	1011·0·····0·····1·····	00···010·····1···0·00·····0010···0·····
Lindsaea orbiculata var. commixta	0····0·····0····1111	···1···01·0·1·11···010110·00···01·	111···1111···1111001·110111···11110·111101
Smilax nervo-marginata	··0·····0	··00····00·001···0···00····0····0	·····10·1···0·····1·0·1000····0····111·1
Tylophora japonica	·····	·····010····0·0·····	·····11·····0·1···1···0····11·····
Species group 4			
Elaeocarpus japonicus	·01000···0·1···0···0····	···0·0·1····11·11···0···000·····1·	0101110101101011110111101010111100110011
Dendropanax trifidus	·····0·····	·0·0···0···1·····0···0····00···	101010010010··001011·1000··0011····0·000
Syzygium buxifolium	·····0·····0·	·····10·1·····	0·111111111110··11111111··11101111111··11
Ardisia crenata	0·····	·····0···0···0·····0·0·1	··0·00·0·01010···10·00111···00·11·01110·0
Neolitsea aciculata	··0·····0····0·····	·····0···1·0·····	··0·1·110111·1·00111111···0·01111·001·111
Daphniphyllum teijsmannii	···0·····	···0·····01····0···0	··1·0·0111110···0···1·0111···0·111010···10011
Elaeocarpus sylvestris var. ellipticus	····1·····0·····	·····0·0····0···1··0·····0·	····0·····0····011011·00···0011··000011
Cleyera japonica	·····	···1···0·····0·	1·00···001·0·0···000·11001··10···1···0···0·
Tricalysia dubia	·····	·····0····0·····	··00·0·00100·0····0·110···000·11···1···1·1
Eurya japonica	·····	·····0·····0·····	·····0·0····0·1111···0·01··101001·01
Cinnamomum doederleinii	··0·····	·····0·····	···0·····1··00·1·0·110·00·0·····1·
Podocarpus nagi	·····	·····	0·100···0···0···1····1·1····1···1····0···0·
Rhaphiolepis indica var. umbellata	·····	·····	····0·····001·····001···0·0·1
Symplocos prunifolia	·····	·····0·0·····	0·001·····0·····1·0·0·····1·····1·1
Pittosporum tobira	·0·····0·····	·····	···0···0···1···0·····0·····0·0·0
Microtropis japonica	·····	·····	0·0·····0·····00·····

Table 5. (Continued)

Other species			
Ardisia quinquegona	1121112212222121111011111	22222112222222222222122212222111	21211221111122111112220211012211111111111
Castanopsis sieboldii ssp. lutchuensis	111111221121···11111111	11111100101122101101101211011	21112211111201112211222112111212111211123
Randia canthioides	1111·1100011·101·001111	11111111·1001110111111110·0111111	11101011111111·0011111111111111111111111
Psychotria serpens	·0101·0·0011·1000110··0	101001·1111110111011111010111·01	11101111·0111111111111111·11101211111211
Dryopteris sordidipes	···0·0·000011··11···1111	11222112·11112112222122222001222	211000211·0·2110100111··21110111·210121·0
Alpinia intermedia	·1100111·11101111111111	··1110·000110·11111111·101111·01	10····11010·010·····101··00·01010011·11
Machilus thunbergii	001···0·011··00····0··0	00000··00··111·11··00111000··101	10111·100·11·0011111111011011111·1111111
Ilex warburgii	0·00··11·1010·····1·10	001111011·11010·01111111··101110	111·00101110·111000·010001···0···111·10··
Antidesma japonicum	·111·00·10·110·0··01011	00·1100·0·0·01···0·1·0··1·01···	11110·1001·11·01110001000010····10001·001
Psychotria rubra	·00·10····1·0··1010·10·	10100001····100·0·0··1110·1··101	····1··100·0·····000·0···0·1·0··11100000
Morinda umbellata	····0··0·0·0·000··0···0	·01001·1·011··0···0·····0·····	10··0··00·1····0···0·110····0011100100·1
Tarenna gracilipes	00··0·0···0·····1···	0011·····0····00··0·0···00··0·	0·····0010·0·····101·1·1··10··001·1··0·
Meliosma squamulata	···1·0····0···0····0···	·1·00·····001·····011··1·00··	100001·1·0····0··0··1·····000··0·0·10··
Gardenia jasminoides	··1··1·····1··0·0··	···00··0····0···0·00·1··11·100	100··0·····0···011·01·0·1···0···01·0
Meliosma rigida	00·0··00·····000	··10·0·0·00·00··0··100··0···1···	1····010···010·····0···0·0····1·····
Symplocos microcalyx	0·1·····1····0···001	···0··0····10110·10·····00····	··0·····1·····1·0·····0··0····0·
Lemmaphyllum microphyllum var. obovatum	1···0·101··0····10··1··	1···11·11···1·0·····0·····	000·0·····01···1·····
Sapium japonicum	··00···0·0··0·····	1·····0·1··0··1001·0·0·0···	·····00·····0000·····0···1···
Styrax japonicus	·····0·0·1·0·1·0····	0··0·0··01···0·····0·0··0··0·	·····0·0·0·····0·····0·····
Cheiropleuria bicuspis	·····11	··11···0···011·1·····011·····0··	11·····2·····11·····1··01··
Symplocos glauca	····00·····	·····0·····0·0·0·····	0·····0···0···0·0·····0·1··0·····
Myrica rubra	·····0·····	·····0·····0·····0·0	···0·····0·····0···0··0···0·0···0·0·
Lophatherum gracile	·····0·····0	·····0····0··0	·····10·····0·1·····
Glochidion acuminatum	·····00···00·····	·····0·0·····	··0·····0·····
Liparis formosana	·····01·10	·····1···0·····1····	·····0·····
Elaeagnus thunbergii	····0··000·····0·····0····	····0·····
Damnacanthus biflorus	·····0·····0·····0·····	·····10·····0·····0··
Vaccinium wrightii	·····0	·····0	·····00····0·00
Lasianthus curtisii	·····0···0·····	···0·····0·····	·····0··0·····
Camellia sasanqua	··0···1·····1·····	·····0·····	·····0·····
Aristolochia liukiuensis	·····0·····0···	····0·····0·····	·····
Monotropastrum humile	·····1·····1	·····0·····0·····0·····
Cinnamomum japonicum	··0·····	····0··0·····
Cinnamomum okinawense	··0·····	·····00·····
Trachelospermum jasminoides	·····	0····0·····
Eurya osimensis	·····0·····	·····0·····	·0·····0·····	·····
Disporum sessile var. micranthum	·····	·····	·····1·····1·····2····
Ficus erecta	·····0·····	·····1·····0·····	·····
Neolitsea sericea	·····	·····0·····0·····	·····0·····	·····
Meliosma oldhamii	·····	·····0·····	·····0··0·····
Erycibe henryi	·0·····0····	·····
Alocasia odora	·0·····1·····	·····
Symplocos cochinchinensis	·····	·····0·····	0·····	·····
Ilex maximowicziana var. kanehirae	·····	·····	·····1·····0·····
Desmodium laxum ssp. leptopus	·····0·0·····	·····	·····
Glochidion zeylanicum	·····	·····	·····0·····0·····
Diplazium doederleinii	·····0·····1·····	·····	·····
Rhus succedanea	·····0·0·····	·····	·····

Species occurring in one subplot. No. 3; Litsea acuminata, 0; Listera japonica, 1. No. 5; Actinidia rufa, 0. No. 6; Diplazium mettenianum, 1. No. 13; Ternstroemia gymnanthera, 0. No. 17; Photinia wrightiana, 0. No. 44; unknown tree, 0. No. 60; Thelypteris parasitica, 0. No. 61; Mallotus japonicus, 0. No. 67; Lacanorchis sp., 0. No. 77; Thelypteris taiwanensis, 0; Aucuba japonica, 0. No. 78; Asplenium wilfordii, 0. No. 79; Rubus sieboldii, 0. No. 80; Croomia japonica, 0. No. 85; Calanthe discolor var. divaricatipetala, 1.

sessile var. *micranthum* (Miyawaki, 1989).

Okinawa

The plot is composed of two parts, a rectangular main part covering the whole slope and a tail-like extension covering the valley bottom down the stream (Fig. 5b). The main part includes the uppermost part of the slope and the valley bottom. A small stream begins at this valley bottom and meets a main creek about 20 m down. A transversally convex slope runs from the ridge on the left side of the Fig. 5b, and a concave slope on the right. A contour map, the layout of micro-landform units and the stand structure have already been reported in the previous paper (Hara *et al.*, 1996a). The canopy is dominated by *Castanopsis sieboldii* ssp. *lutchuensis*, *Distylium racemosum* and *Schima wallichii* (Hara *et al.*, 1996a).

A total of 135 taxa (species, subsp. and var.) occurred and 131 taxa were identified in the plot. The variation in species composition among the subplots was sorted out as in Table 6. Ten species groups and five subplot groups (O1 to O5) were discriminated. O1, O2, O3, O4 and O5 were characterized by the combination of species group 1 to 4, 2 to 7 (except 6), 3 to 8, 4 to 9 and 7 to 10, respectively.

The distribution of subplot groups is shown in Fig. 5c. These subplot groups O1 to

Table 6. Floristic composition of the plot in Okinawa. Numerals (0–3) represent the density class. "+" represents occurrence of the species in that subplot, but the density class was not recorded. Subplot groups enclosed by thick or thin lines indicate that the frequency of the species is significantly (at $P<0.01$ or $P<0.05$ respectively) higher than in the rest of the subplot groups.

Subplot group	O1	O2	O3	O4	O5
Subplot no.	333333 321546	21020 11122	12102102 23334445	102102 556667	10210210321 77888999000
Species group 1					
Blechnum orientale	++++++	·0···	····· ·····	····· ·····	····· ·····
Calanthe sp.	++·+·+	·····	····· ·····	····· ····0	····· ·····
Diplazium dilatatum	++·+++	·····	····· ·····	····· ·····	····· ·····
Hetaeria cristata?	+++···	·····	····· ·····	····· ·····	····· ·····
Ardisia sieboldii	·+·+·+	·····	····· ·····	····· ·····	····· ·····
Maesa tenera	·+·+++	·····	····· ·····	····· ·····	····· ·····
Kadsura japonica	++··++	·····	····· ·····	····· ·····	····· ·····
Bredia hirsuta	+··+++	·····	····· ·····	····· ·····	····· ·····
Pilea aquarum ssp. brevicornuta	·+·+++	·····	····· ·····	····· ·····	····· ·····
Mucuna macrocarpa	+··+·+	·····	····· ·····	····· ·····	····· ·····
Ficus ampelas	+···++	·····	····· ·····	····· ·····	····· ·····
Calanthe gracilis var. venusta	+·++··	·····	····· ·····	····· ·····	····· ·····
Stephania japonica	···+++	·····	····· ·····	····· ·····	····· ·····
Codonacanthus pauciflorus	···+++	·····	····· ·····	····· ·····	····· ·····
Ardisia pusilla	···+++	·····	····· ·····	····· ·····	····· ·····
Litsea acuminata	···++·	·····	····· ·····	····· ·····	····· ·····
Ctenitis subglandulosa	··+··+	·····	····· ·····	····· ·····	····· ·····
Fatsia japonica var. luikiuensis	·+·+··	·····	····· ·····	····· ·····	····· ·····
Species group 2					
Bolbitis subcordata	++++++	22210	1····· ·····	····· ·····	····· ·····
Turpinia ternata	++·+++	01000	····· ·····	····· ·····	····· ·····
Diplazium subsinuatum	++··+·	111·1	···1···· ·····	····· ·····	····· ·····
Ficus bengutensis	+··++·	·11·0	····· ·····	····· ·····	····· ·····
Desmodium laxum ssp. leptopus	·+·++·	·1·0·	····· ·····	····· ·····	····· ·····
Machilus japonica	·+·+++	0101·	··1····· ··00··	0····· ·····	····· ·····
Angiopteris lygodiifolia	++·+·+	····1	····· ·····	····· ·····	····· ·····
Ophiorrhiza japonica	···+++	·1···	····· ·····	····· ·····	····· ·····
Microsorium buergerianum	+··+++	··0··	····· ·····	····· ·····	····· ·····
Alocasia odora	·+·+++	·0···	····· ·····	····· ·····	····· ·····
Hoya carnosa	·++···	·0···	····· ·····	····· ·····	····· ·····
Species group 3					
Diplazium donianum	++++··	11122	22101···	····· ·····	····· ·····
Cephalomanes obscurum	··+++·	·1101	·1111101	····· ·····	····· ·····
Lasianthus wallichii	+···+++	·0··0	0001·000	·0···· ·····	····· ·····
Ficus nipponica	··++··	1·101	0101·00·	····· ····0	····· ·····
Species group 4					
Lasianthus fordii	++++++	11111	11111111	111100	··00·1·1···
Cyathea podophylla	++++··	10111	1·111111	·11111	111·····
Cibotium barometz	++·+++	1·11·	122·····	·01·00	····· ·····
Species group 5					
Pileostegia viburnoides	+·+····	011·1	10111111	20·000	····· ·····
Selaginella doederleinii	··+····	··0·1	··11·1·0	1····0	····· ·····
Ilex warburgii	·····	·0·01	·1·11···	00·0··	·····0····
Species group 6					
Cheiropleuria bicuspis	·····	····1	1·111221	222212	2111·0····
Dryopteris sordidipes	·····	·····	·0·00110	10·110	····· ·····
Quercus miyagii	·····	·····	····0·01	··1001	1··0·····
Species group 7					
Castanopsis sieboldii ssp. lutchuensis	··+····	10111	0·322231	221212	32233222123
Species group 8					
Meliosma squamulata	·····	·····	00101111	000·11	11110110100
Lindsaea chienii	·····	·····	·1·1·111	101212	11221211111
Antidesma japonicum	·····	·····	0··00000	0·0110	01·1·100100
Ilex goshiensis	·····	·····	0··0·0·0	0·1100	00110·0·0··
Smilax china var. okinawensis	+·····	····0	··00·000	··0011	0000011·00·
Syzygium buxifolium	·····	·····	·0·0···0	000110	01·11111111
Lophatherum gracile	·····	····0	1·001···	·1·00·	1110···0100
Randia canthioides	·++···+	0···1	01111111	111111	11111111111
Species group 9					
Myrsine seguinii	·····	·····	·····02	11112·	21122121111
Rhododendron tashiroi	·····	·····	··0···0·	·00110	1110000110·
Ternstroemia gymnanthera	·····	·····	·····	0·0000	11101111101
Lasianthus curtisii	·····	·····	····0··0	011·11	1111·11····
Daphniphyllum teijsmannii	·····	·0···	·····	··101·	010·101·10·
Elaeocarpus japonicus	·····	·····	·····	00001·	0101·1··11·
Ilex liukiuensis	·····	·····	·····	010···	·1·0·111110
Gardenia jasminoides	·····	·····	·····	···000	·0001··00··
Symplocos okinawensis	·····	·····	·····	0···0··	·0·0·0·010·
Eurya japonica	·····	·····	·····	0····0	1·0110·····
Tricalysia dubia	·····	···0·	·····	·1···1	·0·11·1111·
Machilus thunbergii	·····+	···01	·0·····	1	110011 10·1011·111
Tarenna gracilipes	·····	·1··0	···0··1·	10·00·	010·1000··1
Smilax nervo-marginata	···++·	·····	···0····	011110	··11·01··00
Ilex integra	·····	·····	·····	·00··0	··00·····0·
Distylium racemosum	+··++·	····0	···00·01	111110	11211222221
Schima wallichii	++··+·	·····	·0·····	00·00·	0·000··11·0
Trachelospermum jasminoides var. pubescens	·····	·····	·····	00··0·	·····0·
Species group 10					
Dendropanax trifidus	·····	···0·	·····10·	···10·	111111111111
Tutcheria virgata	·····	·····	····10·0	·····1	00110211111
Cinnamomum doederleinii	·····	·····	·····0	·····0	0011000·111
Damnacanthus biflorus	·····	····1	·····	···1··	0111110·110
Coptosapelta diffusa	·····	·····	·····0··	···0··	00·010·1110
Pleioblastus linearis	·····	·····	·····	·····	··0·111·110
Ilex maximowicziana var. kanehirae	·····	·····	·····	·····	··00··0·0·0
Osmanthus marginatus	·····	·····	·····	·····	·01·····0·
Skimmia japonica var. lutchuensis	·····	·····	·····	·····	10··1·····
Rhaphiolepis indica var. umbellata	·····	·····	·····	·····	···10····1·
Other species					
Ardisia quinquegona	++·+·+	11111	11111211	111112	1111·1·1·01
Alpinia intermedia	++++++	11111	21111112	1·2011	111··001··1
Psychotria serpens	+++++·	0·111	···0·110	011111	011111111110
Psychotria rubra	+···++	···01	0010·10·	0·1000	11000111001
Neolitsea aciculata	+·····	10001	0·1·1·11	11001·	110·0101111
Schefflera octophylla	+·++·+	···0·	0··1010·	1·0···	0···00·0····
Cinnamomum japonicum	·····	·1·01	·0·10···	·0····	·10·1··1111
Symplocos glauca	···+++	·0··0	·····	·0··0·	·····0·01·
Euonymus tashiroi	·+·+··	···0·	···00·0·	·····	····0·····
Meliosma rigida	·····	···0·	··0·0··1	0·····	····0·000·
Ardisia crenata	··+···	0····	·····	·00···	···0·00·00·
Wendlandia formosana	··++··	·1···	····01·	·0···1	·0·····
Diospyros morrisiana	·····	·0···	·0···0·	·0·0··	····00···0·
Hydrangea liukiuensis	·····	····1	···00·0·	····1	··1··0·····
Camellia japonica	·····	·····	····010·	·1····	·0·····0
Adinandra ryukyuensis	·····	·····	····0··	····1	0···0···0···0
Tylophora japonica	···+··	·····	·····	····0·	····0···11·
Styrax japonicus	+·····	·····	·····	····00	····· ·····
Lasianthus cyanocarpus	·····	·····	·····	····0·	·····0··1··
Microtropis japonica	·····	···+··	·····	·····	·····0·1
Arachniodes dimorphophylla	·····	····1	·0·····	·····	····· ·····
Viburnum japonicum	·····	·····	·····	·····	··1·····0
Callicarpa japonica var. luxurians	·····	·····	·····	·····	···0·0·····
Carex sp.	·····	·0···	·····0·	·····	····· ·····
Anodendron affine	·····	·····	··0···0·	·····	····· ·····
Bredia okinawensis	·····	·····	·····	00····	····· ·····
Podocarpus macrophyllus	·····	·····	·····	·····	···01·····
Illicium anisatum	·····	·····	·····	···0··	·····0····
Vaccinium wrightii	·····	·····	·····	·····	····0·0····
Elaeocarpus sylvestris var. ellipticus	···+··	·····	·····	·····	·····0
Camellia sasanqua	·····	·····	·····	·····	·····0···0·
Cleyera japonica	·····	·····	·····	····0	·····1····

Species occurring in one subplot. No. 7; Symplocos stellaris, 0. No. 9; Symplocos prunifolia, 0. No. 11; Oplismenus compositus var. patens, 1. No. 12; Orchidaceae sp., 0. No. 16; Asplenium nidus, 0; Myrica rubra, 0. No. 25; Michelia compressa, 0. No. 31; Elaeagnus thunbergii, +. No. 33; Zanthoxylum scandens, +; Lemmaphyllum microphyllum var. obovatum, +; Diplocyclos palmatus, +; Diospyros japonica, +. No. 34; Camellia lutchuensis, +; Berchemia racemosa f. stenosperma, +; Damnacanthus indicus ssp. major, +. No. 35; Actinidia rufa, +; Rhus succedanea, +; Ficus erecta, +; Thelypteris taiwanensis, +; Deparia petersenii, +; Pteris fauriei, +; Habenaria polytricha, +; Farfugium japonicum, +. No. 36; Meliosma oldhamii, +.

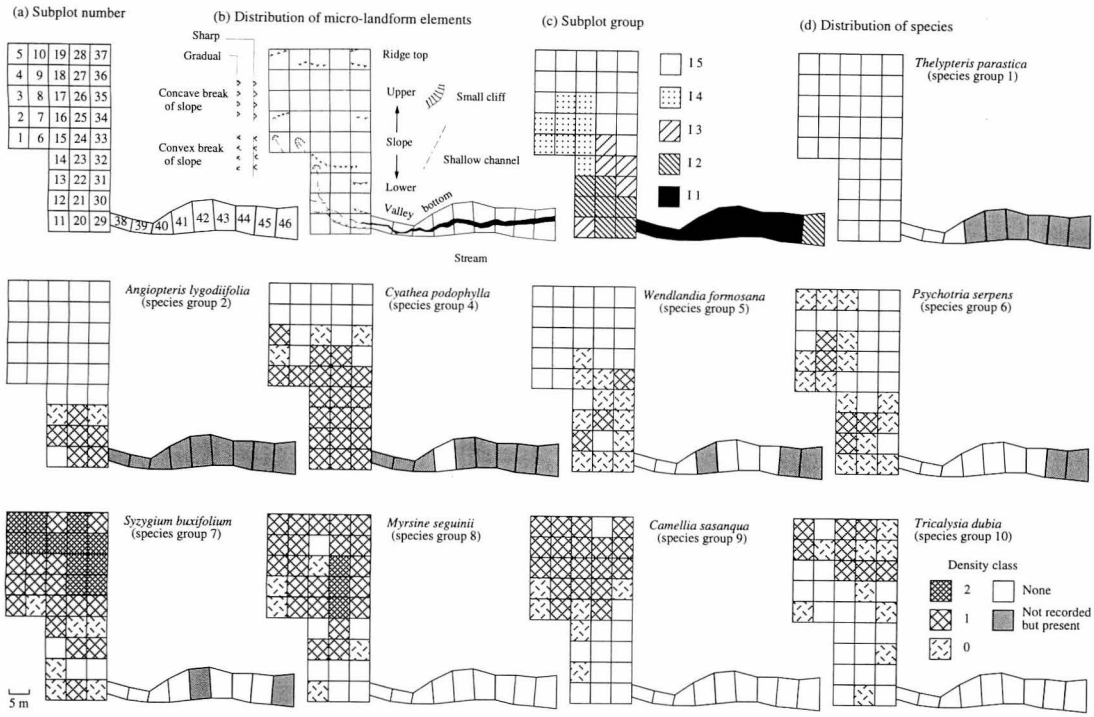


Fig. 6. Subplot number (a), distribution of micro-landform elements (b), layout of subplot groups (c), and distributional patterns of some representative species (d) in the plot of Iriomote. Subplot number (a) corresponds to that in Table 7. For the density classes and the subplot groups, refer to Table 2 and Table 7, respectively.

O5 were distributed in sequence along the slope from valley bottom to ridge, and were closely associated with the relative position of slope as follows: O1 was on the valley bottom, O2 on the valley bottom and the lowermost part of the slope, O3 on the lower part of slope, O4 on the middle part of slope and O5 on the upper part of slope. This layout of the subplot groups seems to be correlated with the arrangement of micro-landform units classified by Hara *et al.* (1996 a), although they did not coincide exactly. For example, O2 occurred on their bottom-land and lower side slope, O3 included both their lower and upper side slope, O4 their upper side slope, and O5 included both their upper side slope and crest slope.

The distribution of representatives of the species groups within the plot is also shown in Fig. 5. Species group 1 (18 spp.) *e.g. Blechnum orientale* and *Diplazium dilatatum* was confined to the valley bottom. Species group 2 (11 spp.) *e.g. Bolbitis subcordata* and *Turpinia ternata* grew on the valley bottom and the lowest part of slope. Species group 3 (4 spp.) *e.g. Diplazium donianum* and *Cephalomanes obscurum* was distributed from the valley bottom to the lower part of slope. Species group 4 (3 spp.) *e.g. Cyathea podophylla* and *Lasianthus fordii* covered the slope widely from the valley bottom to the middle part of the slope. Species group 5 (3 spp.) *e.g. Pileostegia viburnoides* and *Selaginella doederleinii* grew on the lower and middle part of the slope. Species group 6 (3 spp.) *e.g. Cheiropleuria bicuspis* and *Dryopteris sordidipes* was distributed on the middle part of the slope. Species group 7 represented only by *Castanopsis sieboldii* ssp. *lutchuensis* occurred on the whole slope. In some of the subplots on the middle and upper part of the slope, the number of *Castanopsis* reached to some hundreds, although most were seedlings less than 20 cm in height. Species group 8 (8 spp.) *e.g. Meliosma squamulata* and *Ilex goshiensis* covered most of the slope, although their densities were mostly higher on the upper part of the slope. Species group 9 (18 spp.) *e.g.*

Table 7. Floristic composition of the plot in Iriomote. Numerals (0–2) represent the density class. "+" represent occurrence of the species in that subplot, but the density class was not recorded. Subplot groups enclosed by thick or thin lines indicate that the frequency of the species is significantly (at $P<0.01$ or $P<0.05$ respectively) higher than in the rest of the subplot groups.

Subplot group	I1	I2	I3	I4	I5
Subplot no.	33444444 89012345	32222114 09210326	33221 21431	011110000 176548762	3333322221110000 7654387659809543
Species group 1					
Thelypteris parasitica	···+++++	·····+	·····	·····	·····
Diplazium donianum	···++·+·	·0·····	····1	·····	·····
Crepidomanes birmanicum	·++·····	·····	·····	·····	·····
Ophiorrhiza japonica	··+···+·	·····	·····	·····	·····
Ardisia pusilla	···++···	·····	·····	·····	·····
Alocasia odora	····+·+·	·····	·····	·····	·····
Deparia petersenii	····++··	·····	·····	·····	·····
Carex sp.	·····++·	·····	·····	·····	·····
Species group 2					
Angiopteris lygodiifolia	++++++++	1111101+	·0···	·····	·····
Bolbitis subcordata	++++++++	1111··1+	·····	·····	·····
Thelypteris liukiuensis	++++++++	·1·0101+	·····	·····	·····
Lindsaea merrillii ssp. yaeyamensis	+++·++++	11110··+	·····	·····	·····
Oplismenus compositus var. patens	·+··+·++	01··110+	·1···	····1····	·····
Argostemma solaniflorum	+++·+···	21221·2·	·1···	·····	·····
Codonacanthus pauciflorus	+++++··+	·1·11··+	·····	·····	·····
Diplazium subsinuatum	·+++++··	·1·11·0·	····1	·····	·····
Cyathea metteniana	·+····+·	0101001·	·····	·····	·····
Ficus bengutensis	++++++++	·1··000·	·····	·····	·····
Hoya carnosa	+···+·+·	1001·0·+	·····	·····	·····
Callicarpa japonica var. luxurians	·····++·	··00·0·+	·····	····0····	·····
Ficus erecta	···+··++	0··0···+	·····	·····	·····
Malaxis bancanoides	··+·++··	10·····	·····	·····	·····
Rhynchotechum discolor	+·+·····	·0··1··+	·····	·····	·····
Lemmaphyllum microphyllum var. obovatum	·····+	·····0+	·····	·····	·····
Isachne kunthiana	·····++	·····+	·····	·····	·····
Species group 3					
Hydrangea yaeyamensis	·····	0·00·00·	·····	·····	·····
Species group 4					
Cyathea podophylla	+++·++++	1111111+	11111	10111··10	··0·1···1·····1
Lasianthus wallichii	++++···+	1001101+	·11·1	00111010·	····1·····
Arachniodes sporadosora	+·++++·+	0·11112+	·1021	···11001·	·····
Thelypteris triphylla	····++++	·11·111+	01110	1··22·12·	·····
Ardisia sieboldii	+·++++++	0000·01+	·0·01	·0·11111·	·····0·····1·0·
Desmodium laxum ssp. leptopus	·+++····	2·21·11+	·1·0·	0··11··10	·····
Bridelia balansae	···++++·	0··0001+	····0	··0····00	·····
Species group 5					
Wendlandia formosana	···+···+	001·001+	00000	··00·····	····1·····
Tylophora japonica	·····	1··0·00+	·101·	····1····	·····0·····
Schefflera octophylla	·····	1·0··00·	0·001	·····	·····0·····0
Cephalomanes obscurum	·····	·····1·	·1··0	·····	·····
Species group 6					
Psychotria serpens	·····+	·0100111+	00··0	000·01100	·····0·0··
Camellia lutchuensis	····+··	·1·1111·	·1·00	·0111111·	·····0·····1···
Ficus nipponica	·····	··11·01·	·0···	·010·1110	·····
Lasianthus fordii	·····++	1·0110··	1111·	·0010··00	·····
Euonymus lutchuensis	·····+	0·00101·	··011	1·11·1101	··0···0·0····000
Species group 7					
Syzygium buxifolium	····+···	·01·1·0+	01100	111111101	1222122221222221
Elaeocarpus sylvestris var. ellipticus	·····	··0000·+	0·0··	0·101·010	011·11101·001100
Symplocos glauca	·····	0·0··10·	··0·1	110·11101	·00··0010·111·11
Tarenna gracilipes	·····	··000···	·00·0	·110·11·0	10000·011···11·00
Lasianthus cyanocarpus	·····	·00··0··	·011·	00·010011	·001··010··0·000
Dryopteris sordidipes	·····	·1··0··+	···11	··1··1100	··1·0··10····011
Ardisia quinquegona	····+·+	1111111+	21111	112222221	1222211121221221
Randia canthioides	·+····+	1011·1·+	11111	111111111	1112111211011111
Antidesma japonicum	+·····	··1001·+	11110	·1101110·	1111111112112111
Quercus miyagii	·····	··0··1·+	0111·	·1···0··1	·0··1···10·0000·
Tutcheria virgata	·····	··10····	·00··	·1010··11	··1·····0···0011
Species group 8					
Myrsine seguinii	·····	··1··1··	·0210	0011·1110	1111111221·11111
Castanopsis sieboldii ssp. lutchuensis	····+··+	··0·····	1·10·	·1·10110·	2112111111111011·
Ilex liukiuensis	·····	·····0··	·000·	0··011000	1·010··00·001·00
Anodendron affine	·····+·	·····	··11·	·11101111	111111111·111211
Rhus succedanea	·····	·····	··1··	·000·1···	··00·001··00·0··
Lindsaea chienii	·····	··0·····	··211	1011111·0	·11111···1··0···11
Lindsaea orbiculata var. commixta	·····	·····0·	··0·0	··0···010·	·0101···1··0···11
Species group 9					
Ardisia crenata	·····+·	··10·0··	·10··	001·110··	1110111101110111
Rhaphiolepis indica var. umbellata	···+·++·	·····	··0··	·000010·1	1111011112121121
Ilex goshiensis	·+·····	01···0··	·····	001111001	11100·10111100·1
Osmanthus marginatus	·++···+	·0·0····	·····	·110111·1	11···01101011111
Camellia sasanqua	·····	·····0·	··1··	011001110	1110···1111111111
Cinnamomum doederleinii	·····	·····	·····	·00·000·0	11100111110100··
Archidendron lucidum	·····	·····+	·····	·0001··0·	1111001111·····
Elaeocarpus japonicus	·····+	···0····	··0··	000·10···	11·1··0·0001001·
Illicium anisatum var. tashiroi	·····+·	·····	···0·	···101·10	·····0···1110111
Cynanchum liukiuense	·····	·····0··	·····	·····10·0	···0·101·11·1001
Ternstroemia gymnanthera	·····	·····	·····	·····0···	·0···0····0·1···

Table 7. (Continued)

Species group 10					
Tricalysia dubia	·····	····0···	·0···	01·····	001·0101011·011·
Symplocos prunifolia	·····	·····0··	·0···	··01·····	011·0··000100·0·
Podocarpus macrophyllus	·····	·····	·0···	0·····	01···0·0·0·111·0
Microtropis japonica	·····	·····00·	·0···	··0·0···1	01·01·1·1111·011
Other species					
Psychotria rubra	+··+·+++	1011211+	12111	222112211	2121112222222112
Distylium racemosum	····++++	··00·0·+	·01·0	0111·1111	2211·12101111211
Machilus thunbergii	···+++++	·00·110+	·011·	1·1··1101	0011·11·11121111
Alpinia intermedia	··++·+·+	0·11011+	··101	111111111	··1·1·0110·11111
Smilax china var. okinawensis	····++·+	··1·000+	1···1	0001·00··	·01101000011·110
Sarcandra glabra	·····+·+	0·1·11·+	·0·11	1·1100111	·01···111100·211
Lophatherum gracile	···++++·	0111111+	·10·0	··01100·0	··10·····0·1·1··
Freycinetia formosana	+·+·+·++	111101·+	·11··	··0·····	···100·0111·····
Trachelospermum gracilipes	+++···++	·1··1··+	··1··	·····10··	·1···11··0122221
Lasianthus curtisii	····+···	····0···	111··	··10·····	···00·001·····0
Ilex warburgii	+···+···	0·10··0+	··1··	···1·····	·0···0·1·····
Glochidion zeylanicum	····+++·	·····	·····	··0···0··	0110··01·····
Machilus japonica	·····++	·····+	·····	0·0····0·	··········0100·
Morinda umbellata	·····+·	·····	··0··	·····0·1·	··00·····0····11
Ilex maximowicziana	·····	·1·····+	···1·	0·····	··0·0··0····1·1·
Neolitsea aciculata	·····+·	·····	···0·	··00·····	11···0···0·····
Symplocos caudata	·····	·····+	····0	····01·0·	·····0·0··0·
Asplenium australasicum	····+·+·	00·····	·1···	·····	····0·····1··
Blechnum orientale	·+·+·+··	·····00·	·····	0···0····	·····
Glochidion rubrum	····++··	·····+	·····	··0·0···0	·····
Adinandra yaeyamensis	·····+·	·····	·····	0·0··0···	·····0·····
Carex breviscapa	·····	·····0··	·····	··1·····	··1·····1·····
Gardenia jasminoides	·····	·1··0···	·····	0·····	·····0·····
Kadsura japonica	····++··	·····	·····	···0·····	·····
Vaccinium wrightii	·····	·····	·····	·····0·	·····0·····0····
Daphniphyllum teijsmannii	·····	·····	·····	·····0·00	·····
Dendropanax trifidus	·····	···0····	·····	·····1··	·····0·····
Styrax japonicus	···+····	··0·····	·····	·····	·····0··
Myrica rubra	·····	·····	·····	·····	00·····
Eurya japonica	·····	·····	·····	0·····	··0·····
Coptosapelta diffusa	·····	··0·····	·····	·····	··1·····
Rhododendron simsii	·····	·····	·····	·····	··00·····
Pileostegia viburnoides	··+·····	·····	·1···	·····	·····
Selaginella doederleinii	·····	1·····	·0···	·····	·····
Calanthe triplicata	·····	0·····	··0··	·····	·····
Glochidion obovatum	·····	·····0··	·····	·····	·····0·····
Michelia compressa	·····	·····	··0··	·····	·····0·····
Diospyros ferra var. buxifolia	·····	·····0·	·····	·····0·	·····
Lasianthus obliquinervis	···+····	·····	·····	·····0·	·····
Mussaenda parviflora	·····+··	·····+	·····	·····	·····
Saurauia tristyla	·····+	·····+	·····	·····	·····

Species occurring in one subplot. No. 2; Ilex rotunda, 0. No. 7; Cheiropleuria bicuspis, 1; Helicia cochinchinensis, 0. No. 8; Eurya osimensis, 0. No. 9; Lindsaea lucida, 1. No. 11; Symplocos nakaharae, 0. No. 16; Symplocos cochinchinensis, 0. No. 17; Eurya sakishimensis, 0. No. 22; Cleyera japonica,1. No. 27; Elaeagnus glabra, 0. No. 41; Ficus virgata, +. No. 42; Cyathea spinulosa, +; Piper kadzura, +; Arenga engleri, +. No. 43; Pteris dispar, +. No. 45; Diplazium incomptum, +. No. 46; Diospyros oldhamii, +; Microsorium buergerianum, +.

Myrsine seguinii and *Ternstroemia gymnanthera* occurred on the middle and upper part of the slope. Species group 10 (10 spp.) *e.g. Dendropanax trifidus* and *Tutcheria virgata* was mostly restricted to the uppermost part of slope. Other species such as *Ardisia quinquegona* and *Alpinia intermedia* occurred widely, irrespective of topographic position, or occurred too rarely to detect any topographic preference.

Phytosociologically, the overall stand of the plot can be identified as Illicio anisati-Castanopsietum sieboldii, an association unique to Okinawa Island, by its character- and differential-species as *Adinandra ryukyuensis*, *Euonymus tashiroi*, *Arachniodes dimorphophylla* and *Illicium anisatum* (Miyawaki, 1989).

Iriomote

As in Okinawa, the plot is composed of two parts, a rectangular main part with one missing corner and a tail-like extension (Fig. 6b). The main part includes the whole slope from the waterless valley bottom to the ridge top. A small stream begins just at the bottom end of the main part, flows down the flat valley bottom of the extended part and meets a main creek at the end of the extended part. Also, a transversally convex slope runs from the ridge on the right side of Fig. 6b, and a concave slope is on the left, which forms the head of this small valley. The canopy of the plot is mainly dominated by *Quercus miyagii* and *Castanopsis sieboldii* ssp. *lutchuensis*.

A total of 134 taxa (species, subsp. and var.) occurred and 133 taxa were identified in the plot. The variation in species composition among the subplots was sorted out as in Table 7. Ten species groups and five subplot groups (I1 to I5) were differentiated. I1 is characterized by joint occurrence of species

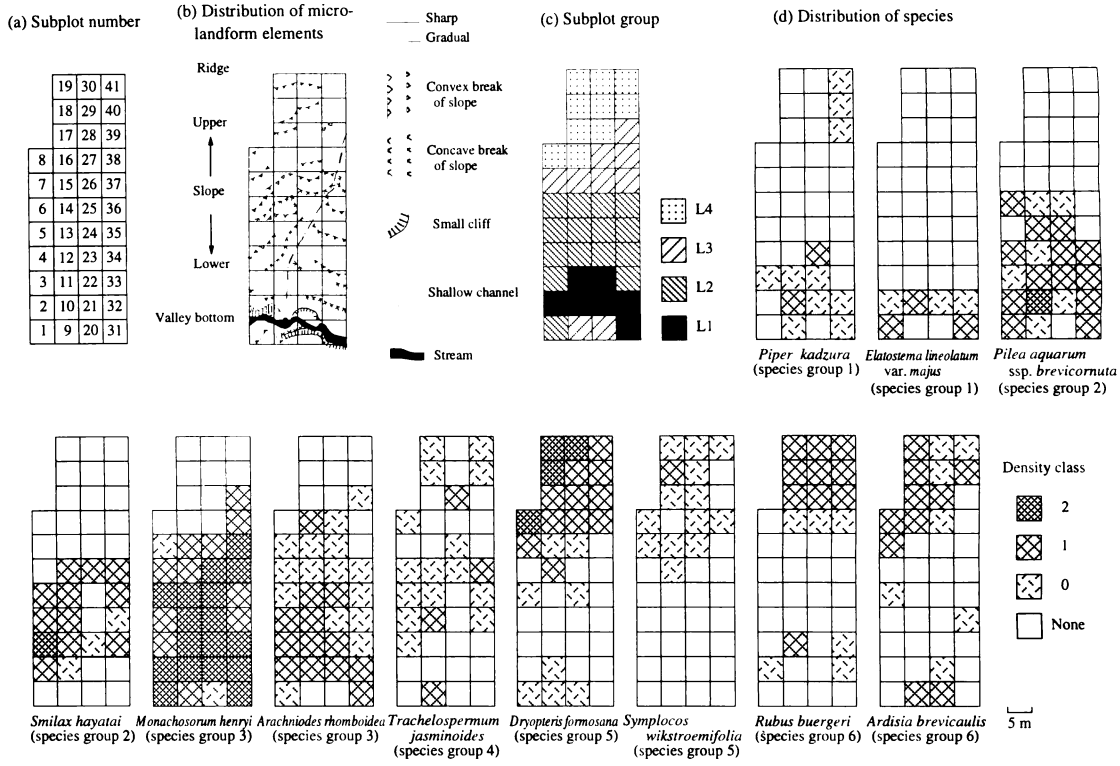


Fig. 7. Subplot number (a), distribution of micro-landform elements (b), layout of subplot groups (c), and distributional patterns of some representative species (d) in the Lopeishan plot. Subplot number (a) corresponds to that in Table 8. For the density classes and the subplot groups, refer to Table 2 and Table 8, respectively.

group 1, 2, and 4. Likewise, subplot groups I2, I3, I4 and I5 are characterized by the combination of species groups 2 to 7, 4 to 8, 4 to 9 (except 5) and 7 to 10, respectively (Table 7).

The layout of the subplot groups within the plot is shown in Fig. 6c. The distribution of subplot groups, I1 to I5, was closely related to the geomorphological position as follows: I1 was on the valley bottom with waterflow, I2 on the waterless valley bottom and the lowermost part of the slope, I3 on the lower slope, I4 on the concave middle slope of the valley head and I5 on the upper slope and ridge.

The distribution of representatives of the species groups within the plot is also shown in Fig. 6. Species group 1 (8 spp.) *e.g. Thelypteris parasitica* and *Diplazium donianum* was confined to the valley bottom. Species group 2 (17 spp.) *e.g. Bolbitis subcordata* and *Angiopteris lygodiifolia* covered the valley bottom and the lowest part of slope. Species group 3, represented only by *Hydrangea yaeyamensis*, was found on the lowest part of slope. Species group 4 (7 spp.) *e.g. Cyathea podophylla* and *Lasianthus wallichii* covered the slope widely from the valley bottom to the middle part of the slope. Species group 5 (4 spp.) *e.g. Wendlandia formosana* and *Tylophora japonica* grew on the lower and middle part of the slope. Species group 6 (5 spp.) *e.g. Psychotria serpens* and *Camellia lutchuensis* was distributed on the middle part of the slope and the concave valley head. Species group 7 (11 spp.) *e.g. Syzygium buxifolium* and *Elaeocarpus sylvestris* var. *ellipticus* occurred throughout the slope from the lower part of slope to the ridge except the valley bottom, and their densities were mostly higher on the upper part of slope and the ridge. Species group 8 (7 spp.) *e.g. Myrsine seguinii* and *Anodendron affine* was distributed on the middle and upper part of the slope, including the concave valley head. Species group 9 (11 spp.) *e.g.*

Camellia sasanqua and *Cinnamomum doederleinii* occurred on the middle and upper part of slope. Species group 10 (4 spp.) *e.g. Tricalysia dubia* and *Symplocos prunifolia* was mostly restricted to the the upper part of the slope and the ridge. Other species such as *Psychotria rubra* and *Alpinia intermedia* were found throughout the plot irrespective of topographic position, or occurred too rarely to detect any topographic preference.

Phytosociologically, the plot seems to consist of two associations. Based on Miyawaki (1989), subplot group I3, I4 and I5 covering most of the slope can be identified as Adinandro yaeyamensis-Castanopsietum sieboldii by such character- and differential-species as *Adinandra yaeyamensis*, *Illicium anisatum* var. *tashiroi*, *Symplocos caudata* and *Eurya sakishimensis*. Likewise, subplot group I1 and I2 covering the lowest part of slope and the valley bottom can be identified as Rhynchotecho discoloris-Perseetum japonicae by the presence of such character- and differential-species as *Argostemma solaniflorum*, *Rhynchotechum discolor* and *Saurauia tristyla*.

Lopeishan

The plot includes the whole slope from a valley bottom with constant waterflow to the uppermost part of the slope connecting to a gentle ridge (Fig. 7b). An indistinct waterless channel crosses the plot from the lower left to the upper right. A contour map and the layout of micro-landform units of the plot are reported in another paper of this volume (Hara *et al.*, 1997). The canopy of the plot is dominated by *Quercus longinux* and *Machilus thunbergii*, with some mixture of *Diospyros morrisiana*, *Quercus sessilifolia* and *Illicium arborescens* (Hara *et al.*, 1997).

A total of 188 taxa (species, subsp. and var.) occurred and 182 taxa were identified in the plot. The variation in species composition among the subplots was sorted out as in Table 8. Six species groups and four subplot groups (L1 to L4) were differentiated. Subplot group L1, L2, L3 and L4 was characterized by the combination of species groups 1 to 3, 2 to 4, 3 to 5 and 4 to 6 (Table 8).

The layout of the subplot groups within the plot is shown in Fig. 7c. The territories of the subplot groups, L1 to L4, corresponds with the relative position along the slope from the valley to the ridge such that L1 was on the valley bottom along a stream, L2 on the lower part of slope, L3 on the middle part of slope, L4 on the upper part of slope.

The distribution of the representatives of the species groups within the plot is also shown in Fig. 7. Species group 1 (7 spp.) *e.g. Piper kadzura* and *Elatostema lineolatum* var. *majus* was confined mostly to the valley bottom. Species group 2 (4 spp.) *e.g. Pilea aquarum* ssp. *brevicornuta* and *Smilax hayatae* grew on the valley bottom and the lower part of slope. Species group 3 (5 spp.) consisted of ferns such as *Monachosorum henryi* and *Arachniodes rhomboidea* and covered the slope widely from the valley bottom to the middle part of the slope. Species group 3, represented only by *Trachelospermum jasminoides*, occurred widely but sporadically throughout the slope, except the valley bottom. Species group 5 (17 spp.) *e.g. Dryopteris formosana* and *Symplocos wikstroemifolia* grew on the middle and upper part of the slope. Species group 6 (10 spp.) *e.g. Rubus buergeri* and *Ardisia brevicaulis* was distributed mainly on the upper part of the slope. Other species such as *Selaginella doederleinii* and *Pellionia arisanensis* were found throughout the plot irrespective of topographicr position, or occurred too rarely to detect any topographic preference.

This plot, especially the part of L3 and L4, may belong to the association, Maeseto-Cyclobalanopsidetum pseudomyrsinifoliae of Suzuki (1953, 1954), by having most of the character species of the association such as *Rubus buergeri*, *Monachosorum henryi*, *Quercus longinux* (=*Cyclobalanopsis pseudomyrsinifolia* in his description), *Maesa japonica*, *Eurya leptophylla*, *Pellionia arisanensis*, *Plagiogyria euphlebia*, *Alpinia japonica* and *Dryopteris formosana*. This association reportedly develops in the cloud zone in the middle elevation of northeastern Taiwan (Suzuki, 1954).

Concerning the floristic composition of the Lopeishan plot, there are two unique features worth noting. One is an abundant growth of *Hymenophyllum* spp. like *H. badium*, *H. polyanthos*, *H. barbatum* and *H. oligosorum*. They sometimes covered much of the tree boles,

Table 8. Floristic composition of the plot in Lopeishan. Numerals (0–3) represent the density class. Subplot groups enclosed by thick or thin lines indicate that the frequency of the species is significantly (at $P<0.01$ or $P<0.05$ respectively) higher than in the rest of the subplot groups.

Subplot group	L1	L2	L3	L4
Subplot no.	3221103 2120121	333322211100000 345634523434561	333221020 789675709	4422311110 0189067898
Species group 1				
Piper kadzura	00010·0	····1·····0····	··0·····0	00····
Elatostema lineolatum var. majus	00·1·01	·····1	·····	·····
Cornopteris opaca	·00·0·0	·····0·····	·····	·····
Diplazium heterophlebium	·10·01·	·····0·····	·····	·····
Ardisia virens	1·0·100	·····0·····	·000·····	0·0·0·····
Ampelopsis leeoides	···100·	·····00···	·····	·····
Asplenium filipes	1·····2	·····	·····	·····
Species group 2				
Pilea aquarum ssp. brevicornuta	1012111	11··11001001·11	·····0	·····
Smilax hayatae	··0011·	1011··1111211··	·····	·····
Diplazium doederleinii	·0101·1	0···0···11·····	·····	·····
Acrophorus nodosus	·0·1·0·	0···100····0···	·····1	·····
Species group 3				
Monachosorum henryi	2222222	2112222221112 12	2111·1001	·····
Arachniodes rhomboidea	1111111	0000010110110 00	··00000··	·····1····
Diplazium dilatatum	211·1··	0121212210111110	21·110000	··0·····0
Diplazium pullingeri	00·1101	11··1101·011·10	1··1·2011	·0·0·····
Arachniodes sporadosora	···010·	·····0····10··	10101·0··	·····
Species group 4				
Trachelospermum jasminoides	·····	·001··01000000·	···0···1	001···000
Species group 5				
Dryopteris formosana	···0···	·····0···1··0·0	·11010100	1111211222
Symplocos wikstroemifolia	·····	·····0·····	·0·0000··	·0000·0100
Adinandra formosana	··0····	····00·····	1000···0	100·0·100·
Syzygium buxifolium	···1···	·····0·	00000·0··	0·000··010
Helicia cochinchinensis	·····	·····	1·0····0·	00·0·····
Ternstroemia gymnanthera	·····	·····	·00····1·	·0·0··0···
Diospyros morrisiana	00·····	01110010···1·1·	102101011	1111100011
Ophiopogon sp.	··1···1	·111··1····112·	0·111013·	2231221122
Pyrenaria shinkoensis	··00·0·	·····01·	0·00·001·	11·11·0000
Plagiogyria adnata	·····0·	··0·····0···0·	··0··00·0	01·01·2001
Myrsine seguinii	·····	·0··0··00·····	·00··0·11	10·0010·10
Viola formosana	·····01	·····	·11···01·	20··1···2·
Meliosma squamulata	·····	···0·····	··10··0··	0···0··10·
Sabia swinhoei	·····	·····0··	··1·01···	··1··0···0
Sarcandra glabra	·····	····0·····	·····1·0·	·1··10··0·
Smilax bracteata	·····	·····0·····	·····000	·0··0··0··
Schizophragma integrifolium var. fauriei	·····	·····	·0····0··	····10····
Species group 6				
Rubus buergeri	0···10·	0·····	·01·0····	111110111·
Ardisia brevicaulis	·0·····	·0·····0··	····0·111	1010011111
Tricalysia dubia	0·····	0·····100···	··0···0··	1101·1··11
Michelia compressa	·0·····	·10··0·····1·	··00·····	·0011·0100
Symplocos caudata	0·····	····0··0·····	···0·0···	01·00··010
Morinda umbellata	·····	···000·····	·1·0·····	001·0·100·
Symplocos shilanensis	·····	0·····0···0·0··	··1···1··	10·01···00
Carex morii	·····	·····0····1	·····0··	00·00···1·
Sanicula lamelligera	·0·2·0·	·····	·····0···	10··0·0·1·
Machilus zuihoensis	·····	·····	·····	·····0·01·
Other species				
Selaginella doederleinii	2221222	233322222233223	232222323	2222322222
Pellionia arisanensis	2233233	322222222222222	222222222	2222222222
Plagiogyria euphlebia	1111011	110111111110101	1011·0111	1111111111
Tetrastigma formosanum	111·101	·10100111011101	111110000	1111110010
Maesa japonica	212121·	221121212211211	121121111	1·10122112
Alpinia japonica	1111111	111·11111111211	1111111·1	1111011201
Pileostegia viburnoides	0111011	111111·11011110	11110·10·	1001111000
Illicium arborescens	011·001	1111·100·1·1110	112111110	1201111111
Machilus thunbergii	0111011	111100001111110	0110··01·	100·20·111
Prunus phaeosticta	·00·11·	111100100010001	110100011	·101001·00
Carex sociata?	1111222	00··111110111·1	11··00111	0·2111·111
Osmanthus matsumuranus	···000·	0011·101000101·	100111100	1111111·11
Athyrium arisanensis	·110020	0·0·1100·121101	0·100·101	110·111·01
Hydrangea angustipetala	1010010	101101000·110··	0·0000·01	··010·01··
Diplazium subsinuatum	·021120	111·1121112·211	11011211·	110··1····
Quercus sessilifolia	·0·0··0	101010·00·11100	·1011000·	0001·1011·
Litsea acuminata	0···00·	111011001··111·	0001·101·	10·011·111
Diplazium petri	0·0····	·1000·1·0011110	1121111··	2·11111101
Stauntonia hexaphylla	0··0000	000·0010000····	01··00100	0110·0·101
Quercus longinux	··0··0·	0·00·1··011111·	111011110	111111011·
Parachampionella rankanensis	2122221	11·1112111221·2	·1·11··11	0·1·1···2·
Microsorium buergerianum	0111011	1··01·0··0···01	0·0100011	··00·1·0·0
Damnacanthus indicus	0101·10	0·1·01·1111···1	·00·0101·	100··011··
Smilax lanceifolia	··00·00	01·0100·10··0··	00·000··1	1001·0·000
Callicarpa randaiensis	·0·0·00	·0·100·1··0···0	11100··0·	1001000010
Stegnogramme griffithii var. wilfordii	1··101·	1··0···000·1111·	0··001001	000·10···1
Eurya leptophylla	··0·0·0	·0110···1··00·0	1·0010011	·11·0·1110

Table 8. (Continued)

Plagiogyria stenoptera	0··0·11	0·0·0····00··00	·1100··01	11000·1··0	
Kadsura japonica	·00000·	·····0·100·0·	·00·0000·	11·001··01	
Ficus nipponica	0·0·000	00··0·····0···	·0010··0·	·100·0010·	
Lasianthus japonicus	·0····0	00····0····1010	00·10·100	····000··1	
Calanthe reflexa	01·100·	00···00··0·····	····00··0	·101··00··	
Microlepia obtusiloba	··10100	··0·11111··1·0·	··0····0·	···01····0	
Pteris bella	0·0·0··	·01··10··0·00·0	····100··	·00···0···	
Neolitsea aciculata var. variabillima	·0··0·0	0·····0··01····	0·0·00···	··00·1·00·	
Dendropanax dentiger	·····	·0··100·····0··	00··1·01·	01110···0·	
Lasianthus fordii	··00···	00··0··1····0··	0·000·10·	·····1·0·	
Hedera rhombea var. formosana	····0··	·····0··0000···	··0·0··0·	···000010·	
Hymenophyllum badium	·1·10·0	····1··1··00··2	···0·0·01	·1·····0··	
Goodyera foliosa	0···0··	···1001··0·····	1·01·1···	···11···1·	
Lemmaphyllum microphyllum	····00·	··10·····01···1	···0·0···	··00·0·0··	
Thelypteris uraiensis	···001·	·····00·····	101··0·01	·1····1···	
Ophiorrhiza japonica	10···21	····111·0··1···	·····1···	·····0·	
Gardneria shimadai	·00·0··	·····0	··01·0··	·00·0····0	
Ilex formosana	··00·0·	·····0·····	·0·0··01·	··0·0····0	
Osmanthus heterophyllus	·0·1···	····0·····	·0·0···0·	·1··10···0·	
Hymenophyllum polyanthos	···1··1	0·····1	·····21	11····0···	
Tripterospermum taiwanense	·····	···0··0·0···0··	·····00	·1·00·····	
Elaeocarpus japonicus	·····	··0·····1··	·1··100··	····1·0·0·	
Rubus corchorifolius	····0··	·····0··000·0	····0··0·	··0·····	
Asarum macranthum	1·····	0·····0····00··	·····0·10	·····	
Eurya loquaiana	·····	·0·····0·0·····	·····0	0··00···0·	
Daphniphyllum teijsmannii	···0···	·····00·	·0···0··0	0·····1··	
Cinnamomum subavenium	··0····	·····0·	·····10·	·0···0·0·1	
Fatsia polycarpa	···0···	····1·1·0···1·	·····00	···1·····	
Athyrium silvicola	·0·····	000····0·····0	·····0	·····	
Sarcopyramis napalensis var. delicata	00····0	·····1·0·····	·····1·	·····	
Hymenophyllum barbatum	·····0	·····0··1·1··	····0·1·	·····0···	
Symplocos theophrastiifolia	·····	·00·····0·	·····1	····1···0	
Trachelospermum jasminoides var. pubescens	·····0	·0·····	··0·····	···00···0·	
Ligustrum sp.	·····	····0·····	·0·····0	····0·0·1·	
Camellia brevistyla	····0··	·····	··0·000··	····0····	
Lepisorus monilisorus	·····0	····0·····	····0···	····1··00·	
Cleyera japonica var. morii	·····	·····0·····	··0····0·	····00··0·	
Ilex rotunda	·····	·····0	··0····0·	····0·00·	
Trochodendron aralioides	····0·	·····0	···0····	00····0··	
Collabium formosanum	22····	·····0···2··	·····1	·····	
Lysimachia aridisioides	····00·	·0··0·····	·····	·····1·	
Hymenophyllum oligosorum	····0·0	··0·····1··	·····	·····1··	
Ficus formosana	··0····	·····0··	·····	00·····0·	
Ficus erecta var. beecheyana	····0··	·0··01·····	····0····	·····	
Dryopteris sparsa	····1·	1····0·····	····0···	·····	
Asplenium normale	·····	·0··11·····	···1····	·····	
Goodyera velutina	·····	·····0·····1	00·····	·····	
Calanthe triplicata?	·····	·····0·····	·····0··	··0····0·	
Asplenium nidus	·····0	···0·····	···0····	·····	
Calanthe densiflora	·····	·····	··2·····	2·2·····	
Goodyera hachijoensis var. matsumurana	·····	·····	··0····0·	····0····	
Pourthiaea beauverdiana var. notabilis	·····	·····0···	·····0··	·0·····	
Ilex goshiensis	·····	·····00··	·····	··0·····	
Lycopodium serratum var. longipetiolatum	·····	·····	·····1·	····01····	
Selaginella delicatula	···0··1	·····	·····0·	·····	
Dryopteris hendersonii	0·····	·····	···0····	·····	
Diplazium kawakamii	0·····	·····1·····	·····	·····	
Balanophora laxiflora	··0····	·1·····	·····	·····	
Crepidomanes auriculatum	···0···	···0·····	·····	·····	
Skimmia reevesiana	·····	·····	··0···1·	·····	
Viburnum integrifolium	·····	·····	·····	·0·····0·	
Tainia shimadai	·····	·····	·····	····0···0·	
Davallia mariesii	····0··	·····0·····	·····	·····	
Angiopteris lygodiifolia	·····	·····0·····	·····0···	·····	
Coniogramme intermedia	·····	·····0···0··	·····	·····	
Trichosanthes rosthornii	·····	·····	·····0··	·····0··	
Ilex lonicerifolia	·····0	·····	·····	·····1·	
Hemiboea bicornuta	·····1·	·····0····	·····	·····	
Ilex ficoidea	·····	·····	·····	·····00··	

Species occurring in one subplot. No. 1; Orchidaceae sp. , 0; Acer kawakamii, 0; Microsorium fortunei, 0. No. 5; Berchemia formosana, 0. No. 6; Rhododendron latoucheae, 1. No. 8; Pteris tokioi, 1. No. 9; Symplocos glauca, 0; Dysosma pleiantha, 0. No. 10; Ardisia quinquegona, 0; Symplocos confusa, 0. No. 14; Euonymus tanakae, 0. No. 15; Gastrochilus formosanus, 1. No. 17; Diospyros eriantha, 0. No. 18; Daphne kiusiana var. atrocaulis, 0; Acer serrulatum, 0; Myrica rubra, 0; Prunus campanulata, 0. No. 19; Eurya chinensis, 0; Yushania niitakayamensis, 1; Elaeagnus thunbergii, 0. No. 20; Ilex liukiuensis, 0; Damnacanthus angustifolius, 1. No. 21; Coptosapelta diffusa, 0; Elatostema parvum, 1; Deparia petersenii, 0; Goldfusia formosana, 0. No. 22; Ctenitis subglandulosa, 0. No. 23; Celastrus punctatus, 0. No. 24; Aucuba japonica, 0. No. 25; Ilex asprella, 0. No. 26; Asplenium wilfordii, 0; Pyrrosia shearei, 0. No. 29; Meringium holochilum, 0. No. 30; Benthamidia japonica var. chinensis, 0. No. 31; Heloniopsis acutifolia, 1; Salvia nipponica var. formosana, 0; Alpinia intermedia, 1; Solanum lysimachioides, 1; Crepidomanes minutum, 1. No. 33; Diplazium mettenianum, 1. No. 36; Diplazium sp., 0; Viola nagasawai, 0. No. 37; Castanopsis carlesii var. sessilis, 0. No. 38; Oplismenus undulatifolius, 0. No. 41; Liparis caespitosa, 0; Lindsaea chienii, 0; Malus doumeri, 0.

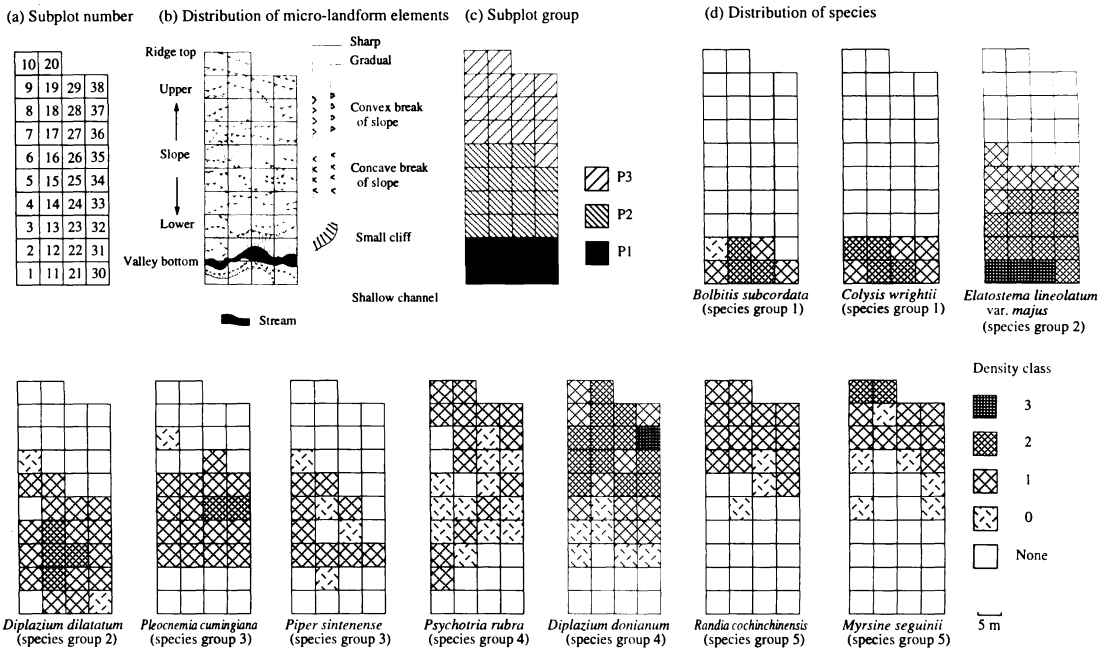


Fig. 8. Subplot number (a), distribution of micro-landform elements (b), layout of subplot groups (c), and distributional patterns of some representative species (d) in the Pinglin plot. Subplot number (a) corresponds to that in Table 9. For the density classes and the subplot groups, refer to Table 2 and Table 9, respectively.

although not as thick as in the moss forest. A rich appearance of such epiphytic filmy ferns indicates the higher air moisture of the area. Another unique feature of Lopeishan is that a higher percentage (76.5%) of the component species showed no topographic preference, whereas the corresponding value was less than 59% in other plots. In fact, many such species, which are classified as "other species" in Table 8, appeared almost all over the plot. A possible explanation is the high moisture condition of the atmosphere. This may reduce the difference in soil moisture between the valley and ridge, resulting in floristic similarity between positions along the slope. In northern Taiwan, the cloud zone lies approximately between 700 and 1500 m (Su, 1984). The plot in Lopeishan falls in the center of this zone. The floristic composition of this plot is therefore probably influenced strongly by the habitat conditions of the cloud zone.

Pinglin

The plot includes a ridge in the uppermost part and a valley bottom with constant waterflow in the lowest part (Fig. 8b). A steep slope begins from the upper slope and ends in a small cliff falling into the stream. A small gentle bank develops on the other side of the stream. A contour map and the layout of micro-landform units of the plot are reported in another paper in this volume (Hara *et al.*, 1997). The first dominant species is *Castanopsis carlesii* var. *sessile*. However, many other species, such as *Cryptocarya chinensis*, *Schefflera octophylla*, *Machilus kusanoi*, *Engelhardtia roxburghiana*, share the canopy dominance (Hara *et al.*, 1997).

A total of 183 taxa (species, subsp. and var.) occurred and 176 taxa were identified in the plot. The variation in species composition among the subplots was sorted out as in Table 9. Five species groups and three subplot groups (P1 to P3) were distinguished. P1, P2 and P3 were characterized by joint occurrence of species groups 1 to 2, 2 to 4 and 4 to 5 (Table 9).

The distribution of each subplot group is shown in Fig. 8c. These subplot groups, P1,

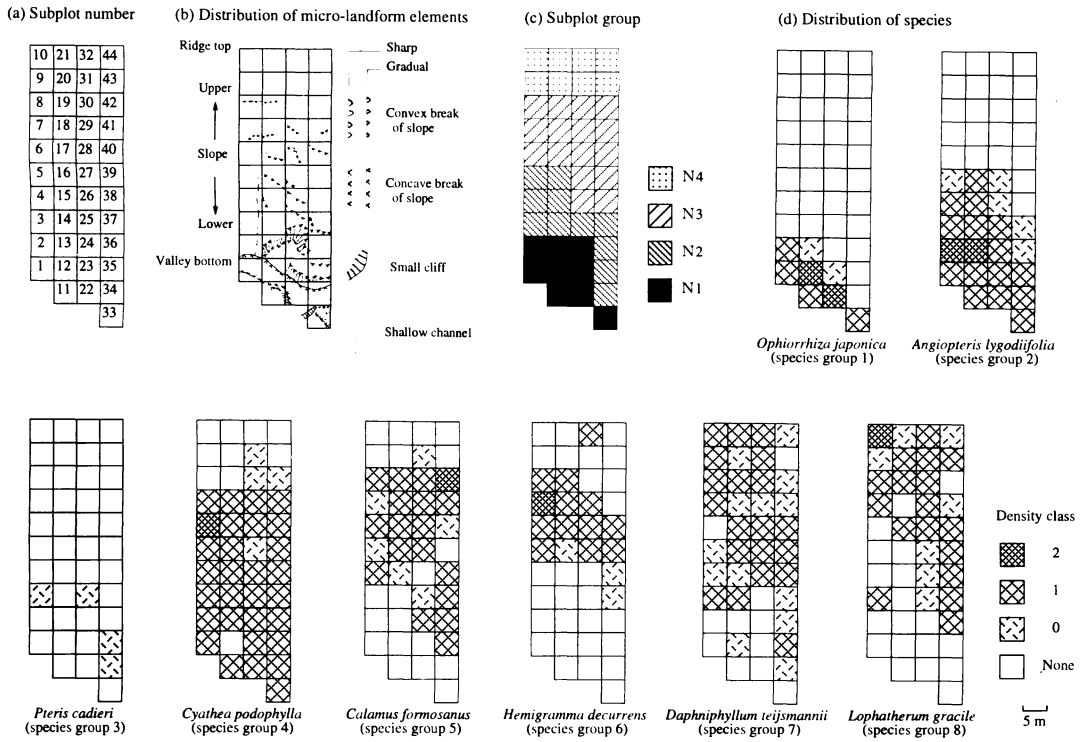


Fig. 9. Subplot number (a), distribution of micro-landform elements (b), layout of the subplot groups (c), and distributional patterns of some representative species (d) in the Nanjenshan plot. Subplot number (a) corresponds to that in Table 10. For the density classes and the subplot groups, refer to Table 2 and Table 10, respectively.

P2 and P3, were distributed in sequence along the slope from valley bottom to ridge. P1 was along the stream and the adjacent bank, P2 on the lower half of slope and P3 on the upper half of slope and the ridge.

The distribution of representatives of the species groups within the plot is also shown in Fig. 8. Species group 1 (12 spp.) *e.g. Bolbitis subcordata* and *Colysis wrightii* grew on the valley bottom and the gentle stream bank. Species group 2 (18 spp.) *e.g. Elatostema lineolatum* var. *majus* and *Diplazium dilatatum* was distributed from the valley bottom to the lower half of slope. Species group 3 (12 spp.) *e.g. Pleocnemia cummingiana* and *Piper sintensis* was restricted mainly to the lower half of the slope. Species group 4 (7 spp.) *e.g. Psychotria rubra* and *Diplazium donianum* grew widely from the lower part of the slope to the ridge top. Species group 5 (26 spp.) *e.g. Psychotria rubra* and *Diplazium donianum* grew on the upper half of slope including the ridge top. Other species such as *Lasianthus fordii* and *Staurogyne concinnula* occurred widely irrespective of topographic position, or occurred too rarely to detect any topographic preference. There are no phytosociological studies to identify the association of the plot.

Nanjenshan

The plot includes a whole slope from a waterless valley bottom to a gentle ridge (Fig. 9b). Since the valley bottom has a comparable scale to that of the other plots, the reason why there was no waterflow is probably because the the time of study (January), which corresponds to the driest season. The slope gets steeper in the lower part and ends in a cliff to the valley. A transversally concave part with an indistinct shallow channel is on the lower left of Fig. 9b, and a convex part is on the right. A contour map and the layout of micro-landform units of the plot are reported in another paper of this volume (Hara *et al.*, 1997). Canopy dominance is

Table 9. Floristic composition of the plot in Pinglin. Numerals (0–3) represent the density class. Subplot groups enclosed by thick of thin lines indicate that the frequency of the species is significantly (at $P<0.01$ or $P<0.05$ respectively) higher than in the rest of the subplot groups.

Subplot group	P1	P2	P3
Subplot no.	01230123 22211110	0000111122223333 3456345634562345	0001111222333 3 7890789078956 78
Species group 1			
Bolbitis subcordata	021·1221	····	····
Colysis wrightii	22111221	····	····
Alocasia odora	1··00000	····	····
Piper kadzura	01·00000	····111	····
Diplazium doederleinii	10001110	00···0··10·····	····
Diplazium heterophlebium	·111····	····	····
Asplenium cheilosorum	·0·0·0··	····	····
Bolbitis appendiculata	··1···00	····	····
Asplenium excisum	·····100	····	····
Cayratia tenuifolia	·····000	····	····
Goodyera sp.	·11····1	·····1·····	····
Microsorium dilatatum	·0·1····	····	····
Species group 2			
Elatostema lineolatum var. majus	22223332	2111221·221·221	····
Diplazium dilatatum	1211·110	11·12211211·111	0···
Microlepia obtusiloba	0000··0·	·11100100112111	····0·····0···
Angiopteris lygodiifolia	11·1·1·1	111111101101101	····
Pellionia arisanensis	1·11··1·	1112111·1111111	1·····1···
Cephalomanes obscurum	1122····	221133212221211	·····1···
Pothos chinensis	0011·111	11··111·1110111	·····10··
Crepidomanes auriculatum	0011·11·	11··11111111211	····
Arachniodes rhomboidea	1111····	111·11·01110211	·····0···
Desmodium laxum ssp. leptopus	1100····	000·110010··00·	····
Tropidia angulosa	1110····	01··120·111·1·0	····
Ophiorrhiza japonica	11·2····	1111121·111·211	····
Lindsaea obtusa	·00·····	10··120·111·····	····
Ficus bengutensis	0000··0·	1·00····00·····	0···
Cyathea metteniana	11·1··0·	1···11····0·1··	····
Habenaria longitentaculata	·1···1·0	····0···11···0·	····
Lasianthus bunzanensis	···1··0·	00··00··11····0	·····0·····
Saurauia tristyla	··0···00	0···0···0·····	····
Species group 3			
Pleocnemia cumingiana	·····	1111111111121112	·0·····1··1···
Piper sintenense	·0·····	11111·01101·1··	0·····
Stegnogramme griffithii var. wilfordii	·····	111··11·011····	0·····
Turpinia formosana	·0·1····	1·0·1000000·111	····
Ficus formosana	·····	··001·00··0·00·	·····0··
Rhynchotechum discolor	1·····	··0·100·00··0··	····
Pteris cadieri	·····	00···10··0·····	····
Helicia formosana	··1··0··	·0100011000·001	·0··00·····1···
Pileostegia viburnoides	01·····	11110·11··11·01	·····0···10·
Lasianthus wallichii	0·00·00·	111111111110111	0·0·1··00····01
Alpinia japonica	··00····	1··0···0·0001·0	0·····
Polypodium formosanum	·····	·····00··00···0	·····0
Species group 4			
Thelypteris triphylla	·····	00100011·010·1·	0·0·0····00100·
Diplazium donianum	·····	0012·0010112011	221122221222231
Cyathea podophylla	·11·····	011111111·01··1	111111111111111
Psychotria rubra	1·····	1000010··010·00	··11111100111011
Daemonoropus margaritae	0·····	·01··100·1110·1	·010000001·1100
Schefflera octophylla	·····0	····0·0··1·0100	001101·0100010·
Ilex pubescens	·····	00·····0···000·	0·11100110000··
Species group 5			
Dryopteris sordidipes	·····	1·00···1·····	0112112202201 12
Diplazium mettenianum	·····	···0·····1·0··0	0100111111011 21
Ardisia quinquegona	·····	0·0·····10·1···	0101101111201 02
Lasianthus curtisii	·····	···0···0·····0·	0010111111101 00
Psychotria serpens	·····	·····0·1·0·	0001111201211 11
Sarcandra glabra	···0····	··0·····0·0··	··010000102·101
Randia cochinchinensis	·····	·····0····0···	1111111101111 11
Dryopteris sparsa	···0····	0·····0	0100··1111111·1
Antidesma japonicum var. desiflorum	·····	·0·····0·0·	01·11·100011011
Stauntonia hexaphylla	·····	···10··0·····	0·1100000·00100
Myrsine seguinii	·····	··0·····0	0112·1020110111
Ardisia chinensis	·····	·····0·····	0·1·0·0·111···1
Elaeocarpus sylvestris	·····	···0·0·····	·00·00000··000·
Castanopsis carlesii var. sessilis	·····	·····00·····	··11·1010·10·01
Engelhardtia roxburghiana	·····	·····0	··110011·110·11
Diospyros morrisiana	·····	·····0·····	·000··11·01··10
Meliosma rigida	·····	···0·····	0010···1··010··
Daphniphyllum teijsmannii	·····	·····0··	··0·0··0·00··01
Ilex ficoidea	·····	·····	··00··100·0··0·
Smilax lanceifolia	·····	····0··1···0··0	00·0·0100··0·00
Fissistigma oldhamii	···0····	·····0··0····	···10·00··0·001
Symplocos theophrastiifolia	·····	·····0·····0	0·1101··0···10·
Adinandra formosana	·····	·····00·	··0····1000·0··
Dicranopteris linearis	·····	··1·····	11·0··0···1···1

Table 9. (Continued)

Diplazium donianum var. aphanoneuron	·····	···1·····	·····1··01·01··
Diospyros eriantha	·····	·····0·····	···00··0·0··0··
Other species			
Lasianthus fordii	1·11001·	111111111111111	110011001101110
Staurogyne concinnula	1111····	222312322222222	32212210210221·
Lemmaphyllum microphyllum	·1·1·011	1··010001111111	001·111111·112·
Blastus cochinchinensis	1111····	211112111211111	111·100·0·111··
Selaginella doederleinii	111·····	0·1·11110101·01	101010··0·00···
Aeschynanthus acuminatus	·1·0·111	10·0110··11·110	00·····00··
Vernonia andersonii var. albipappa	···0····	000000·0·000···	000··0···20·000
Arachniodes sporadosora	0··1····	10···00···10111	·10·01··11·01··
Microsorium buergerianum	··10·110	0···11·00·0·110	·0·····0··000
Asplenium nidus	···0··1·	11··1·10·11·111	·····0···0·11··
Mussaenda parviflora	·0·····	0·····00·10000	0···0·0·0····0·
Carex sociata?	·101····	·1·11···0··01·0	···0··0···0···0
Tylophora taiwanensis	·0·0····	·100100··0···0·	····000·····
Symplocos glauca	·····	1·····0···0·01	···00··0·0·1·11
Dioscorea japonica var. oldhamii	···0···0	·····0···0···00·	·0·····0·0··10
Ardisia sieboldii	·····	·····00··1·0·	0···100·0··0···
Smilax bracteata	0·00····	···0··0·00··0··	1·····
Calanthe formosana	11·····	·0··1···10···00	·0·····
Alpinia intermedia	·····	···0····0·0··1·	·101···00·····
Lophatherum gracile	··11····	·10·····1·0·1·0	·····0····
Eurya loquaiana	·····	···00···0·00···	··00·····0·
Erycibe henryi	···0····	·····0·0·0·	·0·····01··0·
Calanthe gracilis var. venusta	·10·····	····0···0·1·0··	··0·····0··
Michelia compressa	·····	1·····0····	···1·1·····00·0
Ilex formosana	·····	····0··0·····0	···0··0···0··0·
Wendlandia formosana	···0····	0·····0·····	0·····000·
Begonia aptera	0·····	00···0·····0··	·····
Pyrenaria shinkoensis	·····	0·····	····00···0···0·
Glochidion acuminatum	··0···0·	0·····0···0·	·····
Cymbidium lancifolium	·····	·····00·····0·	·1·····0·····
Lindsaea chienii	·····	·····0	··110··1·····
Cryptocarya chinensis	·····	00····0·····	·····0··0····
Codonacanthus pauciflorus	··11····	·····1···11·	·····
Ilex liukiuensis	·····	·····0···	··0····1·00····
Elaeocarpus japonicus	·····	·····0··	···0·····00·0·
Liparis nigra	0·····	·····0·····	·····00··
Sarcopyramis napalensis var. delicata	0·····	·0·····0·····	·····0···
Blechnum orientale	·····	··00·····	10·····
Eurya chinensis	·····	·····0·····	···0·····0··0··
Liparis bootanensis	·····	0·····0··	·····0··0··
Machilus kusanoi	·····0	·····00·0··	·····
Cyathea spinulosa	·····	···0·····0·	0·····
Litsea acuminata	·····	·····	·0·····00
Plagiogyria adnata	·····	·····01·····	·0·····
Syzygium buxifolium	·····	·····	··0·····0···0
Asplenium apoganum	·····0·	····1·····0··	·····
Tectaria kusukusensis	·····	····11··0·····	·····
Lindsaea javanensis	·····	·····0···1···0	·····
Ficus nipponica	·····	·····0····1	·····0·····
Styrax suberifolia	·····	·····	·····0···0·0···
Morinda umbellata	·····	·····	··0··0·····0·
Quercus gilva	·····	·····	··0·····0··0·
Ficus nervosa	·····	0·····0···0····	·····
Trachelospermum jasminoides	·····	·····0·0	·····0···
Curculigo capitulata	0·····	·····0·····	·····
Tectaria phaeocaulis	0·····	·····0··	·····
Clematis henryi	·····	0·····0··	·····
Pericampylus formosanus	·····	0·····	0·····
Lycopodium serratum var. longipetiolata	·····	·····0·····	0·····
Cryptostylis arachnitis	·····	·····	··1··0·····
Prunus phaeosticta	·····	····0·····	·····0·
Ctenitis subglandulosa	···0····	·····0·····	·····
Machilus zuihoensis	·····	·····	····1··0·····
Coptosapelta diffusa	·····	·····	····0···0·····
Pilea aquarum ssp. brevicornuta	···1····	·····1··	·····
Lindera communis	·····	·····0··	·····0
Anodendron affine	·····	·····0	·····0·····
Lycopodium hamiltonii	·····	·····0·····	·····0··
Quercus longinux	·····	·····	·····0····0···

Species occurring in one subplot. No. 2; Arenga engleri, 1; Acanthephippium striatum, 0. No. 3; Thelypteris glanduligera, 0; Deparia petersenii, 0. No. 5; Ampelopsis leeoides, 0. No. 6; Oberonia sp., 0; Mallotus paniculatus, 0. No. 7; Rubus pyrifolius, 1; Symplocos lucida, 0; Cheiropleuria bicuspis, 0; Dioscorea cirrhosa. No. 9; Damnacanthus indicus, 0; Asarum macranthum, 1. No. 10; Tricalysia dubia, 0; Glochidion rubrum, 0. No. 11; Hemiboea bicornuta, 0. No. 13; Lagerstroemia subcostata, 0. No.18; Davallia mariesii, 0. No. 20; Calanthe triplicata?, 1. No. 21; Crepidomanes radicans var. naseanum, 1; Vittaria zosterifolia, 1; Strobilanthes cusia, 0. No. 23; Ecdysanthera utilis, 0; Goodyera velutina, 0. No. 24; Marsdenia sp., 0. No. 28; Sloanea formosana, 0. No. 31; Thelypteris taiwanensis, 0; Selaginella delicatula, 1. No. 32; unknown, 0; unknown liana, 0. No. 33; Itea oldhamii, 0. No. 35; Sabia swinhoei, 0. No. 36; Symplocos caudata, 0; Trochodendron aralioides, 0. No. 37; Aglaomorpha meyeniana, 0. No. 38; Kadsura japonica, 0; Gordonia axillaris, 0.

Table 10. Floristic composition of the plot in Nanjenshan. Numerals (0–3) represent the density class. Subplot groups enclosed by thick or thin lines indicate that the frequency of the species is significantly (at $P<0.01$ or $P<0.05$ respectively) higher than in the rest of the subplot groups.

Subplot group	N1	N2	N3	N4
Subplot no.	001122123 122334123	00011123333 34545655674	0001112222333444 6787896789089012	01223344 90011234
Species group 1				
Cephalomanes thysanostomum	32322·123	··	··	··
Bolbitis appendiculata	313·2·232	0·	··	··
Ophiorrhiza japonica	11200·121	··	··	··
Rhynchotechum discolor	·101·11·0	·1··0·	··	··
Habenaria longitentaculata	000·0·0·0	·····0··	··	··
Ficus bengutensis	10110001·	···0·····	·····010·····	··
Desmodium laxum ssp. leptopus	1·1·110··	···0···0···	··	··
Thelypteris taiwanensis	·00·····	··	··	··
Crepidomanes birmanicum	··1····0·	··	··	··
Species group 2				
Angiopteris lygodiifolia	121211111	11011111001	·····00·····	··
Calanthe formosana	10000·01·	01·1··01··1	····00·····	·····00·
Tapeinidium pinnatum	···111·0·	·111001001·	0···0·01·····	··
Elatostema lineolatum var. majus	222221222	21·20·01··1	··	··
Thelypteris liukiuensis	121222·23	11·1··11··2	··	··
Cephalomanes javanicum var. asplenioides	2212222·2	11·10·····0	··	··
Selaginella doederleinii	··0110··1	211111·0···	·····1····	··
Astronia formosana	1·11·1110	111·1·0··10	·····1·····	··
Syzygium kusukusense	0·0···010	·10·10·····	··	··
Codonacanthus pauciflorus	01000·011	0·····01··1	··	··
Pteris grevilleana	·0····0··	0··0·····0	··	··
Curculigo capitulata	···0··1··	11·····1··	··	··
Mussaenda parviflora	1·00·0··1	01·0·000··0	·0·····0·····0··	·0··0···
Ardisia kusukusensis	·1·0·····	··0···01·0·	··0·····	··
Cephalomanes obscurum	··0·00···	·0····0····	··	··
Species group 3				
Pteris cadieri	·····	0·····00··0	··	··
Species group 4				
Cyathea podophylla	11·111111	111111111111	21·11·1011011110	····0···
Lindsaea merrillii ssp. yaeyamensis	111111111	21121121211	1111111121111111	1··2·1··
Species group 5				
Calamus formosanus	·····1···	·10·010111·	101111·11111·012	····0···
Liparis nigra	·····	1·1···1·0·1·	1···101·11···1111	·····
Microtropis japonica	···0····0	1000·01···1	·000011101·11101	···0··00
Syzygium euphlebium	····00···	00·0···1101	··100101·0011100	000·····
Species group 6				
Hemigramma decurrens	·····	··1··0···0·	121111·111·011··	·····1··
Symplocos ?theophrastiifolia	····0····	0·····0·	0·0·0011····0001	·····
Ilex lonicerifolia var. matsudai	·····	·····	··0·0·00·····	·····
Beilschmiedia erythrophloia	···0·0···	·····0001·	110··0···1010110	··00····
Oplismenus compositus var. patens	·0·····	0·····	12··11··1····11·	1·····
Podocarpus fasciculus	·····	····0·····	··0···1·0··111··	·····
Specis group 7				
Ilex cochinchinensis	·····0	111··1···11	11111111111111011	01111112
Daphniphyllum teijsmannii	··0·····	100101·1000	·111011110111100	110111·0
Calanthe gracilis var. venusta	·····	0··10101··0	·11·1·1··00·1·00	···01001
Neolitsea hiiranensis	·····	·0·0·00····	0111·1·01101011·	1111·0··
Psychotria serpens	01·1·····	11·0100111·	11111111111101111	12111111
Illicium arborescens	·0·1·····	1111·10··1·	011111111111111·	22111011
Litsea acutivena	····00··0	01111110001	01101121111111111	1·1011·1
Prunus phaeosticta	····0··0·	111·0·11001	·111111101111110	111·10·1
Lasianthus cyanocarpus	····0····	·····00001	01·000··01101011	··00·001
Quercus longinux	····0····	1··0··0·010	11···1010·1···10	1·10100·
Castanopsis carlesii	·····	··0·1····0·	0··0·001·0·1·00·	00··00··
Species group 8				
Lophatherum gracile	·····	1·····0·11·	·111·1001111110·	02101110
Tricalysia dubia	····0····	10····0····	·1··0·0101111000	110001·0
Ardisia quinquegona	·····0··0	·····0···1	···1010101000101	0··000·1
Fissistigma oldhamii	·····	11·····	00···1100···100·	01000100
Garcinia multiflora	·····	··1·····	··0··1·000101·01	·001·000
Euonymus tashiroi	·····	···0·····	00·00··0··0·00··	·1·10··0
Ficus aurantiaca var. parvifolia	···0·00··	111011·1·1·	11111111111111	11111111
Piper kadzura	·····	00·····0···	0···0000·0··110·	101·10··
Sloanea formosana	·····1·	·····0	·····0·0····0·10	000·001·
Lithocarpus amygdalifolius	·····	·····0	0·0·10···0···00·	000·····
Strychnos henryi	·····	··0·····	0·····0··1·11·0	····001·
Sarcandra glabra	·····	·0·····	····0····00·000·	··1····0
Glochidion lanceolatum	·····	···0·····	··0····0····00·1	···000··
Elaeocarpus sylvestris	·····	·····	··0·····0·101·	0··0····
Diplazium lobatum	·····	·····	·····0···11·····	··1·22··
Coptosapelta diffusa	·····	·····	··0·····0···0·	1·····0·
Other species				
Psychotria rubra	000000·01	11111111111	11111111111111	01111111
Ophiopogon sp.	011121111	11111111112	1132121122211211	321211·1
Lasianthus wallichii	010210111	21112111111	1111121121111112	·11·1111
Diplazium donianum	010112111	12222222222	2212122211122211	1·2·2·22
Lithosantes biflora	·10010100	11110111110	11111110111111111	··001122

Table 10. (Continued)

Beilschmiedia tsangii	·10100·00	1111111111·	1222111112211111	11212212
Pothos chinensis	0011··101	0010·000111	1121111·00110111	11111111
Schizostachyum diffusum	·101·0···	11100101111	011111111·000110	11111111
Daemonoropus margaritae	11011·1·0	1111100·01·	0·1000·1·10111·1	11·11011
Alpinia intermedia	0··00····	1111·00001·	1111211111110110	00011·10
Diplazium dilatatum	11··0·111	11111101·02	0·01·1000·0·10·0	·1110111
Schefflera octophylla	110011·01	0100··11101	·00··01·1110101·	··100·00
Lasianthus fordii	0··10·10·	11110111010	0001010·111000·1	·····111
Pleocnemia cumingiana	·111210··	·10·101111·	·112121·1011011·	··120122
Lasianthus bunzanensis	·00·00·1·	01110110000	00·100101·0·1··1	0·0·0100
Piper sintenense	0101·110·	1·0··0·10·1	111111··1··0101·	1111·111
Callicarpa remotiflora	··00···00	·01··00000·	0·000100··00010·	011011·0
Freycinetia formosana	·1···00·0	110···0·01·	··01·1··01211111	1111101·
Osmanthus marginatus	·0··0····	0···0·00001	··10111110111011	1·100·0·
Quercus pachyloma	··········	··1··0·10··	·010··0····1·1··	0···0·0
Helicia formosana	·1··00111	010·110·011	1··0··0····1··11	··001011
Kadsura japonica	··0011···	0··01010010	··1·000·00·0·10·	1110····
Antidesma hiiranense	·····10·1	··11·00011·	21·1·10110·1121·	11·0··1·
Alpinia pricei	··010····	1·00··0·111	001···0··0110001	··0·101·
Machilus thunbergii	·1·····	01··10·1··1	0·10011····111·1	1·0··0·0
Celastrus paniculatus	····1···0	·11111····1	1··1·011··0·0···	1·11101·
Ilex liukiuensis	···01·00·	10···0·0·11	··0···0·1·0·0110	··1···1·
Smilax lanceifolia	···10··0·	0·····000··	0·01····0·0···1·	01·0·0·1
Crepidomanes auriculatum	·····1··	·11··11100·	·0010·1····01···	··0··1·0
Lasianthus obliquinervis	···1·····	0·00····010	··0··0···0·····0	·····0·
Calanthe triplicata	·····0	1···0··1···	010··········0·	····00·0
Thelypteris triphylla	1·····	··1·11·····	··1·0·010·····	2·····
Dioscorea japonica var. oldhamii	····0·00·	·····0··0	·0····00·····	·10·····
Engelhardtia roxburghiana	·····	·····0·1·	··1·····0·1·1	0···00·1
Wendlandia formosana	··01···01	·0·1·····	·0·1···0·····	·····
Zanthoxylum nitidum	·····	0··0·····	··1···0···000··0	0·····
Diospyros eriantha	·····	··0···0····	··00·····0·010·	··1·····
Pasania harlandii	·····	0·····0··	···1···0··01··1·	····0···
Trachelospermum gracilipes	·····	··1···0····	··1···0·····0··0	·0···0··
Castanopsis fabri	··0····0·	··0····0···	0·····0·····	·····0·1
Scleria terrestris	·····	···0·····0·	····0·····0···0·	0···0·0·
Michelia compressa	·····	·0·0····0··	·····0·0·1··0··	·0·····
Ardisia cornudentata	·····	·····0	··0·····0···011	···0··1·
Tarenna ?gracilipes	·0·····	··0····0···	·····0····0·	0··00···
Anodendron affine	·····	0·····	·····00·10··1··	1·····
Decaspermum gracilentum	·····	1··0·0·····	·0·····00···	0·····
Fissistigma glaucescens	·····	··0·····	·····1·····00	00··0···
Turpinia ternata	··1·····	·0·1··1····	·····0····0····	·····
Lindsaea orbiculata var. commixta	·····	··0···0·0··	·····01····0··	·····
Stauntonia hexaphylla	·····	·····1··	·····0·····	0·1·0··0
Adinandra formosana	·····	··0·····	·····0·0···0····	00·····
Glochidion zeylanicum	·····0·	·····	·····0···0··	····0··1
Saurauia tristyla	0·····	0·····	·0·····	·····0
Callicarpa remotiserrulata	·1·····	·····	·····1···0····	··1·····
Carex sp.	·····	00·····	·0·····0·	·····
Machilus zuihoensis	····0····	0·····	·····0·····0··	·····
Cryptocarya chinensis	·····	····1·····	··0·····	··0··1··
Cinnamomum brevipedunculatum	·····	·····	··0·····00·	··0····
Melastoma candidum	·····	·····0····	·····1·····	00·····
Bridelia balansae	····0····	·····	·····0·····	0·0·····
Eurya chinensis	·····	···1··0····	·····0····0····	·····
Liriope sp.	·····	·····	····01···0·····	·····0
Ficus formosana	·····0·	·····0··	·····0···0····	·····
Ilex maximowicziana	0·····	·····	·0·····	0·····
Arisaema grapsospadix	·1·····	1·····	·····	·····0·
Malaxis roohutuensis	·····	1·····1	···1·····	·····
Oplismenus undulatifolius	·····	·····	··0··1·····	··0····
Dryopteris sparsa	·····	···1····0··	·····0·····	·····
Glochidion rubrum	·····	·····0···	·····0·····0··	·····
Glycosmis citrifolia	····0····	·1·····1	·····	·····
Eurya nitida var. nanjenshanensis	·····	·····0··	·····0····0····	·····
Zingiber kawagoii	·····0·	·····0	·····	·····0·
Magnolia kachirachirai	····0····	·····	·····0·····0··	·····
Orchidaceae sp.	0·····	·····	·····	·····0··
Tropidia angulosa	·0·····	··1·····	·····	·····
Davallia solida	·····	0·····	·····0···	·····
Melicope semecarpifolia	·····	···00·····	·····	·····
Symplocos glomerata var. congesta	·····	·····	·····0·····	·····0
Aucuba chinensis	·····	·····1··0	·····	·····
Ternstroemia gymnanthera	·····	·····	·····0··1···	·····
Symplocos shilanensis	·····	·····	0·····0··	·····
Syzygium densinervium var. insulare	·····0··	····0·····	·····	·····
Cyathea lepifera	··0·····	0·····	·····	·····
Machilus kusanoi	·0·····	·····0	·····	·····

Species occurring in one subplot. No. 1; Stephania japonica, 0. No. 2; Ficus variegata var. garciae, 0. No. 3; Capparis sikkimensis ssp. formosana, 0; Tectaria decurens, 0; Psilotum nudum, 0. No. 8; Dryopteris sordidipes, 0. No. 10; Schefflera arboricola, 0. No. 11; Medinilla formosana, 1. No. 13; Eria ovata, 0; Lasianthus chinensis, 0. No. 15; Ficus ruficaulis var. antaoenesis, 0. No. 17; Vernonia andersonii var. albipappa, 0. No. 18; Vittaria anguste-elongata, 0. No. 19; Ventilago elegans, 0. No. 20; Asplenium nidus, 0. No. 21; Machilus obovatifolia, 0. No. 23; Ardisia sieboldii, 0. No. 27; Blechnum orientale, 0. No. 32; Podocarpus nagi, 0. No. 34; Piper betle, 0. No. 38; Elaeagnus thunbergii, 0. No. 40; Lasianthus curtisii, 0. No. 42; Lasianthus hiiranensis, 0.

Table 11. Number of taxa occurring in all the plots.

		Family	Genus	Species	Subsp. & var.
Total		115	284	576	19
Pteridophyte		22	46	130	2
Spermatophyte		93	238	446	17
Gymnosperm		3	3	5	0
Angiosperm		90	235	441	17
Dicotyledon		79	191	371	16
Monocotyledon		11	44	70	1
Species-rich families	Orchidaceae		19	34	
	Rubiaceae		17	31	2
	Theaceae		9	21	1
	Lauraceae		7	20	1
	Dryopteridaceae		8	16	
	Woodsiaceae		4	19	1
Species-rich genera			*Ilex*	16	
			Symplocos	16	
			Diplazium	14	1
			Ficus	12	1
			Ardisia	10	
			Lasianthus	9	1

shared by many species. Although no single species predominated, such species as *Astronia formosana*, *Lithocarpus amygdalifolius* and *Castanopsis carlesii* showed higher basal area (Hara *et al.*, 1997).

A total of 171 taxa (species, subsp. and var.) occurred and 167 taxa were identified in the plot. The variation in species composition among the subplots was sorted out as in Table 10. Eight species groups and four subplot groups (N1 to N4) were distinguished. Subplot group N1 was characterized by a joint occurrence of species groups 1, 2 and 4. Similarly, N2, N3 and N4 were characterized by the combination of species groups 2 to 7 (except 6), 4 to 8 and 7 to 8 (Table 10).

The layout of the subplot groups within the plot is shown in Fig. 9c. The territories of the subplot groups, N1 to N4, corresponded with the relative position along the slope from the valley to the ridge, such that N1 was mostly on the valley bottom, N2 on the lower part of slope, N3 on the middle part of slope, N4 on the uppermost part of slope.

The relationship between the distributional pattern of the species groups and topography is also shown in Fig. 9. Species group 1 (9 spp.) *e.g. Cephalomanes thysanostomum* and *Ophiorrhiza japonica* was confined to the valley bottom. Species group 2 (15 spp.) *e.g. Angiopteris lygodiifolia* and *Elatostema lineolatum* var. *majus* grew on the valley bottom and the lower part of slope. Species group 3, represented only by *Pteris cadierii*, sporadically appeared on the lower part of slope. Species group 4 (2 spp.) consisting of *Cyathea podophylla* and *Lindsaea merrillii* ssp. *yaeyamensis* covered the slope widely from the valley bottom to the middle part. Species group 5 (4 spp.) *e.g. Calamus formosanus* and *Liparis nigra* was distributed on the lower and middle part of the slope. Species group 6 (6 spp.) *e.g. Hemigramma decurrens* and *Beilschmiedia erythrophloia* grew mainly on the middle part of slope. Species group 7 (11 spp.) *e.g. Ilex cochinchinensis* and *Daphniphyllum teijsmannii* was distributed widely throughout the slope except on the valley bottom. Species group 8 (15 spp.) *e.g. Lophatherum gracile* and *Tricalysia dubia* grew on the middle and upper part of the slope. Other species such as *Psychotria rubra* and *Lasianthus wallichii* were found throughout the plot irrespective of topographic position, or oc-

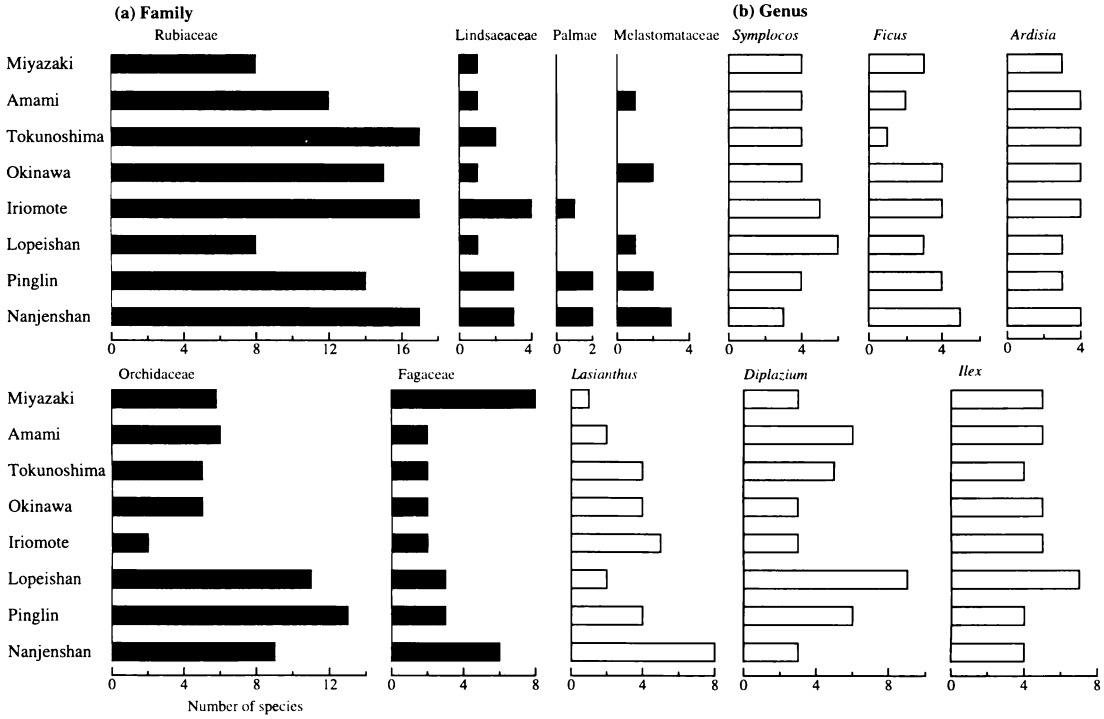


Fig. 10. Comparison of species richness of some representative taxa among the plots. Family and genus are represented by solid bar and open bar, respectively.

curred too rarely to detect any topographic preference. There seem to be no phytosociological studies to identify the association of the plot.

Taxon Richness of the Plots

General features of the composition of family and genus in the forests studied

As shown in Table 11, a total of 115 families, 284 genera, 576 species, 2 subspecies and 17 varieties occurred in the eight plots. Of these vascular plants, pteridophytes comprised 22 families, 46 genera, 130 species and 2 varieties, representing 22.6% of the total species. Monocotyledons comprised 11 families, 44 genera and 70 species. Gymnosperms were a minor element, consisting of 3 families, 3 genera and 5 species (Table 11).

Species-rich families and genera are listed in Table 11. Among the families, Orchidaceae consisting of 19 genera and 34 species was the richest in species number. Rubiaceae (17 genera, 31 spp., 2 var.), Theaceae (9 genera, 21 spp., 1 var.), Lauraceae (7 genera, 20 spp., 1 var.) and Dryopteridaceae (8 genera, 20 spp.) followed in decreasing order. In the case of the genus, *Symplocos* (16 spp.) and *Ilex* (16 spp.) were the richest, followed by *Diplazium* (14 spp., 1 var.), *Ficus* (12 spp., 1 var.), *Ardisia* (10 spp.) and *Lasianthus* (9 spp. 1 var.) (Table 11).

Species richness of some selected families was compared among the plots (Fig. 10). Orchidaceae was particularly rich in the plots in Taiwan (11–17 spp.) compared to Japan (1–6 spp.). Fagaceae was scant in the plots of Ryukyu. Rubiaceae was the most abundant (12–17 spp.) in every plot of Ryukyu and lowland Taiwan. In the other two plots, Lopeishan and Miyazaki, Woodwardiaceae and Fagaceae, respectively, were the richest. Lindsaeaceae, Palmae, Melastomataceae, Rubiaceae Acanthaceae and Gesneriaceae seemed to be richer in the south, whereas Aceraceae, Caprifoliaceae, Plagiogyriaceae, Labiatae and Rosaceae were richer in cooler areas like Miyazaki and Lopeishan. The richness of Rubiaceae, Theaceae and Lauraceae have also been reported in *Machilus-Castanopsis* forests in Taiwan (Hsieh *et al.*,

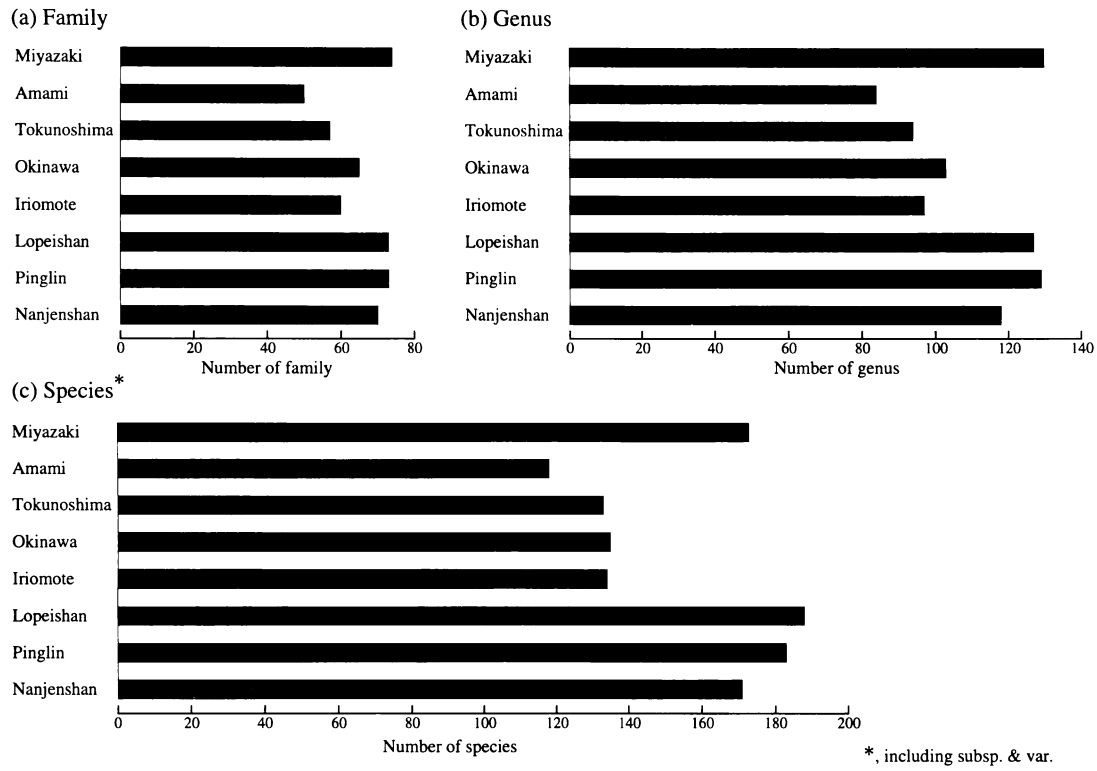


Fig. 11. Richness of family, genus and species in each plot.

1997).

Fig. 10 also shows the species richness of the representative genera in each plot. Species of *Lasianthus* were more abundant in the warmer sites (8 in Nanjenshan and 5 in Iriomote) and scarce in the cooler sites (1 in Miyazaki and 2 in Lopeishan). In contrast, species richness of *Symplocos* (3–6 spp.), *Ilex* (4–7 spp.) and *Ardisia* (3–4 spp.) varied less among the plots (Fig. 10).

The family composition of these lucidophyll forest was compared to that of *Fagus crenata* forest, a representative of temperate deciduous forest in Japan. According to the compositional table in Hukushima *et al.* (1995), Orchidaceae, Rubiaceae, Theaceae, Lauraceae and Dryopteridaceae were minor groups in *Fagus* forest. Comparison with the *Fagus* forest also revealed that the pteridophytes seem to be richer in lucidophyll forest both in number of species and in ratio to the total vascular flora. Acanthaceae, Aspleniaceae, Cyatheaceae, Ebenaceae, Lindsaeaceae, Melastomataceae, Moraceae and Myrtaceae also occurred commonly in the lucidophyll forest, whereas they scarcely, if at all, occur in *Fagus* forest (Hukushima *et al.*, 1995). Therefore, the abundance or occurrence of these families in the lucidophyll forest seems to be characteristic at least in comparison with the *Fagus crenata* forest. However, most of these families may be common to the tropical rain forest (Tryon, 1989; Whitmore, 1990; Richards, 1996), although no comparable data are available.

Comparison of taxon richness among the plots

The number of taxa in the plots on Miyazaki and Taiwan was consistently larger than that in the Ryukyu Islands. The numbers for family, genus and species identified in each plot are shown in Fig. 11. The number of families in three plots in Taiwan and one in Miyazaki was similarly high, as many as 70 to 74, in comparison with 50 to 65 in the four plots in the Ryukyu Islands. The number of genera was also larger in Taiwan and Miyazaki (119 to 130) than in Ryukyu (84 to 103). Likewise, the number of species per plot was

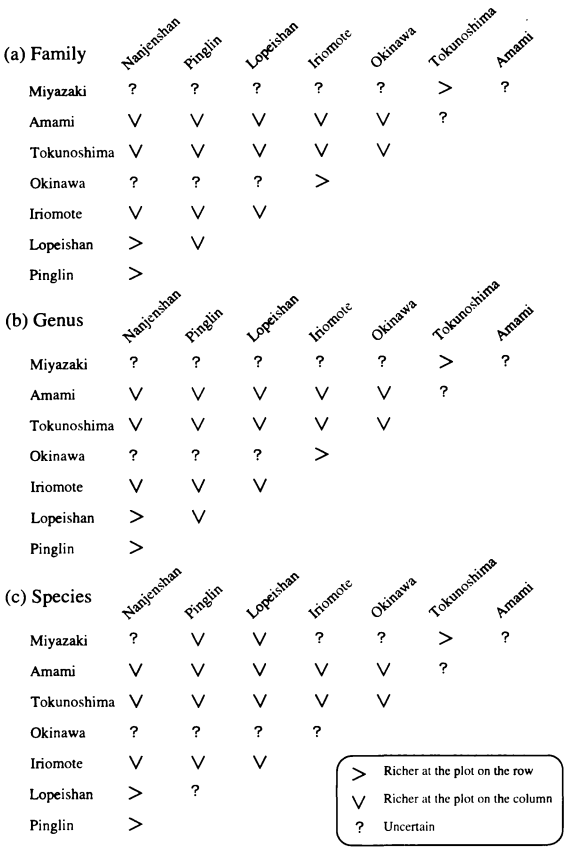


Fig. 12. Comparison of taxon richness among the plots taking the plot area into account.

also higher in Nanjenshan (171), Pinglin (183), Lopeishan (188) and Miyazaki (173) than in Iriomote (134), Okinawa (135), Tokunoshima (134) and Amami (118). Taxon richness per plot thus indicated a richer flora in Taiwan and Kyushu than in the Ryukyu Islands.

We cannot compare these values directly with each other, because the plot areas differ. However, even when taking the area into account, this tendency seems to be valid. We can say that plot A has a richer flora than plot B when more species occur in plot A than B while the area of plot A is smaller. Comparison of taxon richness between pairs of plots considering the plot area like this resulted in the matrices of Fig. 12. These matrices reveal that at least three plots in Taiwan have richer families, genera and species than three of the plots in Ryukyu,

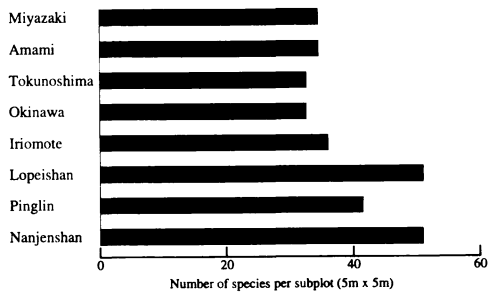


Fig. 13. Average number of species in the subplots.

namely Amami, Tokunoshima and Iriomote. Among the plots in Ryukyu, Okinawa had the richest taxa with respect to family, genus and species. Iriomote then followed and Tokunoma and Amami were the least. The plot in Miyazaki seemed to have a richer flora than in Amami and Tokunoshima.

A similar result was obtained from the comparison of number of species per 5 m×5 m subplot. The average number of species in subplots (Fig. 13) was largest in Lopeishan and Nanjenshan, reaching as many as 51 spp. The plot in Pinglin followed. The remaining five plots in Japan from Miyazaki to Iriomote had a lower number of species (32 to 36 spp.).

Comparisons of taxon richness both per plot and subplot thus demonstrate that the species composition of lucidophyll forest is consistently richer in Taiwan than in the Ryukyu Islands. The richer floristic composition in Taiwan seems to be derived mainly from a denser packing of species into a small area with homogeneous conditions like a subplot, rather than more frequent turn-over of species along the topographic gradient within a plot. Two possible factors may relate to the compositional paucity in the Ryukyu Islands. One is coldness in the north, which may cause dropout of some southern elements toward the north exemplified by *Lasianthus* spp. The other is the smaller and more or less isolated environment of the Islands, especially in the past warmer period, which may cause extinction and difficulty for recolonization for some taxa like Fagaceae. However, further study is necessary to discuss this issue.

Floristic Composition in Relation to Geographic Position

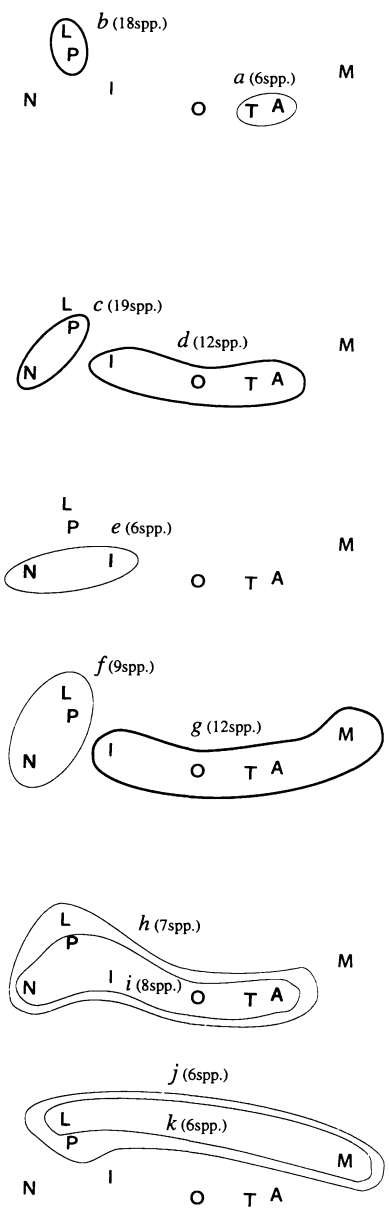
Floristic relationships among the plots

The matrix of Sørensen's similarity index among the plots is presented in Fig. 14. The indices among the plots in the Ryukyu Islands were generally high (54.0–66.7%). The highest similarity index, 66.7%, was found between Amami and Tokunoshima, which means two-thirds of component species were common to both plots. Species unique to a single plot were relatively few (8–20) in Ryukyu. The indices between Iriomote and the other plots in the Ryukyu Islands (54.0–62.1%) were far higher than those between Iriomote and the plots in lowland Taiwan (34.7–35.6%), despite the geographical distances between the former pairs being larger. Also, the similarity index between Amami and Iriomote (54.0%) was far higher than that between Amami and Miyazaki (27.9%), in spite of the larger distance in the former. These facts imply a higher homogeneity of the floristic composition of forests within Ryukyu, and a compositional gap between the Ryukyu Islands and Taiwan, and between Ryukyu and Kyushu. However, compositional similarity of Ryukyu to Taiwan was still slightly higher than to Miyazaki. Within the Ryukyu Islands, the extent of similarity among the four plots corresponded roughly to the array of the islands on which they were located, in such a manner that the further the distance between the pair of islands, the smaller the value for the similarity index. This implies that the geographic gradient along the Ryukyu Islands has resulted in the compositional gradient of their lucidophyll forests. In contrast, values for the similarity index among the three plots in Taiwan were as low as 19.5–43.1% in spite of the pairs within an island. For example, the values between Pinglin and Nanjenshan, and Pinglin and Lopeishan were 43.1% and 41.9%, respectively. This is partly because there were more species unique to a plot in Taiwan (40–85 spp.). Miyazaki, on the other hand, seems to be a little different from the other plot, since its similarity index with other plots did not exceed 30%, and 89 species were peculiar to Miyazaki.

Species common to two or more plots were grouped and the resultant main groups are listed in Fig. 15. As is shown in the Fig. 15, species group *c* being confined to Pinglin and Nanjenshan was the largest, amounting to 19 species, as exemplified by *Calanthe formosana*, *Cryptocarya chinensis* and *Curculigo capitulata*. Species group *b*, restricted to Pinglin and Lopeishan, such as *Pellionia arisanensis* and *Pyrenaria shinkoensis*, was the second

	Nanjenshan	Pinglin	Lopeishan	Iriomote	Okinawa	Tokunoshima	Amami	Miyazaki
Miyazaki	9.4	21.3	24.3	25.6	25.7	29.7	27.9	
Amami	20.6	30.9	22.9	54.0	58.5	66.7		
Tokunoshima	28.9	37.8	24.9	60.6	64.9			
Okinawa	28.9	33.9	22.4	62.1				
Iriomote	34.7	35.6	21.0					
Lopeishan	19.5	41.9						
Pinglin	43.1							
Nanjenshan								

Fig. 14. Values for Sørensen's index of similarity among the plots.



a. Amami - Tokunoshima

Croomia japonica
Dryopteris koidzumiana
Ophiorrhiza pumila
Symplocos microcalyx
Thelypteris cystopteroides
Listera japonica

b. Lopeishan - Pinglin

Ampelopsis leeoides
Asarum macranthum
Castanopsis carlesii var. *sessilis*
Dryopteris formosana
Diplazium heterophlebium
Eurya loquaiana
Hemiboea bicornuta
Ilex ficoidea
Ilex formosana
Microlepia obtusiloba
Pellionia arisanensis
Pyrenaria shinkoenesis
Sabia swinhoei
Sarcopyramis napalensis var. *delicata*
Selaginella delicatula
Stegnogramme griffithii var. *wilfordii*
Trachelospermum jasminoides
Trochodendron aralioides

c. Pinglin - Nanjenshan

Calanthe formosana
Cryptocarya chinensis
Curculigo capitulata
Dioscorea japonica var. *oldhamii*
Elaeocarpus sylvestris
Engelhardtia roxburghiana
Fissistigma oldhamii
Habenaria longitentaculata
Helicia formosana
Lasianthus bunzanensis
Liparis nigra
Machilus kusanoi
Piper sintensis
Pleocnemia cumminghiana
Pothos chinensis
Pteris cadieri
Sloanea formosana
Tropidia angulosa
Vernononia andersonii var. *albipappa*

d. Amami - Tokunoshima - Okinawa - Iriomote

Antidesma japonicum
Castanopsis sieboldii ssp. *lutchuensis*
Cinnamomum doederleinii
Elaeocarpus sylvestris var. *ellipticus*
Gardenia jasminoides
Hoya carnosa
Ilex warburgii
Neolitsea aciculata
Randia canthioides
Raphiolepis indica var. *umbellata*
Tylophora japonica
Vaccinium wrightii

e. Iriomote - Nanjenshan

Bridelia balansae
Freycinetia formosana
Ilex maximowicziana
Lasianthus obliquinervis
Lindsaea merrillii ssp. *yaeyamensis*
Thelypteris liukiuensis

f. Lopeishan - Pinglin - Nanjenshan

Adinandra formosana
Diospyros eriantha
Elatostema lineolatum var. *majus*
Eurya chinensis
Ficus formosana
Machilus zuihoensis
Prunus phaeosticta
Quercus longinux
Smilax lanceifolia

g. Miyazaki - Amami - Tokunoshima - Okinawa - Iriomote

Ardisia crenata
Ardisia pusilla
Camellia sasanqua
Cleyera japonica
Dendropanax trifidus
Distylium racemosum
Eurya japonica
Ficus erecta
Machilus japonica
Rhus succedanea
Styrax japonicus
Symplocos prunifolia

h. Amami - Tokunoshima - Okinawa - Iriomote - Lopeishan - Pinglin - Nanjenshan

Alpinia intermedia
Angiopteris lygodiifolia
Ardisia quinquegona
Ilex liukiuensis
Lasianthus fordii
Selaginella doederleinii
Tricalysia dubia

i. Amami - Tokunoshima - Okinawa - Iriomote - Pinglin - Nanjenshan

Ardisia sieboldii
Blechnum orientale
Dryopteris sordidipes
Lasianthus curtisii
Psychotria rubra
Psychotria serpens
Schefflera octophylla
Wendlandia formosana

j. Miyazaki - Lopeishan - Pinglin

Alpinia japonica
Arachniodes rhomboidea
Davalia mariesii
Goodyera velutina
Lycopodium serratum var. *longipetiolatum*
Symplocos thephrastiifolia

k. Miyazaki - Lopeishan

Crepidomanes minutum
Lasianthus japonicus
Maesa japonica
Plagiogyria euphlebia
Quercus sessilifolia
Rubus buergeri

Fig. 15. Some of the representitive species groups classified by occurrence pattern among the plots. Plots where the species group (*a* to *k*) occurred are represented on the left, and the members of the species group are listed on the right. Lines enclosing groups of plots indicate that members of the species group occur in common, and do not occur in the plots outside. Thick line indicates a larger group in which ten or more species are included and thin line indicates a group with 5 to 9 species. Abbreviation of the plot names is as in Table 1.

largest. This was followed by species group *d* that occurred throughout the Ryukyu Islands (12 spp.), like *Castanopsis sieboldii* ssp. *lutchuensis* and *Cinnamomum doederleinii*, and group *g* from Ryukyu to Kyushu (12 spp.) like *Dendropanax trifidus* and *Camellia sasanqua*. Species group *h* and *i*, which were common to the plots in Ryukyu and Taiwan, amounted to 7 species and 8 species, respectively. Species of these two groups, such as *Alpinia intermedia*, *Ardisia quinquegona*, *A. sieboldii*, *Psychotria rubra* and *P. serpens*, jointly connected Ryukyu and Taiwan floristically, although they are relatively minor groups. These facts also indicate a similarity among the Ryukyu Islands and a compositional gap between Taiwan and Ryukyu.

In the case of species not in common, there were some vicarious relationships in which closely related species or conspecific varieties occurred in mutually adjacent areas. This also contributes to the increase in similarity between the plots. For example, *Castanopsis sieboldii* ssp. *lutchuensis* common to the plots in the Ryukyu Islands was replaced by *C. sieboldii* ssp. *sieboldii* in Miyazaki, and *C. cuspidata* in Miyazaki was replaced by *C. carlesii* in Taiwan. Also, *Adinandra formosana* occurring in the three plots in Taiwan was replaced by vicarious species in the plots on the Ryukyu Islands (*A. yaeyamensis* in Iriomote and *A. ryukyuensis* in Okinawa). Similar examples in the Ryukyu Islands and mainland Japan are *Antidesma japonicum* (*A. japonicum* var. *densiflorum* in Taiwan), *Neolitsea aciculata* (*N. aciculata* var. *variabillima* in Taiwan), *Elaeocarpus sylvestris* var. *ellipticus* (*E. sylvestris* in Taiwan), *Camellia sasanqua* (*C. brevistyla* in Taiwan), *Eurya japonica* (*E. chinensis* or *E. nitida* in Taiwan), *Cleyera japonica* (*C. japonica* var. *morii* in Taiwan) and *Dendropanax trifidus* (*D. dentiger* in Taiwan). Interestingly, such vicarious relationships were found only in tree and shrub species. These vicarious taxa also indicate the similarity within the Ryukyu Islands and the compositional gaps between Taiwan and the Ryukyu Islands and between the Ryukyu Islands and mainland Japan.

Floristic relationship between northern Taiwan and Kyushu

Another important pattern of species occurrence among the plots was a disjunctive occurrence in which a species appeared separately in Miyazaki and in Taiwan (especially in Lopeishan) beyond the Ryukyu Islands. For example, 6 species *e.g. Lasianthus japonicus*, *Plagiogyria euphlebia* and *Maesa japonica* occurred only in Miyazaki and Lopeishan (Fig. 15*k*). Similarly, 6 species *e.g. Alpinia japonica* and *Goodyera velutina* were found in Miyazaki, Lopeishan and Pinglin (Fig. 15*j*). These species are ones common in the lucidophyll forests not only in the plot on Miyazaki, but also widely in the southwestern part of mainland Japan. Although the similarity index between Miyazaki and Lopeishan was not specially high, this disjunctive occurrence is noteworthy as a compositional connection between mainland Japan and Taiwan. Among these species, *Quercus sessilifolia*, *Rubus buergeri* and *Symplocos theophrastiifolia* do not occur in the Ryukyu Islands, and *Lasianthus japonicus*, *Maesa japonica*, *Plagiogyria euphlebia*, *Alpinia japonica* and *Goodyera velutina* are quite rare in the Ryukyu Islands, being restricted to near mountain tops on Okinawa or Amami (Hatusima and Amano, 1994). In addition to these species, there occurred several with a similar distributional pattern like *Calanthe reflexa*, *Hymenophyllum barbartum* and *Osmanthus heterophylla* in Lopeishan, although they were not found in the Miyazaki plot. They scarcely, if at all, occur in the Ryukyu Islands, but occur commonly in both mainland Japan and Taiwan. Such a distributional pattern may be conditioned by the thermal environment, since the estimated annual mean temperatures of Miyazaki and Lopeishan are similarly low in comparison to those in the Ryukyu Islands and lowland Taiwan (Table 1). Also, there are no higher mountains in the Ryukyu Islands. Therefore, the floristic similarity between Lopeishan and Miyazaki is considered to be caused by their similar cooler temperature.

Another interesting group of species in Lopeishan is one confined mostly to the mountain of Yakushima Island in Japan. They are all ferns like *Acrophorus nodosus*, *Asplenium*

filipes, *Athyrium arisanensis*, *A. sylvicola*, *Cornopteris opaca*, *Diplazium heterophlebium*, *Diplazium kawakamii*, *Dryopteris hendersonii*, *D. formosana*, *Pteris stenoptera* and *Thelypteris uraiensis*. They can probably spread widely across the sea by spores. However, growth of these ferns in Yakushima Island is reportedly not as common as in Lopeishan (Miyawaki, 1980). Therefore, it is assumed that some of the climatic conditions, presumably the less seasonality, supporting the growth of these ferns deteriorate toward the north and have virtually been lost in mainland Japan, even if the annual mean temperature is identical. On the other hand, some climatic conditions in Yakushima Island may be similar to those in the mountain of Taiwan as is presumed by lack of temperate deciduous forests in both areas. This may allow the sporadic growth of these ferns in Yakushima Island.

Phytogeographic consideration of the plots

Fig. 16 shows the number and ratio of the species native to mainland Japan and those native to Taiwan among the species in each plot. The ratio of species native to mainland Japan steadily decreased in the Ryukyu Islands and Taiwan from the north to the south. In the plots in Taiwan, these species amounted 35 to 75 and comprised 20 to 40% of the total. On the other hand, the ratio of the species native to Taiwan was 80% in Iriomote and 62% in Miyazaki, decreasing toward the north. Only 20 to 40% of the species occurred in the Taiwan plots were distributed in mainland Japan, whereas 62% of the species in Miyazaki were distributed in Taiwan. This imbalance of distribution implies that the species that spread their range toward the north to mainland Japan from Taiwan were more numerous than the species that spread southward from mainland Japan to Taiwan. Two factors may have caused this pattern, although the details remain unclear. One is the geographic situation of mainland Japan lying in the northern limit of lucidophyll forest, and the other is

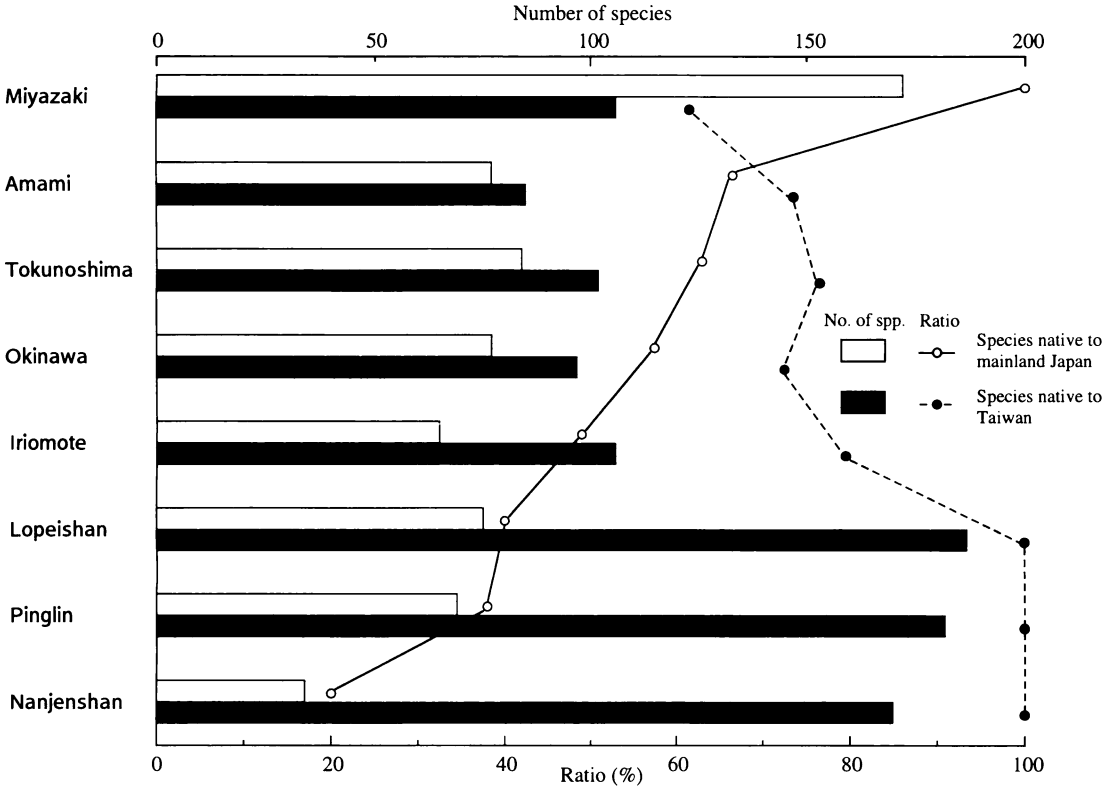


Fig. 16. Number and ratio of species common to mainland Japan or Taiwan.

Table 12. Number of species in relation to the distributional area of species. Bold and italic numerals represent the first and second largest distributional type in each plot, respectively.

Plot Total	Nanjenshan 167	Pinglin 176	Lopeishan 182	Iriomote 133	Okinawa 131	Tokunoshima 131	Amami 116	Miyazaki 172
Related to the Continent								
C-F	*31*	*38*	30	—	—	—	—	—
C-F-R	24	37	16	*26*	*22*	*21*	*15*	—
C-F-R-J	17	**40**	*36*	**32**	**36**	**35**	**30**	**61**
C-F-J	1	3	6	—	—	—	—	12
C-R	—	—	—	0	1	1	1	—
C-R-J	—	—	—	2	4	4	4	8
C-J	—	—	—	—	—	—	—	13
Related to the Philippines								
R-F	6	1	0	—	—	—	—	—
R-F-R	9	2	0	4	2	1	0	—
P-F-R-J	1	2	3	1	1	1	1	0
P-R	—	—	—	2	0	0	0	—
Related to both of the Continent and the Philippines								
P-C-F	1	3	5	—	—	—	—	—
P-C-F-R	15	11	7	9	7	6	5	—
P-C-F-R-J	10	18	20	14	12	19	*15*	22
P-C-F-J	0	0	0	—	—	—	—	1
P-C-R-J	—	—	—	1	0	0	1	0
P-C-J	—	—	—	—	—	—	—	1
Restricted to the study area								
F-R	10	10	8	12	6	5	7	—
F-R-J	5	5	7	8	11	14	12	8
F-J	0	1	3	—	—	—	—	1
R-J	—	—	—	7	13	11	14	14
Endemic to the each area								
F	**32**	13	**39**	—	—	—	—	—
R	—	—	—	14	15	12	11	—
J	—	—	—	—	—	—	—	*29*
Introduced	0	0	0	0	0	0	0	1
Uncertain	5	2	2	1	1	1	0	1

P, Philippines; ***C***, Continental China; ***F***, Taiwan; ***R***, Ryukyu Islands; ***J***, mainland Japan; *e.g.* ***C-F*** represents the species distributed in the Continental China and Taiwan.

the lack of higher mountain in the Ryukyu Islands. These two factors may have inhibited the movement of northern species toward the south in the past, whereas the southern species may have been able to spread northward more easily via the Ryukyu Islands.

Table 12 shows the composition of distributional types in each plot. Among 24 distributional types identified in our plots, *C-F-R-J*, whose constituents are distributed in the mainland China, Taiwan (Formosa), Ryukyu Islands and mainland Japan, was the largest type in most of the plots except in Lopeishan and Nanjenshan. *C-F-R* was the second largest group in the Ryukyu Islands. The species related to mainland China including *C-F-R-J*, *C-F-R*, *C-F* and others were far more than ones related to the Philippines. In addition, there occurred many endemic species in the plots. The endemic species comprised the largest portion of the floristic composition in Lopeishan and Nanjenshan, whereas they were a relatively minor group in the plots of Pinglin and the Ryukyu Islands. These facts imply that the major portion of species of the lucidophyll forests in the Ryukyu Islands is derived from mainland China.

Differentiation of Floristic Composition along the Topographic Gradient

Species distribution along the topographic gradient

Topographic distributions of each species were similar among the plots in most cases. Table 13 shows the habitat scores representing the distributional center along the slope from valley to ridge for the main species occurred in three or more plots. The majority of the species showed relatively similar habitat scores, indicating that they are distributed on a similar portion of the topographic gradient, irrespective of the locality of the plot. For example, *Podocarpus nagi*, *Vaccinium wrightii* and *Cinnamomum doederleinii* consistently scored 0.4 or more (Table 13), indicating that these species are distributed in every case on the upper part of slope and the ridge. Likewise, *Thelypteris taiwanensis*, *Bolbitis appendiculata* and *Alocasia odora* always showed the score of −0.9 or −1.0, indicating that they are generally confined to the valley bottom.

One significant feature of species distribution along the gradient is that the majority of species (63 out of 69 spp.) scoring positive values were trees, shrubs or woody vines, whereas more than half of those (27 out of 45 spp.) scoring negative value were herbaceous. This means that most of the woody species have their distributional center on the upper part of the slope, and herbaceous species on the lower part or on valley bottom.

On the other hand, there were some species whose habitat scores varied markedly among the plots, although they were not abundant. For instance, in Pinglin, *Ardisia sieboldii* did not occurred on the valley bottom or the lower part of the slope, but only on the upper half of the slope and the ridge, whereas it was distributed on the valley bottom or from the valley bottom to the middle part of the slope in the Ryukyu Islands and Nanjenshan. Other examples were *Diplazium dilatatum*, *D. donianum*, *Piper kadzura* and *Blechnum orientale*, which occurred on the lower part of the slope and valley bottom in the Ryukyu Islands, shifted or spread their range upwards on slopes in Taiwan (Table 13). The explanation for these shifts in ranges is uncertain.

Arrangement of species groups along the topographic gradient

The distributional pattern of the species groups along the topographic gradient from valley to ridge seems to be similar among the plots. In Fig. 17, distributional ranges along the slope from the valley bottom to the ridge are shown schematically for all the species groups in the eight plots. Those species ap-

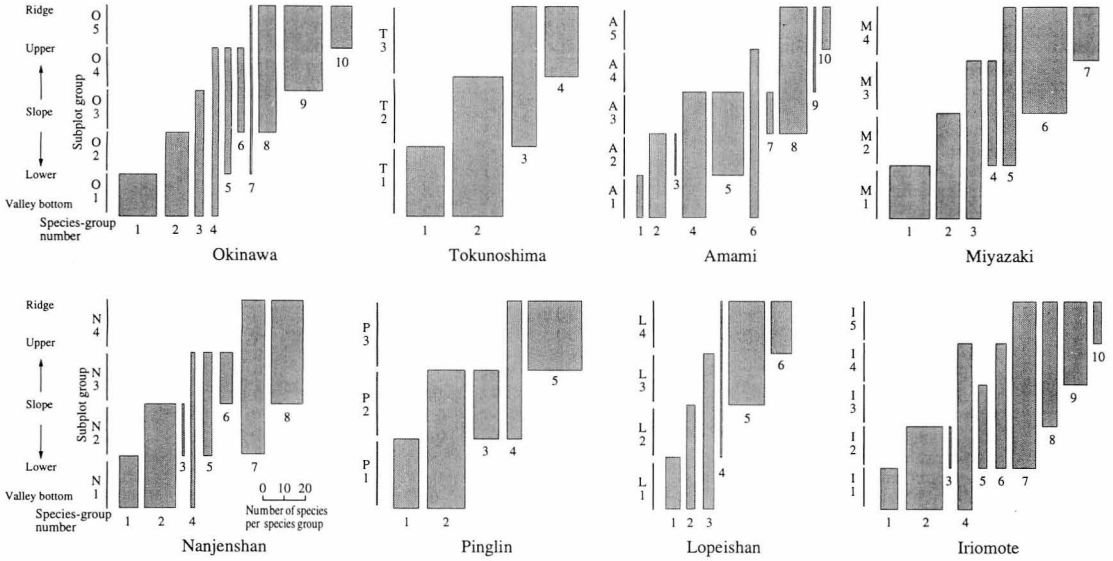


Fig. 17. Scheme showing the distribution of species groups along the topographic gradient from the valley bottom to the ridge.

Table 13. Habitat scores for the species that occurred in at least three of the plots. Abbreviations of the plots are as in Table 1.

Species \ Plot	N	P	L	I	O	T	A	M	Ave.
Species whose habitat score was less variable among the plots									
Podocarpus nagi	1	•	•	•	•	1	0.4	•	0.8
Vaccinium wrightii	•	•	•	0.8	1	0.7	0.7	•	0.8
Cinnamomum doederleinii	•	•	•	0.8	0.8	0.5	0.6	•	0.7
Diospyros eriantha	0.3	0.7	1	•	•	•	•	•	0.7
Ilex integra	•	•	•	•	0.7	•	0.5	0.8	0.7
Ilex maximowicziana var. kanehirae	•	•	•	•	1	1	0.2	•	0.7
Myrica rubra	•	•	1	1	0.5	0.2	0.8	•	0.7
Podocarpus macrophyllus	•	•	•	0.7	1	•	0.3	0.7	0.7
Rhaphiolepis umbellata	•	•	•	0.4	1	1	0.5	•	0.7
Symplocos prunifolia	•	•	•	0.6	1	0.7	0.5	0.7	0.7
Ternstroemia gymnanthera	0.3	•	0.7	0.8	0.8	1	0.4	0.7	0.7
Trachelospermum jasminoides var. pubescens	•	•	0.2	•	0.6	1	1	•	0.7
Dendropanax trifidus	•	•	•	0.3	0.6	0.5	0.8	0.7	0.6
Lycopodium serratum var. longipetiolatum	•	0.5	0.7	•	•	•	•	0.5	0.6
Symplocos caudata	•	1	0.4	0.3	•	•	•	•	0.6
Tricalysia dubia	0.4	1	0.3	0.6	0.6	0.8	0.3	•	0.6
Adinandra formosana	0.5	0.7	0.4	•	•	•	•	•	0.5
Camellia japonica	•	•	•	•	0.4	0.5	0.5	0.6	0.5
Cinnamomum japonicum	•	•	•	•	0.2	0.5	•	0.7	0.5
Cleyera japonica	•	•	•	0.5	0.8	0.8	0.3	0.3	0.5
Elaeocarpus japonicus	•	0.7	0.4	0.4	0.7	0.3	0.5	0.5	0.5
Eurya chinensis	0	0.5	1	•	•	•	•	•	0.5
Eurya japonica	•	•	•	0.8	0.8	0.8	0.2	0.1	0.5
Glochidion zeylanicum	0.3	•	•	0.2	•	1	•	•	0.5
Helicia cochinchinensis	•	•	0.7	0	•	•	•	0.7	0.5
Ilex goshiensis	•	•	0.3	0.4	0.5	0.7	0	0.8	0.5
Lasianthus cyanocarpus	0.3	•	•	0.4	0.8	•	•	•	0.5
Lindsaea chienii	•	0.7	1	0.4	0.5	0.3	0.2	0.5	0.5
Meliosma squamulata	•	0.8	0.5	•	0.5	0.1	•	•	0.5
Microtropis japonica	0	•	•	0.4	0	1	0.3	1	0.5
Morinda umbellata	•	1	0.6	0.3	•	0.1	0.2	•	0.5
Myrsine seguinii	•	0.8	0.5	0.4	0.6	0.3	0.2	0.6	0.5
Osmanthus marginatus	0.2	•	•	0.3	1	•	•	•	0.5
Quercus longinux	0.3	1	0.2	•	•	•	•	•	0.5
Symplocos theophrastiifolia	•	0.8	0.3	•	•	•	•	0.4	0.5
Syzygium buxifolium	•	1	0.4	0.2	0.6	0.6	0.2	0.8	0.5
Ardisia crenata	•	•	•	0.4	0.4	0.4	0.1	0.7	0.4
Damnacanthus biflorus	•	•	•	•	0.7	0.5	0.1	•	0.4
Daphniphyllum teijsmannii	0.3	0.8	0.1	0.5	0.6	0.6	0.3	0.3	0.4
Diospyros morrisiana	•	0.8	0.2	•	0.4	•	0.2	0.5	0.4
Ilex liukiuensis	-0.1	0.7	0.3	0.4	0.8	0.4	0.3	•	0.4
Rhododendron tashiroi	•	•	•	•	0.6	0.4	0.2	•	0.4
Stauntonia hexaphylla	0.6	0.8	0	•	•	•	•	0.3	0.4
Dryopteris sordidipes	0.3	0.7	•	0.4	0.3	0.2	-0.2	•	0.3
Elaeocarpus sylvestris var. ellipticus	•	•	•	0.3	0	0.4	0.6	•	0.3
Gardenia jasminoides	•	•	•	0.1	0.8	0	0.3	•	0.3
Lasianthus curtisii	0.3	0.8	•	0.2	0.6	0	0	•	0.3
Meliosma rigida	•	0.8	•	•	0.3	0	•	0.3	0.3
Michelia compressa	0.2	0.7	0.3	0.5	0	•	•	•	0.3
Neolitsea aciculata	•	•	•	0.3	0.2	0.5	0.4	•	0.3
Smilax lanceifolia	0.2	0.7	0.1	•	•	•	•	•	0.3
Tarenna gracilipes	•	•	•	0.4	0.4	0.1	•	•	0.3
Antidesma japonicum	•	•	•	0.2	0.5	0	0.1	•	0.2
Distylium racemosum	•	•	•	0.2	0.2	0.4	-0.2	0.3	0.2
Lindsaea orbiculata var. commixta	-0.1	•	•	0.4	•	0.2	•	•	0.2
Plagiogyria adnata	•	0.5	0.4	•	•	•	-0.1	-0.1	0.2
Prunus phaeosticta	0.1	0.5	0.1	•	•	•	•	•	0.2
Psychotria serpens	0.2	0.8	•	0	0	0.1	0	•	0.2
Sarcandra glabra	0.5	0.5	0.5	0.1	•	-0.3	-0.1	0	0.2
Smilax nervo-marginata	•	•	•	•	0.3	0.2	0.2	•	0.2
Symplocos glauca	•	0.6	0.3	0.4	-0.1	0	0.2	0.3	0.2
Tylophora japonica	•	•	•	-0.1	0.4	0.5	0.1	•	0.2
Castanopsis sieboldii ssp. lutchuensis	•	•	•	0.3	0.2	0	0	•	0.1
Ficus nipponica	•	0.5	0	0.1	-0.3	•	•	0.4	0.1
Goodyera velutina	•	0	0.1	•	•	•	•	0.2	0.1
Lophatherum gracile	0.5	-0.2	•	-0.1	0.5	0	•	-0.3	0.1
Psychotria rubra	0	0.4	•	0	0.2	0	-0.2	•	0.1
Quercus miyagii	•	•	•	0.3	0.4	-0.3	•	•	0.1
Randia canthioides	•	•	•	0.2	0.2	0	0	•	0.1
Ficus formosana	-0.3	0.3	0.2	•	•	•	•	•	0
Smilax bracteata	•	-0.2	0.5	•	•	-0.3	0	•	0
Alpinia japonica	•	-0.2	0	•	•	•	•	-0.1	-0.1

Table 13. (Continued)

Arachniodes rhomboidea	•	-0.2	-0.3	•	•	•	•	0.3	-0.1
Cyathea podophylla	-0.3	0.3	•	-0.2	-0.1	-0.4	•	•	-0.1
Ilex warburgii	•	•	•	-0.3	0.1	0.1	-0.2	•	-0.1
Lasianthus fordii	-0.1	0.1	0	-0.1	-0.1	-0.4	-0.3	•	-0.1
Lemmaphyllum microphyllum	•	0	0	•	•	•	•	-0.2	-0.1
Selaginella doederleinii	-0.5	0.2	0	-0.3	-0.1	-0.2	-0.1	•	-0.1
Thelypteris triphylla	0	0.4	•	-0.2	•	-0.5	•	•	-0.1
Trachelospermum gracilipes var. liukiuensis	•	•	•	0	•	-0.1	-0.1	•	-0.1
Lasianthus wallichii	-0.1	-0.1	•	-0.2	-0.4	-0.5	•	•	-0.2
Styrax japonicus	•	•	•	-0.2	0	-0.2	-0.1	-0.5	-0.2
Wendlandia formosana	-0.6	0.3	•	-0.2	-0.1	-0.7	-0.3	•	-0.2
Arachniodes sporadosora	•	0.1	-0.3	-0.3	•	-0.4	-0.7	0	-0.3
Cephalomanes obscurum	-0.8	-0.2	•	-0.2	-0.4	•	0	•	-0.3
Eurya osimensis	•	•	•	-0.5	•	0	-0.3	•	-0.3
Glochidion acuminatum	•	-0.7	•	•	•	-0.2	-0.1	•	-0.3
Machilus japonica	•	•	•	0.1	-0.3	-0.5	-0.3	-0.3	-0.3
Oplismenus compositus var. patens	0.1	•	•	-0.5	-0.5	•	•	•	-0.3
Pileostegia viburnoides	•	-0.1	0	-0.5	-0.1	•	-0.6	•	-0.3
Mussaenda parviflora	-0.2	0.2	•	-0.8	•	-0.7	•	•	-0.4
Aucuba japonica	•	•	-0.3	•	•	-1	•	-0.1	-0.5
Diplazium subsinuatum	•	•	-0.2	-0.7	-0.6	-0.6	-0.7	-0.3	-0.5
Ficus erecta	•	•	•	-0.8	-1	-0.3	-0.5	-0.1	-0.5
Hoya carnosa	•	•	•	-0.7	-0.8	-0.1	-0.3	•	-0.5
Microsorium buergerianum	•	-0.2	-0.1	-0.5	-0.9	•	•	-0.7	-0.5
Saurauia tristyla	0	-0.7	•	-0.8	•	•	•	•	-0.5
Angiopteris lygodiifolia	-0.6	-0.4	0	-0.7	-0.9	-0.8	-0.8	•	-0.6
Ardisia pusilla	•	•	•	-1	-1	-0.4	-0.3	-0.3	-0.6
Cyathea metteniana	•	-0.6	•	-0.6	•	-0.7	-0.5	•	-0.6
Ophiorrhiza japonica	-1	-0.3	-0.3	-1	-0.9	•	•	-0.3	-0.6
Turpinia ternata	-0.3	•	•	•	-0.8	-0.8	•	•	-0.6
Deparia petersenii	•	0	-1	-1	-1	•	•	•	-0.8
Desmodium laxum ssp. leptopus	-0.8	-0.4	•	-0.2	-0.8	-1	•	•	-0.7
Elatostema lineolatum var. majus	-0.7	-0.5	-0.9	•	•	•	•	•	-0.7
Ficus bengutensis	-0.7	-0.4	•	-0.8	-0.7	•	•	•	-0.7
Pilea aquarum ssp. brevicornuta	•	-0.5	-0.6	•	-1	•	•	•	-0.7
Rhynchotechum discolor	-0.9	-0.3	•	-0.8	•	-1	•	•	-0.7
Bolbitis subcordata	•	-1	•	-0.8	-0.7	-1	-0.7	•	-0.8
Crepidomanes birmanicum	-1	•	•	-1	•	•	•	-0.5	-0.8
Ctenitis subglandulosa	•	-0.5	-1	•	-1	-0.8	-0.6	•	-0.8
Diplazium doederleinii	•	-0.7	-0.8	•	•	-1	•	•	-0.8
Codonacanthus pauciflorus	-0.8	-0.7	•	-0.8	-1	-1	•	•	-0.9
Alocasia odora	•	-1	•	-1	-0.9	-1	•	•	-1
Bolbitis appendiculata	-0.9	-1	•	•	•	•	-1	•	-1
Thelypteris taiwanensis	-1	-1	•	•	-1	-1	•	•	-1
Species whose habitat score was highly variable among the plots									
Machilus zuihoensis	-0.3	1	1	•	•	•	•	•	0.6
Ilex rotunda	•	•	0.5	1	•	•	•	0	0.5
Coptosapelta diffusa	0.8	1	-1	0.3	0.8	0.6	•	•	0.4
Cymbidium lancifolium	•	0.5	•	•	•	•	-0.3	1	0.4
Anodendron affine	0.3	0.5	•	0.5	0	0.3	-0.2	0.9	0.3
Cheiropleuria bicuspis	•	1	•	0	0.4	0	-0.2	0.6	0.3
Machilus thunbergii	0.2	1	-0.1	0	0.4	0.2	0.5	0	0.3
Camellia sasanqua	•	•	•	0.6	1	-0.3	0	-0.3	0.2
Damnacanthus indicus	•	1	-0.1	•	•	-0.1	•	0.1	0.2
Davallia mariesii	•	1	-0.7	•	•	•	•	0.3	0.2
Elaeagnus thunbergii	0.3	•	1	•	-1	0.3	•	•	0.2
Glochidion rubrum	0	1	•	-0.3	•	•	•	•	0.2
Oplismenus undulatifolius	0.7	•	0.3	•	•	•	•	-0.5	0.2
Asplenium nidus	1	0	-0.3	•	0.5	-0.4	•	•	0.1
Diplazium mettenianum	•	0.7	-0.3	•	•	0	•	-0.1	0.1
Rhus succedanea	•	•	•	0.6	-1	-1	1	1	0.1
Ardisia quinquegona	0.3	0.7	-1	0.1	0	0	-0.2	•	0
Alpinia intermedia	0.2	0.5	-1	0	0	-0.1	-0.5	•	-0.1
Dryopteris sparsa	0	0.5	-0.3	•	•	-0.8	•	0	-0.1
Asplenium wilfordii	•	•	0.3	•	•	-1	•	0	-0.2
Blechnum orientale	0.3	0.5	•	-0.3	-0.9	-0.5	-0.3	•	-0.2
Kadsura japonica	0	1	0	-0.5	-1	-0.5	-0.7	0.1	-0.2
Litsea acuminata	•	1	0.1	•	-1	-1	•	0	-0.2
Schefflera octophylla	-0.1	0.4	•	-0.1	-0.1	-0.3	-1	•	-0.2
Calanthe gracilis var. venusta	0.3	-0.2	•	•	-1	•	-0.3	•	-0.3
Diplazium donianum	-0.1	0.5	•	-0.6	-0.5	-0.8	•	•	-0.3
Crepidomanes auriculatum	0.1	-0.4	-0.7	•	•	-0.8	-1	0.2	-0.4
Lemmaphyllum microphyllum var. obovatum	•	•	•	-0.7	-1	-0.2	0.2	•	-0.4
Ardisia sieboldii	-1	0.5	•	-0.2	-1	-0.4	-0.6	•	-0.5
Piper kadzura	0.5	-0.8	-0.4	-1	•	-0.9	-0.8	-0.3	-0.5
Diplazium dilatatum	0	-0.4	-0.1	•	-1	-1	-1	•	-0.6

pearing throughout the plot irrespective of topographic position and rare species are omitted here. The species groups are divided roughly into following five types: (*a*) confined to the valley bottom (*e.g.* species group 1 in Pinglin); (*b*) ranging from the valley bottom to the lower or middle part of slope (species group 2 in Pinglin); (*c*) growing on the lower and middle part of slope (species group 3 in Pinglin); (*d*) ranging from the lower or middle part of slope to the ridge (species group 4 in Pinglin) and (*e*) those growing on the upper part of slope and the ridge (species group 5 in Pinglin). Each distributional type was often further subdivided. The striking feature is that species groups occurring only on the slope, except the valley bottom and ridge (type *c*), were relatively few in every plot, and in some plots like Tokunoshima and Lopeishan there were no such groups. In contrast, species groups growing on the valley side, and those on ridge side had a high species total in every plots. As discussed in the previous section, species groups on the valley side consisted mainly of herbaceous species including many ferns, whereas those on the ridge side consisted mostly of woody species.

As shown by the similar shapes of the presentations in Fig. 17, the pattern of combination and replacement of the species groups along a slope seems to be basically the same in all plots, although members of the corresponding species groups were different among the plots. A certain species group in one plot generally has its distributional equivalent in the other plot. For example, species group 1 in Miyazaki is assumed to correspond to species group 1 and 2 in Amami, Okinawa and Iriomote, or to species group 1 in Tokunoshima, Lopeishan, Pinglin and Nanjenshan, because their distributional ranges are all confined to the valley bottom and its adjacent area. Therefore, species groups occupying the lower half of the slope with abundant herbaceous species are replaced on ascending the slope by those occupying the upper half of the slope with rich woody species. Such a successive replacement of species groups along the slope seems to be a basic pattern of the floristic changes of lucidophyll forests.

Another point shown by the patterns of species distributions along the topographic gradient is the floristic importance of the habitat from the valley bottom to the lower parts of the slope. In Fig. 17, the habitat from the valley bottom to the lower part of the slope, and that from the upper part of the slope to the ridge both possess many associated species in almost every plot, and hence have higher floristic independences. On the other hand, the middle part of the slope or ridge top alone scarcely have less associated species (Fig. 17). The middle part of the slope can be regarded as transitional between the two contrasting habitats with floristic independence. Therefore, the valley bottom to the lower part of the slope, and the upper part of the slope to the ridge are equally important habitats supporting many peculiar species. Nevertheless, only slight attention have been given so far to the significance of the habitat from the valley bottom to the lower slope. This is probably because this habitat is characterized mostly by herbaceous species and generally has a low basal area or density of trees (Hara *et al.*, 1996 a, b). For example, Hara *et al.*, (1996a) reported for Okinawa that only *Turpinia ternata* was associated with the valley bottom and the lower slope, whereas many other trees characteristically occurred on the upper slope. However, the valley bottom of exactly the same plot was in fact characterized by many herbaceous species. Phytosociological studies of the Ryukyu Islands have not regarded the floristic composition of the valley bottom or the lower part of the slope as independent associations, but as subordinate units, subassociations *etc.* of the forest communities covering the whole slope, except for the Rhynchotecho discolor-Perseetum japonicae in Iriomote (Miyawaki, 1989). The habitat from the valley bottom to the lower part of the slope is often heterogeneous in stand structure and micro-topography, and generally devoid of large canopy trees. Therefore, this habitat superficially appears to be less important and has been treated as such. However, we consider that the habitat from the valley bottom to the lower part of slope and its associated species are of equal importance to the other habitat on the upper part of slope to the ridge and its associated species.

Difference in geographical differentiation of the floristic composition between ridge and valley

The pattern of geographic divergence in floristic composition differed between the two extreme habitats, the valley bottom and the upper part of the slope to the ridge as shown in Table 14. On the upper part of slope to the ridge, there was a clear distinction in floristic composition between Japan and Taiwan. As shown in Table 14a, eight plots can be divided roughly into two groups, Nanjenshan, Pinglin and Lopeishan on the one hand and Iriomote, Okinawa, Tokunoshima, Amami and Miyazaki on the other. These two groups were distinguished by the

Table 14. Differentiation of the floristic composition among the plots on the ridge (a) and the valley (b). Abbreviations for the subplot group are as in Table 3 to Table 10. ●, present in the subplot group; △, present in the plot but absent from the subplot group.

(a) Among the subplot groups on the ridge

Species \ Subplot group	N 4	P 3	L 4	I 5	O 5	T 3	A 5	M 4
Species group A(common to the plots in Taiwan)								
Adinandra formosana	●	●	●	·	·	·	·	·
Diospyros eriantha	●	●	●	·	·	·	·	·
Quercus longinux	●	●	●	·	·	·	·	·
Prunus phaeosticta	●	●	●	·	·	·	·	·
Smilax lanceifolia	●	●	●	·	·	·	·	·
Eurya chinensis	△	●	●	·	·	·	·	·
Ficus formosana	△	●	●	·	·	·	·	·
Species group B(common to the plots in Ryukyu)								
Antidesma japonicum	·	·	·	●	●	●	●	·
Castanopsis sieboldii ssp. lutchuensis	·	·	·	●	●	●	●	·
Cinnamomum doederleinii	·	·	·	●	●	●	●	·
Elaeocarpus sylvestris var. ellipticus	·	·	·	●	●	●	●	·
Neolitsea aciculata	·	·	·	●	●	●	●	·
Randia canthioides	·	·	·	●	●	●	●	·
Tylophora japonica	·	·	·	●	●	●	●	·
Vaccinium wrightii	·	·	·	●	●	●	●	·
Gardenia jasminoides	·	·	·	●	●	●	△	·
Damnacanthus biflorus	·	·	·	·	●	●	●	·
Quercus miyagii	·	·	·	●	●	●	·	·
Rhododendron tashiroi	·	·	·	·	●	●	●	·
Smilax nervo-marginata	·	·	·	·	●	●	●	·
Tarenna gracilipes	·	·	·	●	●	●	·	·
Ilex maximowicziana var. kanehirae	·	·	·	·	●	●	●	·
Species group C(common to the plots in Japan)								
Ardisia crenata	·	·	·	●	●	●	●	●
Dendropanax trifidus	·	·	·	●	●	●	●	●
Distylium racemosum	·	·	·	●	●	●	●	●
Symplocos prunifolia	·	·	·	●	●	●	●	●
Camellia sasanqua	·	·	·	●	●	●	●	△
Eurya japonica	·	·	·	●	●	●	△	●
Cleyera japonica	·	·	·	△	●	●	●	●
Camellia japonica	·	·	·	·	●	●	△	●
Podocarpus macrophyllus	·	·	·	●	●	·	●	●
Species group D(common to the plots in lowland Taiwan and Ryukyu)								
Psychotria rubra	●	●	·	●	●	●	●	·
Psychotria serpens	●	●	·	●	●	●	●	·
Schefflera octophylla	●	●	·	●	●	●	△	·
Lasianthus curtisii	△	●	·	●	●	●	△	·
Dryopteris sordidipes	△	●	·	●	△	●	●	·
Species group E(common to Lopeishan and Miyazaki)								
Maesa japonica	·	·	●	·	·	·	·	●
Lasianthus japonicus	·	·	●	·	·	·	·	●
Other common species								
Machilus thunbergii	●	●	●	●	●	●	●	●
Daphniphyllum teijsmannii	●	●	●	△	●	●	●	●
Myrsine seguinii	·	●	●	●	●	●	●	●
Syzygium buxifolium	·	●	●	●	●	●	●	●
Symplocos glauca	·	●	△	●	●	●	●	●
Ternstroemia gymnanthera	△	·	●	●	●	●	●	●
Anodendron affine	●	●	·	△	●	●	●	●
Tricalysia dubia	●	●	●	●	●	●	●	·
Ardisia quinquegona	●	●	△	●	●	●	●	·
Ilex liukiuensis	●	●	△	●	●	●	●	·
Ilex goshiensis	·	·	●	●	●	●	△	●
Microtropis japonica	●	·	·	●	●	●	●	●
Coptosapelta diffusa	●	●	△	●	●	●	·	·

(b) Among the subplot groups on the valley

Species \ Subplot group	N 1	P 1	L 1	I 1	O 1	T 1	A 1	M 1
Species group A(common to the plots in Taiwan)								
Elatostema lineolatum var. majus	●	●	●	·	·	·	·	·
Ficus formosana	●	△	●	·	·	·	·	·
Species group B(common to the plots in Ryukyu)								
Randia canthioides	·	·	·	●	●	●	●	·
Hoya carnosa	·	·	·	●	●	●	△	·
Species group C(common to the plots in Japan)								
Machilus japonica	·	·	·	●	●	●	●	●
Ficus erecta	·	·	·	●	●	●	●	●
Ardisia pusilla	·	·	·	●	●	●	△	●
Styrax japonicus	·	·	·	●	●	●	△	●
Species group D(common to the plots in lowland Taiwan and Ryukyu)								
Psychotria rubra	●	●	·	●	●	●	●	·
Psychotria serpens	●	△	·	●	●	●	●	·
Schefflera octophylla	●	●	·	△	●	●	●	·
Ardisia sieboldii	●	△	·	●	●	●	●	·
Wendlandia formosana	●	●	·	●	●	●	●	·
Codonacanthus pauciflorus	●	●	·	●	●	●	·	·
Bolbitis subcordata	·	●	·	●	●	●	●	·
Cyathea podophylla	●	●	·	●	●	●	·	·
Desmodium laxum ssp. leptopus	●	●	·	●	●	●	·	·
Lasianthus wallichii	●	●	·	●	●	●	·	·
Diplazium donianum	●	△	·	●	●	●	·	·
Cyathea metteniana	·	●	·	●	·	●	●	·
Rhynchotechum discolor	●	●	·	●	·	·	·	·
Ficus bengutensis	●	●	·	●	●	·	·	·
Mussaenda parviflora	●	●	·	●	·	●	·	·
Species group E(common to Lopeishan and Miyazaki)								
Maesa japonica	·	·	●	·	·	·	·	●
Plagiogyria euphlebia	·	·	●	·	·	·	·	●
Rubus buergeri	·	·	●	·	·	·	·	●
Quercus sessilifolia	·	·	●	·	·	·	·	●
Other common species								
Kadsura japonica	●	△	●	●	●	●	●	●
Machilus thunbergii	●	△	●	●	●	●	△	●
Selaginella doederleinii	●	●	△	●	●	△	·	·
Angiopteris lygodiifolia	●	●	△	●	●	●	·	·
Ardisia quinquegona	●	△	●	●	●	●	·	·
Lasianthus fordii	●	●	●	●	●	●	·	·
Alpinia intermedia	●	△	●	●	●	●	·	·
Piper kadzura	△	●	●	●	·	●	●	●
Ophiorrhiza japonica	●	●	●	●	●	·	·	●
Diplazium subsinuatum	·	·	●	●	●	●	●	●
Diplazium dilatatum	●	●	●	·	●	●	·	·
Crepidomanes auriculatum	●	●	●	·	·	●	●	△
Arachniodes sporadosora	·	●	●	●	·	●	●	●

presence and absence of two pairs of species groups, *i.e.* A vs. B, C, each of which was mutually exclusive in distribution. For example, the first plot group of Taiwan was characterized by the joint occurrence of species common to all the plots in Taiwan (*i.e.* species group A) including *Adinandra formosana*, *Diospyros eriantha*, *Quercus longinux*, *Prunus phaeosticta*, *Smilax lanceifolia*, *Eurya chinensis* and *Ficus formosana*, whereas none of the species group B and C appeared there. The second group of plots was characterized by the co-occurrence of species common to the Ryukyu Islands (species group B) such as *Cinnamomum doederleinii* and *Castanopsis sieboldii* ssp. *lutchuensis*, or those common to Japan (species group C) like *Ardisia crenata* and *Distylium racemosum*. There was another pair of species groups (D vs. E) which were mutually exclusive. Since species group D were common to lowland Taiwan and Ryukyu Islands, and species group E to Lopeishan and Miyazaki, this contrast, D vs. E, seems to correspond to the difference between subtropical and warm-temperate conditions. However, the contrasting occurrence of species group D vs. E was less conspicuous than that of species group A vs. B, C.

In contrast, the difference in floristic composition of the valleys was more prominent between subtropical and warm-temperate regions than between Japan and Taiwan. As shown in Table 14b, the plots were roughly classified into two groups, one consisting of Nanjenshan, Pinglin, Iriomote, Okinawa, Tokunoshima and Amami, and the other consisting of Lopeishan and Miyazaki. These two groups were distinguished by the presence or absence of a pair of species groups, *i.e.* D vs. E, which were mutually exclusive in distribution. For example, the first plot group of lowland Taiwan and the Ryukyu Islands was characterized by the joint occurrence of species (*i.e.* species group D) common to all the plots in lowland Taiwan and the Ryukyu Islands, including *Psychotria rubra*, *P. serpens*, *Bolbitis subcordata*, *Cyathea podophylla*, *Diplazium donianum* and *Wendlandia formosana*. The second group of plots was characterized by the co-occurrence of species common to Lopeishan and Miyazaki (species group E), including *Maesa japonica*, *Plagiogyria euphlebia*, *Rubus buergeri* and *Quercus sessilifolia*. The contrast of occurrence brought by another pair of species groups (A vs. B, C) was less conspicuous compared to the habitat from the upper part of the slope to the ridge.

The geographical differention pattern of the floristic composition therefore differs between the two contrasting habitats, the upper part of the slope to the ridge and the valley bottom. On the former, the geographical difference between Japan and Taiwan is prominent, whereas on the latter, the climatic difference between subtropical and warm-temperate areas seems to have a greater influence on the floristic differences. Many factors may be involved in causing this pattern, such as dispersibility of the species, turnover rate of individuals associated with life-span of different life forms, and disturbance frequency on different landforms. Further studies are necessary to discuss on this issue more critically.

Conclusion

In every lucidophyll forest studied the floristic composition changed distinctly along the topographic gradient from valley to ridge. The majority of the species occupied the similar part of the gradient in every plot where they occurred. Species showing a biased distribution toward a certain topographic position can roughly be integrated into four groups: species mostly confined to the valley bottom; those distributed from the valley bottom to the lower or middle part of the slope; those confined to the ridge and the upper part of the slope; those distributed from the ridge to the middle or lower part of the slope. The former two groups of species consisted largely of herbaceous plants including many ferns, whereas the latter two consisted mostly of trees and shrubs. Changes in floristic composition from valley to ridge were caused by a stepwise replacement of the former two groups of herbaceous species by the latter two groups of woody species. Therefore, such a stepwise replacement of the species groups with different life-forms seems to be a basic pattern of floristic change along the topographic gradient in the lucidophyll forest.

From a geographical point of view, there seem to be transitional changes of floristic composition from the mainland Japan to Taiwan, as shown by the decrease in species native to mainland Japan and the increase of some taxa like *Lasianthus*. However, there are major floristic gaps in forests between mainland Japan and the Ryukyu Islands, and between the Ryukyu Islands and Taiwan, as shown by comparisons of floristic similarity, distributional patterns of species and vicarious replacement of taxa. Lucidophyll forests in the Ryukyu Islands generally seem to have closer relations to the forests of lowland northern Taiwan than to mainland Japan, sharing about one-third of the component species. Within the Ryukyu Islands, the floristic compositions of the forests are similar, with half or two-thirds of species in common. The species richness of the forests there is generally lower than in Taiwan or mainland Japan. In addition, there is a significant linkage in floristic composition between mainland Japan and the mountains of northern Taiwan, although the species in common were relatively few. This implies that there are two routes of floristic connection between the lucidophyll forests of Japan and Taiwan; one is between the Ryukyu Islands and lowland Taiwan representing linkage in the so-called subtropical zone, and the other is between mainland Japan and montane Taiwan representing the linkage in the so-called warm-temperate zone.

The pattern of floristic connections among the areas differs between the two contrasting topographic positions. On the upper part of slope and ridge the difference in floristic composition is conspicuous between Japan (including the Ryukyu Islands) and Taiwan. On the valley bottom, however, the difference in floristic composition seems to lie between warm-temperate areas (mainland Japan and montane Taiwan) and subtropical areas (Ryukyu Islands and lowland Taiwan).

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References

Editorial Committee of the Flora of Taiwan. 1975–1979. Flora of Taiwan. Vol. 1, 562 pp., Vol. 2, 722 pp., Vol. 3, 1000 pp., Vol. 4, 994 pp., Vol. 5, 1166 pp., Vol. 6, 665 pp. Epoch Publishing Co., Taipei.

Editorial Committee of the Flora of Taiwan, 2nd. ed. 1993–1996. Flora of Taiwan, 2nd. ed., Vol. 1, 648 pp., Vol. 2, 855pp., Vol. 3, 1084 pp. Taipei.

Fujiwara, K. 1981–1986. Phytosociological investigation of the evergreen broad-leaved forests of Japan, I-IV. Bull. Inst. Environ. Sci. Tech., Yokohama Natn. Univ. 7: 67–133, 8: 121–150, 9: 139–160, 13: 99–149. (in Japanese with English summary in part IV)

Hara, M., K. Hirata and K. Oono. 1996a. Relationship between micro-landform and vegetation structure in an evergreen broad-leaved forest on Okinawa Island, S-W. Japan. Nat. Hist. Res. 4(1): 27–35.

Hara, M., K. Hirata, M. Fujihara and K. Oono. 1996b. Vegetation structure in relation to micro-landform in an evergreen broad-leaved forest on Amami Ohshima Island, south-west Japan. Ecol. Res. 11: 325–337.

Hara, M., K. Hirata, M. Fujihara, K. Oono and C. F. Hsieh. 1997. Floristic composition and stand structure of three evergreen broad-leaved forests in Taiwan, with special reference to the relationship between micro-landform and vegetation pattern. Nat. Hist. Res., Special Issue, (4): 81–112.

Hattori, T. and Y. Miyagi. 1987. Ecological studies on the lucidophyllous forest on Iriomote Is. II. Effects of sea wind factor on floristic composition. *In* Papers on Plant Ecology and Taxonomy to the Memory of Dr. S. Nakanishi, pp. 27–39.

Kobe Geobotanical Society, Kobe.

Hatusima, S. 1975. Flora of the Ryukyus, added and corrected. 1002pp. Okinawa seibutukyouiku kenkyukai, Naha. (in Japanese)

Hatusima, S. and T. Amano. 1994. Flora of the Ryukyus, south of Amami Island, 2nd. ed. 393 pp. The Biological Society of Okinawa, Okinawa. (in Japanese)

Hsieh, C. F. 1989. Structure and floristic composition of the warm-temperate rain forest on the Kaoling area. J. Taiwan Mus. 42 (2): 31–42.

Hsieh, C. F., T. H. Hsieh and S. M. Lin. 1989. Structure and succession of the warm-temperate rain forest at Techi Reservoir. J. Taiwan Mus. 42 (2): 77–90.

Hsieh, C. F., T. S. Huang, T. H. Hsieh, K. C. Yang and S. F. Huang. 1990. Structure and composition of the windward and leeward forests in the Wushipi Nature Preserve, northeastern Taiwan. J. Taiwan Mus. 43 (2): 157–166.

Hsieh, C. F., I. L. Lai, G. A. Song, C. C. Liao and K. C. Yang. 1997. Biodiversity and conservation of the evergreen broad-leaved forests in Taiwan. Tropics 6(4): 361–370.

Hukushima, T., H. Takasuna, T. Matsui, T. Nishio, Y. Kyan and Y. Tsunetomi. 1995. New phytosociological classification of beech forests in Japan. Jpn. J. Ecol. 45(2): 79–98.

Iwatsuki, K. 1992. Ferns and Fern Allies of Japan. 311 pp. Heibonsha, Tokyo.

Japan Meteorological Agency. 1991. Climatic Table of Japan. Vol. 1. 478 pp. Tokyo. (in Japanese)

Kikuchi, T. and O. Miura. 1993. Vegetation patterns in relation to micro-scale landforms in hilly land regions. Vegetatio 106: 147–154.

Kira, T. 1991. Forest ecosystem of east and southeast Asia in global perspective. Ecol. Res. 6: 185–200.

Kramer, K. U. 1971. *Lindsaea* group. *In* Flora Malesiana. Ser. II, Vol. 1. pp. 177–254. Wolters-Noordhoff Publishing, Groningen.

Lin, T. P. 1987, 1988. Native Orchids of Taiwan. Vol. 2, 354 pp., Vol. 3, 300 pp. Southern Materials Center, Taipei.

Liu, T. S. and H. J. Su. 1976. Synecological studies on the hardwoods of a small watershed at Wulai in northern Taiwan (I). Bull. Exp. For. Nat. Taiwan Univ. 118: 183–188. (in Chinese with English summary)

Miyagi, Y., K. Shinjyou, M. Yokota and Y. Niiro. 1989. Actual vegetation and flora of Hiji River basin, northern part of Okinawa Island. *In* Studies of Essential Factors for Preservation of Wildlife in Nansei Islands, pp. 45–84. Environment Agency, Japan. (in Japanese with English summary)

Miyawaki, A. (*ed.*) 1980. Vegetation of Japan, Vol. 1, Yakushima, 376 pp. Shibundo, Tokyo. (in Japanese with English and German summary)

Miyawaki, A. (*ed.*) 1981. Vegetation of Japan, Vol. 2, Kyushu, 485 pp. Shibundo, Tokyo. (in Japanese with English and German summary)

Miyawaki, A. (*ed.*) 1989. Vegetation of Japan, Vol. 10, Okinawa and Ogasawara, 676 pp. Shibundo, Tokyo. (in Japanese with English and German summary)

Mueller-Dombois, H. and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology, 547 pp. John Wiley & Sons, New York.

Nakaike, T. 1992. New Flora of Japan, Pteridophyte, revised and enlarged. 868 pp. Shibundo, Tokyo. (in Japanese)

Niiro, Y., Y. Miyagi, K. Shinjo and H. Shimabukuro. 1974. Vegetation of the Yaeyama Islands. *In* Ecological Studies and Nature Conservation of Ryukyu Islands, I. pp. 5–36. Okinawa. (in Japanese with English summary)

Richards, P. W. 1996. The Tropical Rain Forest, 2nd ed. 575pp. Cambridge Univ. Press, Cambridge.

Sakai, A. and M. Ohsawa. 1994. Topographical pattern of the forest vegetation on a river basin in warm temperate hilly region, central Japan. Ecol. Res. 9: 269–280.

Satake, Y., J. Ohwi, S. Kitamura, S. Watari and T. Tominari (*eds.*). 1981–1982. Wild Flowers of Japan. Herbaceous Plants. I. 305 pp., II. 318 pp., III. 259 pp. Heibonsha, Tokyo (in Japanese).

Satake, Y., K. Hara, S. Watari and T. Tominari (*eds.*). 1989. Wild Flowers of Japan. Woody Plants. I. 321 pp., II. 305 pp. Heibonsha, Tokyo (in Japanese).

Su, H. J. 1984. Studies on the climate and vegetation types of the natural forests in Taiwan (II), Altitudinal vegetation zones in relation to temperature gradient. Quarterly Journal of Chinese Forestry 17(4): 57–73.

Sun, I. F., C. F. Hsieh and S. P. Hubbell. 1996. The structure and species composition of a subtropical monsoon forest in southern Taiwan on a steep wind-stress gradient. *In* Turner, I. M., C. H. Diong, S.S.L.Lim and P.K.L.Ng (eds.), Biodiversity and the Dynamics of Ecosystems. DIWPA series 1: 147–169.

Suzuki, K. 1979. Vegetation of Ryukyu Islands, Japan. Bull. Inst. Environ. Sci. Tech., Yokohama Natn. Univ. 5: 87–160. (in Japanese with German

summary)

Suzuki, T. 1953. The forest climaxes of East Asia. Jpn. J. Bot. 14: 1–12.

Suzuki, T. 1954. The forest vegetation of the north-Formosan mountains. Jpn. J. Ecol. 4(1): 7–13. (in Japanese with English summary)

Tanouchi, H. and S. Yamamoto. 1995. Structure and regeneration of canopy species in an old-growth evergreen broad-leaved forest in Aya district, southwestern Japan. Vegetatio 117: 51–60.

Tryon, R. 1989. Pteridophytes. *In* H. Lieth and M. J. A. Werger (eds.), Tropical Rain Forest Ecosystem, pp. 327–338. Elsevier, Amsterdam.

Whitmore, T. C. 1990. An Introduction to Tropical Rain Forests. 226 pp. Oxford Univ. Press, Oxford.

Whittaker, R. H. 1956. Vegetation of the Great Smoky Mountains. Ecol. Monogr. 26: 1–80.

Yamanaka, T. 1957. The forest vegetation of the Amami Islands with special reference to the *Shiia sieboldii* forest. Reports of the Usa Marine Biological Station 4(2): 1–14.

南九州，琉球，台湾の照葉樹林の種組成比較

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南九州，琉球，台湾の照葉樹林の種組成を，地理的位置と地形の両側面から比較をおこなうために，宮崎県北郷町，奄美大島金作原，徳之島三京，沖縄本島与那，西表島大富，および台湾北部の羅培山と坪林，台湾南部の南仁山の計8箇所に調査区を設置した．調査区は谷底から尾根までの斜面全体を含むように設置し，5 m×5 m の小方形区ごとに林床植物を含めた種組成を調べた．種組成には，調査地点間の地理的変化と一地点内での地形傾度に沿った変化の二つが認められ，それぞれ次のようなパターンが見い出された．地形傾度に沿った種の分布は，谷底に限られる種群，谷底から斜面中・下部に広がる種群，尾根から斜面上部に限られる種，尾根から斜面中・下部にまで広がる種群とに4大別することができた．分布が谷や斜面下部に偏る種にはシダ植物など草本が多く，斜面上部に偏る種には木本が多かった．谷から尾根の地形傾度に沿った種組成の変化は，これら種群の交代によって生じており，地点により出現する種は異なっていても，地形傾度上でのこのような種群交代とそれに伴う種組成の変化のパターンは基本的には各調査地に共通して認められた．一方，地理的にみると，日本本土，琉球，台湾という地理的な傾度に沿って，南ほど日本本土生の種が減ったり，島間の距離に対応した組成の類似が一部にみられるなどの漸変的な変化があった．しかし，類似度や共通種の分布，姉妹種の交代様式をみると，本土と琉球，琉球と台湾のそれぞれの間には種組成的なギャップが認められた．琉球は種組成的に日本本土よりも台湾の北部低地と類似性が高く，約1/3の種が共通していた．琉球相互では種組成の類似性が高く，半数から2/3の共通種がみられた．種の豊富さは，台湾で高く琉球で低下し宮崎でまたやや高まった．琉球と台湾低地との種組成上の類似に加え，種数は少ないが，台湾の山地と宮崎には重要な共通種が存在し，これらの地域の照葉樹林には，高温域（いわゆる亜熱帯）での種組成的なつながりと，より低温域（いわゆる暖温帯）での種組成的なつながりとがあることが明らかとなった．地形位置によって地域間の種組成の違いの現れ方に差がみられ，尾根的立地では台湾と日本（琉球を含めた）との間で違いが顕著に現われていたのに対し，谷的立地では台湾低地–琉球と台湾山地–宮崎との違いが顕者で，温度環境（上述の亜熱帯と暖温帯）の違いに対応した種組成の違いが大きく現れていた．

Appendix. A list of vascular plant occurring in the plots studied. Nomenclature basically follows *Wild flowers of Japan* (Satake *et al.*, 1981–1982, 1989) and *Ferns and fern allies of Japan* (Iwatsuki, 1992) for those distributed in Japan, and *Flora of Taiwan, 2nd. ed.* (Editorial Committee of the Flora of Taiwan, 2nd. ed., 1993–1996) if available, otherwise *1st. ed.* (Editorial Committee of the Flora of Taiwan, 1975–1979) for others. Occurrences of the species in the plot are presented by the plot name abbreviated as follows; N, Nanjenshan; P, Pinglin; L, Lopeishan; I, Iriomote; O, Okinawa; T, Tokunoshima; A, Amami; M, Miyazaki. Synonyms are presented after=. Main literature is abbreviated as follows; FT, *Flora of Taiwan* (*1st. ed.*); FT2, *Flora of Taiwan* (*2nd. ed.*); WFJ, *Wild flowers of Japan*; FFAJ, *Ferns and fern allies of Japan.*

	plot	remarks
PTERIDOPHYTA		
Psilotaceae		
Psilotum nudum (L.) Beauv.	N · · · · · · M	
Lycopodiaceae		
Lycopodium hamiltonii Spr.	· P · · · · · ·	=*L. fordii* in FT2
Lycopodium serratum Thunb. var. *longipetiolatum* Spring.	· P L · · · · M	
Selaginellaceae		
Selaginella delicatula (Desv.) Alston	· P L · · · · ·	
Selaginella doederleinii Hieron.	N P L I O T A ·	
Selaginella involvens (Sw.) Spring	· · · · · · · M	
Selaginella remotifolia Spring	· · · · · · · M	
Marattiaceae		
Angiopteris lygodiifolia Rosenst.	N P L I O T A ·	
Plagiogyriaceae		
Plagiogyria adnata (Bl.) Bedd.	· P L · · · A M	=*P. rankanensis* in FT2
Plagiogyria euphlebia (Kunze) Mett.	· · L · · · · M	
Plagiogyria japonica Nakai	· · · · · · · M	
Plagiogyria stenoptera (Hance) Diels	· · L · · · · ·	
Gleicheniaceae		
Dicranopteris linearis (Burm.fil.) Underw.	· P · · · · · ·	
Gleichenia japonica Spr.	· · · · · · · M	=*Diplopterygium glaucum* in FT2
Hymenophyllaceae		
Cephalomanes javanicum (Bl.) van der Bosch var. *asplenioides* (C.Chr.) K.Iwats.	N · · · · · · ·	=*C. laciniatum* in FT2
Cephalomanes obscurum (Bl.) K.Iwats.	N P · I O · A ·	=*Selenodesmium obscurum* in FT2
Cephalomanes thysanostomum (Makino) K.Iwats.	N · · · · · · ·	=*Nesopteris thysanostoma* in FT2
Crepidomanes auriculatum (Bl.) K.Iwats.	N P L · · T A M	=*Vandenboschia auriculata* in FT2
Crepidomanes birmanicum (Bedd.) K.Iwats.	N · · I · · · M	
Crepidomanes latealatum (v.d.B.) Copel.	· · · · · · · M	
Crepidomanes minutum (Bl.) K.Iwats.	· · L · · · · M	=*Gonocormus minutus* in FT2
Crepidomanes radicans (Sw.) K.Iwats. var. *naseanum* (Christ) K.Iwats.	· P · · · · · ·	=*Vandenboschia radicans* in FT2
Hymenophyllum badium Hook. et Grev.	· · L · · · · ·	=*Mecodium badium* in FT2
Hymenophyllum barbatum (v.d.B.) Baker	· · L · · · · ·	
Hymenophyllum oligosorum Makino	· · L · · · · ·	=*Mecodium oligosorum* in FT2
Hymenophyllum polyanthos (Sw.) Sw.	· · L · · · · ·	=*Mecodium polyanthos* in FT2
Hymenophyllum riukiuense Christ	· · · · · · A M	
Meringium holochilum (v.d.Bosch) Copel.	· · L · · · · ·	
Cyatheaceae		
Cyathea hancockii Copel.	· · · · · · A ·	
Cyathea lepifera (J.Sm. ex Hook.) Copel.	N · · · · · · ·	

Cyathea metteniana (Hance) C.Chr. et Tard.	· P · I · TA ·	
Cyathea podophylla (Hook.) Copel.	NP · I OT · ·	
Cyathea spinulosa Wall. ex Hook.	· P · I · · · ·	
Dicksoniaceae		
Cibotium barometz (L.) J.Sm.	· · · · O · · ·	
Dennstaedtiaceae		
Microlepia marginata (Panzer) C.Chr.	· · · · · · · M	
Microlepia obtusiloba Hayata	· PL · · · · ·	
Monachosorum henryi Chist	· · L · · · · ·	
Lindsaeaceae		
Lindsaea chienii Ching	· PL I OTAM	
Lindsaea javanensis Blume	· P · · · · · ·	=*L.orbiculata* var. *deltoidea* in FT2
Lindsaea lucida Blume	· · · I · · · ·	
Lindsaea merrillii Copel. ssp. *yaeyamensis* Kramer	N · · I · · · ·	
Lindsaea obtusa J.Smith	· P · · · · · ·	Kramer (1971)
Lindsaea orbiculata (Lam.) Mett. ex Kuhn var. *commixta* (Tagawa) Kramer	N · · I · T · ·	
Tapeinidium pinnatum (Cav.) C.Chr.	N · · · · · · ·	
Davalliaceae		
Davallia mariesii Moore ex Baker	· PL · · · · M	
Davallia solida (Forst.) Sw.	N · · · · · · ·	
Parkeriaceae		
Coniogramme intermedia Hieron.	· · L · · · · ·	
Vittariaceae		
Vittaria ensiformis Sw.	N · · · · · · ·	=*V. anguste-elongata* in FT2
Vittaria flexuosa Fee	· · · · · · · M	
Vittaria zosterifolia Willd.	· P · · · · · ·	
Pteridaceae		
Pteris bella Tagawa	· · L · · · · ·	
Pteris cadieri Christ	NP · · · · · ·	
Pteris dispar Kunze	· · · I · · · M	
Pteris excelsa Gaud.	· · · · · · · M	
Pteris fauriei Hieron.	· · · · O · · ·	
Pteris grevilleana Wall. ex Ag.	N · · · · · · ·	
Pteris laurisilvicola Kurata	· · · · · · · M	
Pteris tokioi Masamune	· · L · · · · ·	
Aspleniaceae		
Asplenium apoganum Murakami et Hatanaka	· P · · · · · ·	
Asplenium australasicum (J.Sm.) Hook.	· · · I · · · ·	
Asplenium cheilosorum Kunze ex Mett.	· P · · · · · ·	
Asplenium excisum Presl	· P · · · · · ·	
Asplenium filipes Copel.	· · L · · · · ·	
Asplenium nidus L.	NPL · OT · ·	
Asplenium normale D.Don	· · L · · · · ·	
Asplenium wilfordii Mett. ex Kuhn	· · L · · T · M	
Asplenium wrightii Eaton ex Hook.	· · · · · · · M	
Blechnaceae		
Blechnum orientale L.	NP · I OTA ·	

Lomariopsidaceae

Bolbitis appendiculata (Willd.) K.Iwats.	N P · · · · A ·	
Bolbitis subcordata (Copel.) Ching	· P · I O T A ·	

Dryopteridaceae

Acrophorus nodosus Presl	· · L · · · · ·	=*A. stipellatus* in FT2
Arachniodes dimorphophylla (Hayata) Ching	· · · · O · · ·	
Arachniodes rhomboides (Wall. ex Presl) Ching	· P L · · · · M	Nakaike(1992) =*A. amabilis* in FFAJ
Arachniodes sporadosora (Kunze) Nakaike	· P L I · T A M	=*A. pseudo-aristata* in FT2
Arachniodes yakusimensis (H.Ito) Nakaike	· · · · · · A ·	Nakaike (1992) =*A.amabilis* var.*amabilis* in FFAJ
Ctenitis subglandulosa (Hance) Ching	· P L · O T A ·	
Dryopteris commixta Tagawa	· · · · · · · M	
Dryopteris erythrosora (Eaton) O.Ktze.	· · · · · · · M	
Dryopteris formosana (Christ) C.Chr.	· · L · · · · ·	
Dryopteris fuscipes C.Chr.	· · · · · · · M	
Dryopteris hendersonii (Bedd.) C.Chr.	· · L · · · · ·	
Dryopteris koidzumiana Tagawa	· · · · · T A ·	
Dryopteris sordidipes Tagawa	N P · I O T A ·	
Dryopteris sparsa (Hamilt. ex D.Don) O.Ktze	N P L · · T · M	
Hemigramma decurrens (Hook.) Copel.	N · · · · · · ·	
Pleocnemia cumingiana Plesl	N P · · · · · ·	
Polystichum tagawanum Kurata	· · · · · · · M	
Tectaria decurens (Pr.) Copel.	N · · · · · · ·	
Tectaria kusukusensis (Hayata) Lelling	· P · · · · · ·	=*Ctenitopsis kusukusensis* in FT2
Tectaria phaeocaulis (Rosenst.) C.Chr.	· P · · · · · ·	

Thelypteridaceae

Stegnogramme griffithii (Moore) K.Iwats. var. *wilfordii* (Hook.) K.Iwats.	· P L · · · · ·	=*Dictyocline griffithii* var. *wilfordii* in FT2
Stegnogramme pozoi (Lagasca) K.Iwats. ssp. *mollissima* (Fischer ex Kunze) K.Iwats.	· · · · · · · M	
Thelypteris cystopteroides (Eaton) Ching	· · · · · T A ·	
Thelypteris glanduligera (Kunze) Ching	· P · · · · · M	=*Parathelypteris glanduligera* in FT2
Thelypteris liukiuensis (Christ ex Matsm.) K.Iwats.	N · · I · · · ·	=*Pronephrium cuspidatum* in FT2
Thelypteris parasitica (L.) Fosberg	· · · I · T · ·	=*Cyclosorus parasticus* in FT2
Thelypteris taiwanensis (C.Chr.) K.Iwats.	N P · · O T · ·	=*Cyclosorus taiwanensis* in FT2
Thelypteris triphylla (Sw.) K.Iwats.	N P · I · T · ·	=*Pronephrium triphyllum* in FT2
Thelypteris uraiensis (Ros.) Ching	· · L · · · · ·	

Woodsiaceae

Athyrium arisanensis (Hayata) Tagawa	· · L · · · · ·	
Athyrium otophorum (Miq.) Koidz.	· · · · · · · M	
Athyrium silvicola Tagawa	· · L · · · · ·	
Cornopteris opaca (D.Don) Tagawa	· · L · · · · ·	
Deparia petersenii (Kunze) M.Kato	· P L I O · · ·	
Diplazium dilatatum Blume	N P L · O T A ·	
Diplazium doederleinii (Luerss.) Makino	· P L · · T · ·	
Diplazium donianum (Mett.) Tard.	N P · I O T · ·	
var. *aphanoneuron* (Ohwi) Tagawa	· P · · · · · ·	
Diplazium hachijoense Nakai	· · · · · · A ·	
Diplazium heterophlebium (Mett. ex Bak.) Diels	· P L · · · · ·	=*D. formosanum* in FT2
Diplazium incomptum Tagawa	· · · I · · A ·	
Diplazium kawakamii Hayata	· · L · · · · ·	
Diplazium lobatum (Tagawa) Tagawa	N · · · · · · ·	

Diplazium mettenianum (Miq.) C.Chr.	· P L · · T · M	
Diplazium petri Tard.	· · L · · · A ·	
Diplazium pullingeri (Bak.) J.Smith	· · L · · · A ·	
Diplazium sp.	· · L · · · · ·	
Diplazium subsinuatum (Wall. ex Hook. et Grev.) Tagawa	· · L I O T A M	
Diplazium wichurae (Mett.) Diels	· · · · · · · M	
Cheiropleuriaceae		
Cheiropleuria bicuspis (Bl.) Presl	· P · I O T A M	
Polypodiaceae		
Aglaomorpha meyeniana Schott.	· P · · · · · ·	
Colysis pothifolia (Hamilt. ex D.Don) Presl	· · · · · · · M	
Colysis wrightii (Hook.) Ching	· P · · · T · ·	
Lemmaphyllum microphyllum Presl	· P L · · · · M	
var. *obovatum* (Harr.) C.Chr.	· · · I O T A ·	
Lepisorus monilisorus (Hayata) Tagawa	· · L · · · · ·	
Lepisorus thunbergianus (Kaulf.) Ching	· · · · · T · M	
Loxogramme salicifolia (Makino) Makino	· · · · · · · M	
Microsorium buergerianum (Miq.) Ching	· P L I O · · M	
Microsorium dilatatum (Bedd.) Sledge	· P · · · · · ·	
Microsorium fortunei (Moore) Ching	· · L · · · · ·	
Polypodium formosanum Baker	· P · · · · · ·	
Pyrrosia lingua (Thunb.) Farw.	· · · · · · · M	
Pyrrosia sheareri (Bak.) Ching	· · L · · · · ·	
SPERMATOPHYTA		
GYMNOSPERMAE		
Pinaceae		
Abies firma Sieb. et Zucc.	· · · · · · · M	
Podocarpaceae		
Podocarpus fasciculus de Laubenfels	N · · · · · · ·	
Podocarpus macrophyllus (Thunb.) D.Don	· · · I O · A M	
Podocarpus nagi (Thunb.) Zoll. et Moritz.	N · · · · T A ·	=*Nageia nagi* in FT2
Cephalotaxaceae		
Cephalotaxus harringtonia (Knight) K.Koch	· · · · · · · M	
ANGIOSPERMAE		
DICOTYLEDONEAE		
ARCHICHLAMYDEAE		
Myricaceae		
Myrica rubra Sieb. et Zucc.	· · L I O T A ·	
Juglandaceae		
Engelhardtia roxburghiana Wall.	N P · · · · · ·	
Fagaceae		
Castanopsis carlesii (Hemsl.) Hayata	N · · · · · · ·	=*C. cuspidata* var. *carlesii* in FT2
var. *sessilis* Nakai	· P L · · · · ·	=*C. cuspidata* var. *carlesii* f. sessilis in FT2
Castanopsis cuspidata (Thunb. ex Murray) Schottky	· · · · · · · M	
Castanopsis fabri Hance	N · · · · · · ·	
Castanopsis sieboldii (Makino) Hatusima ex Yamazaki et Mashiba	· · · · · · · M	
ssp. *lutchuensis* (Koidz.) H.Ohba	· · · I O T A ·	
Lithocarpus amygdalifolius (Skan ex Forbes et Hemsl.) Hayata	N · · · · · · ·	

Lithocarpus edulis (Makino) Nakai	· · · · · · · M	
Pasania harlandii (Hance) Oerst.	N · · · · · · ·	
Quercus gilva Blume	· P · · · · · M	=*Cyclobalanopsis gilva* in FT2
Quercus glauca Thunb. ex Murray	· · · · · · · M	=*Cyclobalanopsis glauca* in FT2
Quercus hondae Makino	· · · · · · · M	
Quercus longinux Hayata	N P L · · · · ·	=*Cyclobalanopsis longinux* in FT2
Quercus miyagii Koidz.	· · · I O T · ·	
Quercus pachyloma O.Seem.	N · · · · · · ·	=*Cyclobalanopsis pachyloma* in FT2
Quercus salicina Blume	· · · · · · A M	=*Cyclobalanopsis salicina* in FT2
Quercus sessilifolia Blume	· · L · · · · M	=*Cyclobalanopsis sessilifolia* in FT2
Moraceae		
Ficus ampelas Burmann fil.	· · · · O · · ·	
Ficus aurantiaca Griff.		
var. *parvifolia* (Corner) Corner	N · · · · · · ·	
Ficus bengutensis Merrill	N P · I O · · ·	=*F. fistulosa* in FT2
Ficus erecta Thunb.	· · · I O T A M	
var. *beecheyana* (Hook. et Arn.) King	· · L · · · · ·	
Ficus formosana Maxim.	N P L · · · · ·	
Ficus nervosa Heyne ex Roth.	· P · · · · · ·	
Ficus nipponica Franch. et Savat.	· P L I O · · M	=*F. sarmentosa* var. *nipponica* in FT2
Ficus ruficaulis Merr.		
var. *antaoenesis* (Hayata) Hatusima & Liao	N · · · · · · ·	
Ficus thunbergii Maxim.	· · · · · · A M	
Ficus variegata Blume		
var. *garciae* (Elm.) Corner	N · · · · · · ·	
Ficus virgata Reinw. ex Blume	· · · I · · · ·	
Morus australis Poir.	· · · · · · · M	
Urticaceae		
Boehmeria spicata (Thunb.) Thunb.	· · · · · · · M	
Elatostema lineolatum Wight		
var. *majus* Wedd.	N P L · · · · ·	
Elatostema parvum (Blume) Miq.	· · L · · · · ·	
Elatostema umbellatum Blume	· · · · · · · M	
Pellionia arisanensis Hayata	· P L · · · · ·	=*P. radicans* in FT2
Pellionia minima Makino	· · · · · · · M	
Pellionia radicans (Sieb. et Zucc.) Wedd.	· · · · · · · M	
Pilea aquarum Dunn		
ssp. *brevicornuta* (Hayata) C.J.Chen	· P L · O · · ·	
Proteaceae		
Helicia cochinchinensis Lour.	· · L I · · · M	
Helicia formosana Hemsl.	N P · · · · · ·	
Balanophoraceae		
Balanophora laxiflora Hemsl.	· · L · · · · ·	
Polygonaceae		
Antenoron filiforme (Thunb.) Roberty et Vautier	· · · · · · · M	
Magnoliaceae		
Magnolia kachirachirai (Kanehira et Yamamoto) Dandy	N · · · · · · ·	
Michelia compressa (Maxim.) Sargent	N P L I O · · ·	
Annonaceae		
Fissistigma glaucescens (Hance) Merr.	N · · · · · · ·	
Fissistigma oldhamii (Hemsl.) Merr.	N P · · · · · ·	

Schisandraceae		
Kadsura japonica (Thunb.) Dunal	N P L I O T A M	
Illiciaceae		
Illicium anisatum L.	· · · · O · A ·	
var. tashiroi (Maxim.) Walker	· · · I · · · ·	=*I. tashiroi* in FT2
Illicium arborescens Hayata	N · L · · · · ·	
Lauraceae		
Beilschmiedia erythrophloia Hayata	N · · · · · · ·	
Beilschmiedia tsangii Merr.	N · · · · · · ·	
Cinnamomum brevipedunculatum C.E.Chang	N · · · · · · ·	
Cinnamomum doederleinii Engler	· · · I O T A ·	
Cinnamomum japonicum Sieb. et Zucc.	· · · · O T · M	=*C. tenuifolium* f. *nervosum* in FT2
Cinnamomum okinawense Hatusima	· · · · · T · ·	
Cinnamomum subavenium Miq.	· · L · · · · ·	
Cryptocarya chinensis (Hance) Hemsl.	N P · · · · · ·	
Lindera communis Hemsl.	· P · · · · · ·	
Litsea acuminata (Bl.) Kurata	· P L · O T · M	
Litsea acutivena Hayata	N · · · · · · ·	
Litsea coreana Leveille	· · · · · · · M	
Machilus japonica Sieb. et Zucc.	· · · I O T A M	
Machilus kusanoi Hayata	N P · · · · · ·	=*M. japonica* var. *kusanoi* in FT2
Machilus obovatifolia (Hayata) Kanehira et Sasaki	N · · · · · · ·	
Machilus thunbergii Sieb. et Zucc.	N P L I O T A M	
Machilus zuihoensis Hayata	N P L · · · · ·	
Neolitsea aciculata (Bl.) Koidz.	· · · I O T A ·	
var. *variabillima* (Hayata) J.C.Liao	· · L · · · · ·	
Neolitsea hiiranensis Liu et Liao	N · · · · · · ·	
Neolitsea sericea (Bl.) Koidz.	· · · · · T · M	
Trochodendraceae		
Trochodendron aralioides Sieb. et Zucc.	· P L · · · · ·	
Ranunculaceae		
Clematis henryi Oliv.	· P · · · · · ·	
Berberidaceae		
Dysosma pleiantha (Hance) Woodson	· · L · · · · ·	
Lardizabalaceae		
Stauntonia hexaphylla (Thunb.) Decaisne	N P L · · · · M	
Menispermaceae		
Pericampylus formosanus Diels	· P · · · · · ·	
Stephania japonica (Thunb.) Miers	N · · · O · · ·	
Piperaceae		
Piper betle L.	N · · · · · · ·	
Piper kadzura (Chois.) Ohwi	N P L I · T A M	
Piper sintenense Hatusima	N P · · · · · ·	
Chloranthaceae		
Sarcandra glabra (Thunb.) Nakai	N P L I · T A M	
Aristolochiaceae		
Aristolochia liukiuensis Hatusima	· · · · · T · ·	=*A. kaempferi* in FT2

Asarum macranthum Hook.	· P L · · · · ·	
Heterotropa fudsinoi (T.Ito) F.Maek.	· · · · · · A ·	
Heterotropa lutchuensis (T.Ito) Honda	· · · · · · A ·	
Heterotropa hexaloba (F.Maek.) F.Maek. var. *perfecta* F.Maek	· · · · · · · M	
Rafflesiaceae		
Mitrastemon yamamotoi Makino	· · · · · · A ·	
Actinidiaceae		
Actinidia polygama (Sieb. et Zucc.) Planch	· · · · · · · M	
Actinidia rufa (Sieb. et Zucc.) Planch ex Miq.	· · · · O T · ·	
Saurauia tristyla DC.	N P · I · · · ·	=*S.tristyla* var. *oldhamii* in FT2
Theaceae		
Adinandra formosana Hayata	N P L · · · · ·	
Adinandra ryukyuensis Masamune	· · · · O · · ·	
Adinandra yaeyamensis Ohwi	· · · I · · · ·	
Camellia brevistyla (Hayata) Coh.-Stuart	· · L · · · · ·	
Camellia japonica L.	· · · · O T A M	
Camellia lutchuensis T.Ito ex Matsumura	· · · I O · · ·	
Camellia sasanqua Thunb.	· · · I O T A M	
Cleyera japonica Thunb.	· · · I O T A M	
var. *morii* (Yamamoto) Masamune	· · L · · · · ·	
Eurya chinensis Brown	· P L · · · · ·	
Eurya emarginata (Thunb.) Makino	· · · · · · A ·	
Eurya japonica Thunb.	N · · I O T A M	
Eurya leptophylla Hayata	· · L · · · · ·	
Eurya loquaiana Dunn	· P L · · · · ·	
Eurya nitida Korthals var. *nanjenshanensis* Hsieh, Ling & Yang	N · · · · · · ·	
Eurya osimensis Masamune	· · · I · T A ·	
Eurya sakishimensis Hatusima	· · · I · · · ·	
Gordonia axillaris (Roxb.) Dietr.	· P · · · · · ·	
Pyrenaria shinkoensis (Hayata) Keng	· P L · · · · ·	
Schima wallichii (DC.) Korthals	· · · · O · A ·	=*S. superba* in FT2
Ternstroemia gymnanthera (Wright et Arn.) Beddome	N · L I O T A M	
Tutcheria virgata (Koidz.) Nakai	· · · I O · · ·	
Guttiferae		
Garcinia multiflora Champ.	N · · · · · · ·	
Capparidaceae		
Capparis sikkimensis Kurz ssp. *formosana* (Hemsl.) Jacobs	N · · · · · · ·	
Hamamelidaceae		
Distylium racemosum Sieb. et Zucc.	· · · I O T A M	
Crassulaceae		
Sedum subtile Miq.	· · · · · · · M	
Saxifragaceae		
Hydrangea angustipetala Hayata	· · L · · · · ·	
Hydrangea liukiuensis Nakai	· · · · O · · ·	
Hydrangea luteo-venosa Koidz.	· · · · · · · M	
Hydrangea yaeyamensis Koidz.	· · · I · · · ·	
Itea oldhamii Schneider	· P · · · · A ·	

Itea parviflora Hemsl.	・・L・・・・・	
Pileostegia viburnoides Hook.fil. et Thoms.	・PLIO・A・	
Platycrater arguta Sieb. et Zucc.	・・・・・・・M	
Schizophragma hydrangeoides Sieb. et Zucc.	・・・・・・・M	
Schizophragma integrifolium Oliv. var. *fauriei* (Hayata) Hayata	・・L・・・・・	
Pittosporaceae		
Pittosporum tobira (Thunb. ex Murray) Aiton	・・・・・T・・	
Rosaceae		
Duchesnea chrysantha (Zoll. et Mor.) Miq.	・・・・・・・M	
Malus doumeri (Bois.) Chev.	・・L・・・・・	
Photinia wrightiana Maxim.	・・・・・T・・	
Pourthiaea beauverdiana (Schneider) Hatusima var. *notabilis* (Rehder et Wilson) Hatusima	・・L・・・・・	
Prunus campanulata Maxim.	・・L・・・・・	
Prunus pendula Maxim.	・・・・・・・M	
Prunus phaeosticta (Hance) Maxim.	NPL・・・・・	
Prunus spinulosa Sieb. et Zucc.	・・・・・・・M	
Prunus zippeliana Miq.	・・・・・・A・	
Rhaphiolepis indica (L.) Lindl. ex Ker. var. *umbellata* (Thunb. ex Murry) Ohashi	・・・IOTA・	
Rubus buergeri Miq.	・・L・・・・M	
Rubus palmatus Thunb.	・・・・・・・M	
Rubus pyrifolius J.E.Sm.	・P・・・・・・	
Rubus corchorifolius L.f.	・・L・・・・・	
Rubus sieboldii Blume	・・・・・T・M	
Leguminosae		
Archidendron lucidum (Benth.) I.Nielsen	・・・I・・・・	
Desmodium laxum DC. ssp. *leptopus* (A.Gray ex Benth.) Ohashi	NP・IOT・・	
Dumasia truncata Sieb. et Zucc.	・・・・・・・M	
Millettia japonica (Sieb. et Zucc.) A.Gray	・・・・・・・M	
Mucuna macrocarpa Wall.	・・・・O・・・	
Wisteria floribunda (Willd.) DC.	・・・・・・・M	
Euphorbiaceae		
Antidesma hiiranense Hayata	N・・・・・・・	
Antidesma japonicum Sieb. et Zucc.	・・・IOTA・	
var. *densiflorum* Hurusawa	・P・・・・・・	
Bridelia balansae Tutcher	N・・I・・・・	
Glochidion acuminatum Muell.Arg.	・P・・・TA・	
Glochidion lanceolatum Hayata	N・・・・・・・	=*G. zeylanicum* var. *lanceolatum* in FT2
Glochidion obovatum Sieb. et Zucc.	・・・I・・・・	
Glochidion rubrum Blume	NP・I・・・・	
Glochidion zeylanicum (Gaertn.) A.Juss.	N・・I・T・・	
Mallotus japonicus (Thunb.) Muell.Arg.	・・・・・T・M	
Mallotus paniculatus (Lam.) Muell.Arg.	・P・・・・・・	
Phyllanthus flexuosus (Sieb. et Zucc.) Muell.	・・・・・・・M	
Sapium japonicum (Sieb. et Zucc.) Pax. et K.Hoffm.	・・・・・T・M	
Daphniphyllaceae		
Daphniphyllum macropodum Miq.	・・・・・・・M	=*D. himalaense* ssp. *macropodum* in FT2

Daphniphyllum teijsmannii Zoll. ex Kurz	N P L I O T A M	=*D. glaucescens* ssp. *oldhamii* in FT2
Rutaceae		
Melicope semecarpifolia (Merr.) T.Hartley	N · · · · · · ·	
Glycosmis citrifolia (Willd.) Lindley	N · · · · · · ·	
Skimmia japonica Thunb.	· · · · · · · M	
var. *lutchuensis* (Nakai) Hatusima	· · · · O · · ·	
Skimmia reevesiana Fortune	· · L · · · · ·	
Zanthoxylum scandens Blume	· · · · O · · ·	
Zanthoxylum nitidum (Roxb.) DC.	N · · · · · · ·	
Anacardiaceae		
Rhus succedanea L.	· · · I O T A M	
Aceraceae		
Acer kawakamii Koidz.	· · L · · · · ·	
Acer palmatum Thunb.	· · · · · · · M	
Acer serrulatum Hayata	· · L · · · · ·	
Sapindaceae		
Sapindus mukurossi Gaerttn.	· · · · · · · M	
Sabiaceae		
Meliosma oldhamii Miq. ex Maxim.	· · · · O T · ·	=*M. rhoifolia* in FT2
Meliosma rigida Sieb. et Zucc.	· P · · O T · M	
Meliosma squamulata Hance	· P L · O T · ·	
Sabia swinhoei Hemsl.	· P L · · · · ·	
Aquifoliaceae		
Ilex asprella (Hook. et Arn.) Champ.	· · L · · · · ·	
Ilex buergeri Miq.	· · · · · · · M	
Ilex cochinchinensis (Lour.) Loes.	N · · · · · · ·	
Ilex ficoidea Hemsl.	· P L · · · · ·	
Ilex formosana Maxim.	· P L · · · · ·	
Ilex goshiensis Hayata	· · L I O T A M	
Ilex integra Thunb.	· · · · O · A M	
Ilex latifolia Thunb.	· · · · · · · M	
Ilex liukiuensis Loes.	N P L I O T A ·	=*I. uraiensis* in FT2
Ilex lonicerifolia Hayata	· · L · · · · ·	
var. *matsudai* Yamamoto	N · · · · · · ·	
Ilex maximowicziana Loes.	N · · I · · · ·	
var. *kanehirae* (Yamamoto) Yamazaki	· · · · O T A ·	
Ilex pubescens Hook. et Arn.	· P · · · · · ·	
Ilex rotunda Thunb.	· · L I · · · M	
Ilex warburgii Loes.	· · · I O T A ·	
Celastraceae		
Celastrus orbiculatus Thunb.	· · · · · · · M	
Celastrus paniculatus Willd.	N · · · · · · ·	
Celastrus punctatus Thunb.	· · L · · · · ·	
Euonymus tanakae Maxim.	· · L · · · · ·	=*E. carnosus* in FT2
Euonymus lutchuensis T.Ito	· · · I · · · ·	
Euonymus tashiroi Maxim.	N · · · O · · ·	
Microtropis japonica (Franch. et Savat.) H.Hallier	N · · I O T A M	
Staphyleaceae		
Turpinia formosana Nakai	· P · · · · · ·	
Turpinia ternata Nakai	N · · · O T · ·	

Rhamnaceae

Berchemia formosana Schneider	· · L · · · · ·	
Berchemia racemosa Sieb. et Zucc.		
f. *stenosperma* Hatusima	· · · · O · · ·	
Ventilago elegans Hemsl.	N · · · · · · ·	

Vitaceae

Ampelopsis cantoniensis (Hook. et Arn.) Planch.	· P L · · · · ·	
Cayratia tenuifolia (Heyne) Gagnep.	· P · · · · · ·	Hatusima (1975)
Parthenocissus tricuspidata (Sieb. et Zucc.) Planch.	· · · · · · · M	
Tetrastigma formosanum (Hemsl.) Gagnep.	· · L · · · · ·	

Elaeocarpaceae

Elaeocarpus japonicus Sieb. et Zucc.	· P L I O T A M	
Elaeocarpus sylvestris (Lour.) Poir.	N P · · · · · ·	
var. *ellipticus* (Thunb.) Hara	· · · I O T A ·	
Sloanea formosana Li	N P · · · · · ·	

Thymelaeaceae

Daphne kiusiana Miq.	· · · · · · · M	
var. *atrocaulis* (Rehder) Maekawa	· · L · · · · ·	

Elaeagnaceae

Elaeagnus glabra Thunb.	· · · I · · · M	
Elaeagnus thunbergii Serv.	N · L · O T · ·	

Violaceae

Viola formosana Hayata	· · L · · · · ·	
Viola nagasawai Makino et Hayata	· · L · · · · ·	

Begoniaceae

Begonia aptera Blume	· P · · · · · ·	

Cucurbitaceae

Diplocyclos palmatus (L.) C.Jeffrey	· · · · O · · ·	
Gynostemma pentaphyllum (Thunb.) Makino	· · · · · · · M	
Trichosanthes rosthornii Harms	· · L · · · · ·	
Trichosanthes multiloba Miq.	· · · · · · · M	

Lythraceae

Lagerstroemia subcostata Koehne	· P · · · · · ·	

Myrtaceae

Decaspermum gracilentum (Hance) Merr. et Perry	N · · · · · · ·	
Syzygium buxifolium Hook. et Arn.	· P L I O T A M	
Syzygium densinervium Merr.		
var. *insulare* Chang	N · · · · · · ·	
Syzygium euphlebium (Hayata) Mori	N · · · · · · ·	
Syzygium kusukusense (Hayata) Mori	N · · · · · · ·	

Melastomataceae

Astronia formosana Kanehira	N · · · · · · ·	
Blastus cochinchinensis Lour.	· P · · · · A ·	
Bredia hirsuta Bl.	· · · · O · · ·	
Bredia okinawensis (Matsumura) Li	· · · · O · · ·	
Medinilla formosana Hayata	N · · · · · · ·	

Melastoma candidum D.Don	N · · · · · · ·	
Sarcopyramis napalensis Wall. var. *delicata* (C.B.Robinson) S.F.Huang et T.C.Huang	· P L · · · · ·	
Cornaceae		
Aucuba chinensis Benth.	N · · · · · · ·	
Aucuba japonica Thunb.	· · L · · T · M	
Benthamidia japonica (Sieb. et Zucc.) Hara var. *chinensis* (Osborn) Hara	· · L · · · · ·	
Swida controversa (Hemsl.) Sojak	· · · · · · · M	
Araliaceae		
Dendropanax dentiger (Harms ex Diels) Merr.	· · L · · · · ·	
Dendropanax trifidus (Thunb.) Makino	· · · I O T A M	
Fatsia japonica (Thunb.) Decne. et Planch.	· · · · · · · M	
var. *liukiuensis* Hatusima	· · · · O · · ·	
Fatsia polycarpa Hayata	· · L · · · · ·	
Hedera rhombea (Miq.) Bean	· · · · · · · M	
var. *formosana* (Nakai) Li	· · L · · · · ·	
Schefflera arboricola (Hayata) Kanehira	N · · · · · · ·	
Schefflera octophylla (Lour.) Harms	N P · I O T A ·	
Umbelliferae		
Sanicula lamelligera Hance	· · L · · · · ·	
METACHLAMYDEAE		
Pyrolaceae		
Monotropastrum humile (D.Don) Hara	· · · · · T · ·	
Ericaceae		
Pieris japonica (Thunb.) D.Don	· · · · · · · M	
Rhododendron latoucheae Franch.	· · L · · · · ·	=*R. ellipticum* in FT
Rhododendron simsii Planch.	· · · I · · · ·	
Rhododendron tashiroi Maxim.	· · · · O T A ·	
Vaccinium wrightii A.Gray	· · · I O T A ·	
Myrsinaceae		
Ardisia brevicaulis Diels	· · L · · · · ·	
Ardisia chinensis Benth.	· P · · · · · ·	
Ardisia cornudentata Mez	N · · · · · · ·	
Ardisia crenata Sims	· · · I O T A M	
Ardisia japonica (Thunb.) Blume	· · · · · · · M	
Ardisia kusukusensis	N · · · · · · ·	
Ardisia pusilla DC.	· · · I O T A M	
Ardisia quinquegona Blume	N P L I O T A ·	
Ardisia sieboldii Miq.	N P · I O T A ·	
Ardisia virens Kurz	· · L · · · · ·	
Maesa japonica (Thunb.) Moritzi	· · L · · · · M	
Maesa tenera Mez	· · · · O T · ·	
Myrsine seguinii Lev.	· P L I O T A M	
Primulaceae		
Lysimachia aridisioides Masamune	· · L · · · · ·	
Ebenaceae		
Diospyros eriantha Champ. et Benth.	N P L · · · · ·	
Diospyros ferra (Willd.) Bakh. var. *buxifolia* (Rottb.) Bakh.	· · · I · · · ·	

Diospyros japonica Sieb. et Zucc.	· · · · O · · M	
Diospyros morrisiana Hance	· P L · O · A M	
Diospyros oldhamii Maxim.	· · · I · · · ·	
Styracaceae		
Styrax japonicus Sieb. et Zucc.	· · · I O T A M	
Styrax suberifolia Hook.	· P · · · · · ·	
Symplocaceae		
Symplocos caudata Wall. ex DC.	· P L I · · · ·	=*S. sumuntia* in FT
Symplocos cochinchinensis (Lour.) Moore	· · · I · T · ·	
Symplocos confusa Brand	· · L · · · A ·	=*S. pendula* var. *hirtystylis* in FT
Symplocos glauca (Thunb.) Koidz.	· P L I O T A M	
Symplocos glomerata King ex Clarke var. *congesta* (Benth.) Noot.	N · · · · · · ·	
Symplocos lancifolia Sieb. et Zucc.	· · · · · · · M	
Symplocos lucida Sieb. et Zucc.	· P · · · · · ·	
Symplocos microcalyx Hayata	· · · · · T A ·	
Symplocos nakaharae (Hayata) Masamune	· · · I · · · ·	
Symplocos okinawensis Matsumura	· · · · O · · ·	
Symplocos prunifolia Sieb. et Zucc.	· · · I O T A M	
Symplocos shilanensis Liu et Lu	N · L · · · · ·	
Symplocos stellaris Brand	· · · · O · · ·	
Symplocos theophrastiifolia Sieb. et Zucc.	· P L · · · · M	
Symplocos wikstroemifolia Hayata	· · L · · · · ·	
Symplocos ?theophrastiifolia	N · · · · · · ·	different from *Symplocos theophrastiifolia*
Oleaceae		
Ligustrum japonicum Thunb.	· · · · · · · M	
Ligustrum sp.	· · L · · · · ·	
Osmanthus heterophyllus (G.Don) Green	· · L · · · · ·	
Osmanthus marginatus (Champ. ex Benth.) Hemsl.	N · · I O · · ·	
Osmanthus matsumuranus Hayata	· · L · · · · ·	
Loganiaceae		
Gardneria shimadai Hayata	· · L · · · · ·	
Strychnos henryi Merr. et Yamamoto ex Yamamoto	N · · · · · · ·	
Gentianaceae		
Tripterospermum taiwanense (Masamune) Satake	· · L · · · · ·	
Apocynaceae		
Anodendron affine (Hook. et Arn.) Druce	N P · I O T A M	
Ecdysanthera utilis Hayata et Kawakami	· P · · · · · ·	
Trachelospermum asiaticum (Sieb. et Zucc.) Nakai	· · · · · · · M	
Trachelospermum gracilipes Hook.fil.	N · · · · · · ·	
var. *liukiuense* (Hatusima) Kitamura	· · · I · T A ·	
Trachelospermum jasminoides (Lindl.) Lemaire	· P L · · · · ·	
var. *pubescens* Makino	· · L · O T A ·	
Asclepiadaceae		
Cynanchum liukiuense Warb.	· · · I · · · ·	
Hoya carnosa (L.fil.) R.Br.	· · · I O T A ·	
Marsdenia sp.	· P · · · · · ·	
Tylophora japonica Miq.	· · · I O T A ·	

Tylophora taiwanensis	· P · · · · · ·	
Rubiaceae		
Adina pilulifera (Lam.) Franch.	· · · · · · · M	
Argostemma solaniflorum Elmer	· · · I · · · ·	
Coptosapelta diffusa (Champ. ex Benth.) Steen.	N P L I O T · ·	
Damnacanthus angustifolius Hayata	· · L · · · · ·	
Damnacanthus biflorus (Rehde) Masamune	· · · · O T A ·	
Damnacanthus indicus Gaertn.fil.	· P L · · T · M	
f. *microphylla* Makino	· · · · · · A ·	
ssp. *major* (Sieb. et Zucc.) Yamazaki	· · · · O · · M	
Gardenia jasminoides Ellis	· · · I O T A ·	
Lasianthus bunzanensis Simizu	N P · · · · · ·	
Lasianthus chinensis Benth.	N · · · · · · ·	
Lasianthus curtisii King et Gamble	N P · I O T A ·	
Lasianthus cyanocarpus Jack	N · · I O · · ·	
Lasianthus fordii Hance	N P L I O T A ·	
var. *pubescens* (Matsumura) Yamazaki	· · · · · T · ·	=*L. formosensis* in FT
Lasianthus hiiranensis Hayata	N · · · · · · ·	
Lasianthus japonicus Miq.	· · L · · · · M	
Lasianthus obliquinervis Merr.	N · · I · · · ·	
Lasianthus wallichii Wight	N P · I O T · ·	=*L. plagiophyllus* in FT
Lithosantes biflora Blume	N · · · · · · ·	
Morinda umbellata L.	· P L I · T A ·	
Mussaenda parviflora Miq.	N P · I · T · ·	
Ophiorrhiza japonica Blume	N P L I O · · M	
Ophiorrhiza pumila Champ.	· · · · · T A ·	
Paederia scandens (Lour.) Merr.	· · · · · · · M	
Psychotria rubra (Lour.) Poir.	N P · I O T A ·	
Psychotria serpens L.	N P · I O T A ·	
Randia canthioides Champ. ex Benth.	· · · I O T A ·	
Randia cochinchinensis (Lour.) Merr.	· P · · · · · M	
Tarenna gracilipes (Hayata) Ohwi	· · · I O T · ·	
Tarenna ?gracilipes	N · · · · · · ·	different from *Tarenna gracilipes*
Tricalysia dubia (Lindl.) Ohwi	N P L I O T A ·	
Uncaria rynchophylla (Miq.) Miq.	· · · · · · · M	
Wendlandia formosana Cowan	N P · I O T A ·	
Convolvulaceae		
Erycibe henryi Prain	· P · · · T · ·	
Boraginaceae		
Ehretia dicksonii Hance	· · · · · · · M	
Verbenaceae		
Callicarpa japonica Thunb. var. *luxurians* Rehder	· · · I O · · ·	
Callicarpa mollis Sieb. et Zucc.	· · · · · · · M	
Callicarpa randaiensis Hayata	· · L · · · · ·	
Callicarpa remotiflora Lin et Wang	N · · · · · · ·	
Callicarpa remotiserrulata Hayata	N · · · · · · ·	
Clerodendron trichitomum Thunb.	· · · · · · · M	
Labiatae		
Perillula reptans Maxim.	· · · · · · · M	
Salvia nipponica Miq. var. *formosana* (Hayata) Kudo	· · L · · · · ·	
Salvia ranzaniana Makino	· · · · · · · M	

Scutellaria indica L.	· · · · · · · M	
Solanaceae		
Solanum lysimachioides Wall.	· · L · · · · ·	
Acanthaceae		
Codonacanthus pauciflorus (Nees) Nees	N P · I O T · ·	
Goldfusia formosana (Moore) Hsieh et Huang	· · L · · · · ·	
Parachampionella rankanensis (Hayata) Bremek.	· · L · · · · ·	
Staurogyne concinnula (Hance) O.Kuntze	· P · · · · · ·	
Strobilanthes cusia (Nees) O.Kuntze	· P · · · · · ·	=*Baphicacanthus cusia* in FT
Gesneriaceae		
Aeschynanthus acuminatus Wall.	· P · · · · · ·	
Hemiboea bicornuta (Hayata) Ohwi	· P L · · · · ·	
Rhynchotechum discolor (Maxim.) Burtt	N P · I · T · ·	
Caprifoliaceae		
Lonicera hypoglauca Miq.	· · · · · · · M	
Lonicera japonica Thunb.	· · · · · · · M	
Sambucus racemosa L. ssp. *sieboldiana* (Miq.) Hara	· · · · · · · M	
Viburnum integrifolium Hayata	· · L · · · · ·	
Viburnum japonicum (Thunb.) Sprengel	· · · · O · · ·	
Viburnum odoratissimum Ker-Gawler var. *awabuki* (K.Koch) Zabel	· · · · · · A M	
Viburnum tashiroi Nakai?	· · · · · · A ·	
Compositae		
Adenostemma lavenia (L.) O.Kuntze	· · · · · · · M	
Ainsliaea apiculata Sch.Bip.	· · · · · · · M	
Carpesium faberi Winkler	· · · · · · · M	=*C. hosokawae* in FT
Crassocephalum crepidioides (Benth.) Moore	· · · · · · · M	
Farfugium japonicum (L.fil.) Kitam.	· · · · O · · ·	
Vernonia andersonii Clarke var. *albipappa* Hayata	N P · · · · · ·	
MONOCOTYLEDONEAE		
Liliaceae		
Disporum sessile Don var. *micranthum* Hatusima	· · · · · T A ·	
Heloniopsis acutifolia Hayata	· · L · · · · ·	
Liriope sp.	N · · · · · · ·	
Ophiopogon sp.	N · L · · · · ·	
Smilax bracteata Presl.	· P L · · T A ·	
Smilax china L.	· · · · · · · M	
Smilax china L. var. *okinawensis* Sakaguchi	· · · I O · · ·	
Smilax hayatae T.Koyama	· · L · · · · ·	
Smilax lanceifolia Roxb.	N P L · · · · ·	
Smilax nervo-marginata Hayata	· · · · O T A ·	
Stemonaceae		
Croomia japonica Miq.	· · · · · T A ·	
Hypoxidaceae		
Curculigo capitulata (Lour.) O.Kuntze	N P · · · · · ·	

Dioscoreaceae		
Dioscorea cirrhosa Lour.	· P · · · · · ·	=*D. matsudai* in FT
Dioscorea japonica Thunb.	· · · · · · · M	
var. *oldhamii* Uline ex Knuth	N P · · · · · ·	
Graminae		
Isachne kunthiana (Wight et Arn.) Nees	· · · I · · · ·	
Lophatherum gracile Brongn.	N P · I O T · M	
Oplismenus compositus (L.) Beauv.		
var. *patens* (Honda) Ohwi	N · · I O · · ·	
Oplismenus undulatifolius (Arduino) Roemer et Schultes	N · L · · · · M	
Pleioblastus linearis (Hack.) Nakai	· · · · O · · ·	
Schizostachyum diffusum (Blanco) Merr.	N · · · · · · ·	
Yushania niitakayamensis (Hayata) Keng	· · L · · · · ·	
Palmae		
Arenga engleri Beccari	· P · I · · · ·	
Calamus formosanus Beccari	N · · · · · · ·	
Daemonoropus margaritae (Hance) Becc.	N P · · · · · ·	
Araceae		
Alocasia odora (Lodd.)Spach	· P · I O T · ·	=*A. macrorrhiza* in FT
Arisaema grapsospadix Hayata	N · · · · · · ·	
Arisaema tashiroi Kitam.	· · · · · · · M	
Pothos chinensis (Raf.) Merr.	N P · · · · · ·	
Pandanaceae		
Freycinetia formosana Hemsl.	N · · I · · · ·	
Cyperaceae		
Carex breviscapa C.B.Clarke	· · · I · · · ·	
Carex morii Hayata	· · L · · · · ·	
Carex sociata Boott?	· P L · · · · ·	
Carex sp.	N · · I O · · ·	
Scleria terrestris (L.) Fass.	N · · · · · · ·	
Zingiberaceae		
Alpinia intermedia Gagnep.	N P L I O T A ·	
Alpinia japonica (Thunb.) Miq.	· P L · · · · M	
Alpinia pricei Hayata	N · · · · · · ·	
Zingiber kawagoii Hayata	N · · · · · · ·	
Orchidaceae		
Acanthephippium striatum Lindl.	· P · · · · · ·	Lin (1987), =*A. unguiculatum* in FT
Bulbophyllum japonicum (Makino) Makino	· · · · · · · M	
Calanthe reflexa Maxim.	· · L · · · · ·	
Calanthe densiflora Lindl.	· · L · · · · ·	
Calanthe discolor Lindl.		
var. *divaricatipetala* Ida	· · · · · T · ·	
Calanthe formosana Rolfe	N P · · · · · ·	
Calanthe gracilis Lindl.		
var. *venusta* (Schltr.) F.Maek.	N P · · O · A ·	=*Cephalantheropsis gracilis* in FT
Calanthe sp.	· · · · O T · ·	
Calanthe triplicata (Willem.) Ames?	N P L I · · · ·	
Collabium formosanum Hayata	· · L · · · · ·	
Cryptostylis arachnitis (Blu,e) Hassk.	· P · · · · · ·	
Cymbidium goeringii (Reichb.fil.) Reichb.fil.	· · · · · · · M	
Cymbidium lancifolium Hook.	· P · · · · A M	

Eria ovata Lindl.	N · · · · · · ·	
Gastrochilus formosanus (Hayata) Hayata	· · L · · · · ·	
Goodyera foliosa (Lindl.) Benth.	· · L · · · · ·	
Goodyera hachijoensis Yatabe var. *matusmurana* (Schltr.) Ohwi	· · L · · · · ·	=*G.matsumurana* in FT
Goodyera sp.	· P · · · · · ·	
Goodyera velutina Maxim.	· P L · · · · M	
Habenaria longitentaculata Hayata	N P · · · · · ·	
Habenaria polytricha Rolfe	· · · · O · · ·	
Hetaeria cristata Blume ?	· · · · O · A ·	
Lacanorchis sp.	· · · · · T · ·	
Liparis bootanensis Griff.	· P · · · · · ·	Lin (1988), =*L. plicata* in FT & WFJ
Liparis caespitosa (Thou.) Lindl.	· · L · · · · ·	Lin (1988), =*L. laurisilvatica* in FT
Liparis formosana Reichb.fil.	· · · · · T · ·	
Liparis nervosa (Thunb.) Lindl.	· · · · · · · M	
Liparis nigra Seidenf.	N P · · · · · ·	
Listera japonica Blume	· · · · · T A ·	
Malaxis bancanoides Ames	· · · I · · · ·	
Malaxis roohutuensis (Fuk.) S.S.Ying	N · · · · · · ·	Lin (1988)
Oberonia sp.	· P · · · · · ·	
Orchidaceae sp.	N · L · O · · M	
Tainia laxiflora Makino	· · · · · · A ·	
Tainia shimadai Hayata	· · L · · · · ·	
Thrixspermum pricei (Rolfe) Schltr.	· · · · · · A ·	
Tropidia angulosa Blume	N P · · · · · ·	