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Phytosociological Studies on the Beech (*Fagus multinervis* Nakai) Forest and the Pine (*Pinus parviflora* S. et Z.) Forest of Ulreung Island, Korea

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韓國 鬱陵島의 너도밤나무(*Fagus multinervis* Nakai)林 및 섬잣나무(*Pinus parviflora* S. et Z.)林의 植物社會學的 硏究

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ABSTRACT

The montane forests of Ulreung Island, Korea, were investigated by the ZM school method. By comparing the montane forests of this island with those of Korean Peninsula and of Japan, a new order, Fagetalia multinervis, a new alliance, Fagion multinervis, a new association, Hepatico-Fagetum multinervis and *Rhododendron brachycarpum-Pinus parviflora* community were recognized. The Hepatico-Fagetum multinervis was further subdivided into four subassociations; Subass. of *Sasa kurilensis*, Subass. of *Rumohra standishii*, Subass. of *Rhododendron brachycarpum* and Subass. of typicum. Each community was described in terms of floristic, structural and environmental features.

INTRODUCTION

Beeches (*Fagus*) are important dominant species in mesic climax forest of the North Temperate Zone. In the Northern Hermisphere, there are about 12 species (taxonomic treatment varies) in the genus *Fagus* (Yim, 1983). Three species of them are distributed in the Far East Asia. Two species, *Fagus crenata* and *Fagus japonica*, are distributed in Japan and the other, *Fagus multinervis*, is distributed in Ulreung Island, Korea. The Japanese beeches are considerably well-known, but the Korean beech is almost unknown to the world. Pines (*Pinus*) are also dominant species in xerophytic forest which develops on rocky ridges or steep slopes of the montane zone of the Northern Hemisphere. *Pinus parviflora* is distributed on the steep slopes of this island. There are no papers which report the vegetation of this

island from the phytosociological viewpoint, except for a general description about the forest zones by Nakai(1919), Park(1972) and Yim, *et al.* (1980), and about the flora by Nakai (1919), Yang(1956), Lee and Joo(1958) and Oh(1978).

The purpose of this paper is to decide the phytosociological position of the *Fagus multinervis* forest in the Far East Asia. To determine the position of the beech forest of Korea, the surveys on the montane forests of Ulreung Island by the ZM school method, and on the profile of soil, and comparison of the montane forests of Korean Peninsula with those of Japan were carried out. In addition, this study was carried out as a part of the study program of regeneration process of the *Fagus multinervis* forest.

DESCRIPTION OF THE STUDY AREA

Location and topography. Ulreung Island is a Quaternary strato-volcano (Machida *et al.*, 1984) situated in the East Sea (Sea of Japan), 130 km off the eastern coast of the Korean Peninsula (130° 47′ 35″ to 130° 55′ 23″ E.L. and 37° 27′ 16″ to 37° 33′ 02″ N.L.) and measures 12 km by 10 km, covering an area of about 73 sq. km. The visible portion of this island is not very large (983.6 m in height above sea level, Mt. Seongin-bong), but cone rises from the sea floor at the depth of about 2,200 m, having the longest basal diameter of about 30 km (Harumoto, 1970). Though this island has been considerably dissected, it presents conspicuous topographic features of a volcano having remarkable flank caldera with a longer diameter of 3.5 km and an intra-caldera lava dome. This island is pentagonal in shape, and it is characterized by the existence of thick virgin beech forest around the slope of caldera. As those forests are situated on a steep cliff which make difficult of human approach, and so those virgin forests have been preserved with the shape of ancient times.

The beech forest extends from about 400 m to summit of Mt. Seongin-bong. At the lower limit, it abuts on a warm temperate broad-leaved evergreen forest zone dominated by *Camellia japonica*, and *Machilus thunbergii* etc., but this forest zone is almost destroyed by land uses such as cultivation, plantation, cutting for firewood production and grazing.

The greater part of the montane forests are dominated by *Fagus multinervis*, *Acer takesimense*, *Acer okamotoanum* and *Sorbus commixta*. On the aretê (sharp ridge), there is coniferous forest dominated by *Pinus parviflora* and *Tsuga sieboldii*. About 40 endemic species grow on this island.

The present study was made in various places in the montane forests of this island. The localities and topography are indicated in Fig. 1.

Climate and soil. Though the climatic data of this island are very scanty, those for Todong, located 4 km southeast of Mt. Seongin-bong, 221 m above sea level are available. Fig. 2 shows the climatic diagram (Yim and Kim, 1983) and the water balance diagram (Yim and Kira, 1975) of Ulreung Island. The climatic type of this island is characterized by heavy

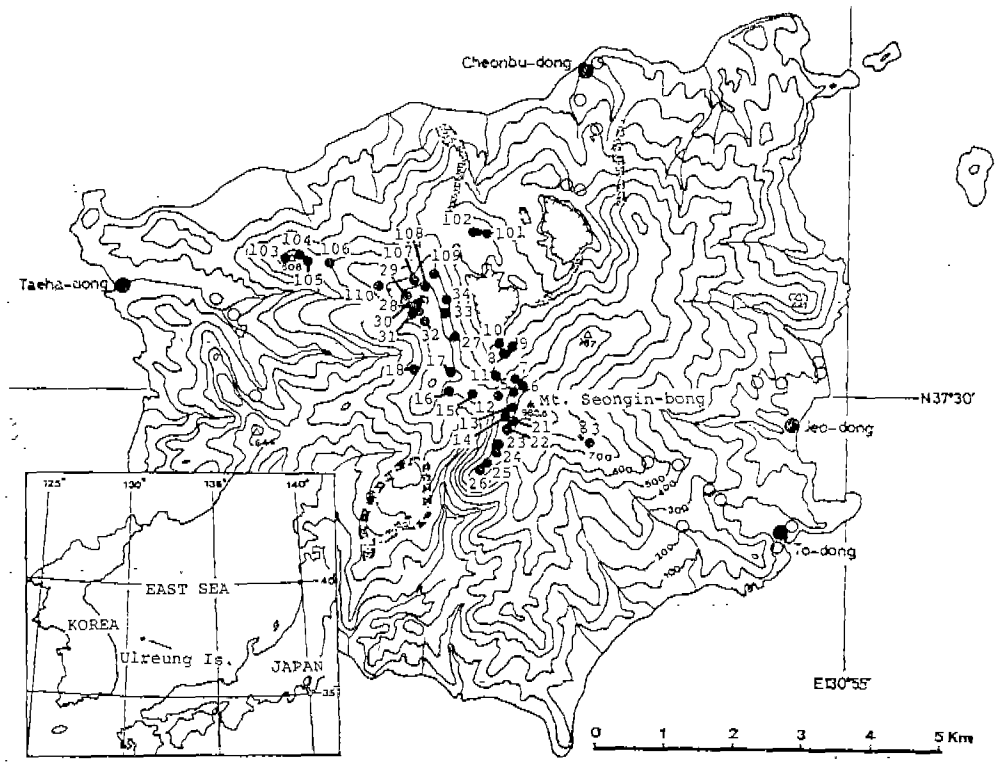

Fig. 1. Topography of Ulreung Island and location of sample sites. The numerals in the map represent the relevé number in Table 1, 2 (opened circle; sample sites of reference relevé).

snowfall in winter, due to the cold winds blowing across the East Sea (Sea of Japan) from the Asian Continent. Mean annual temperature is 12.0°C, and this is higher than that of the same latitude of the Korean Peninsula, Seoul (11.1°C) and Hoengseong (10.7°C),

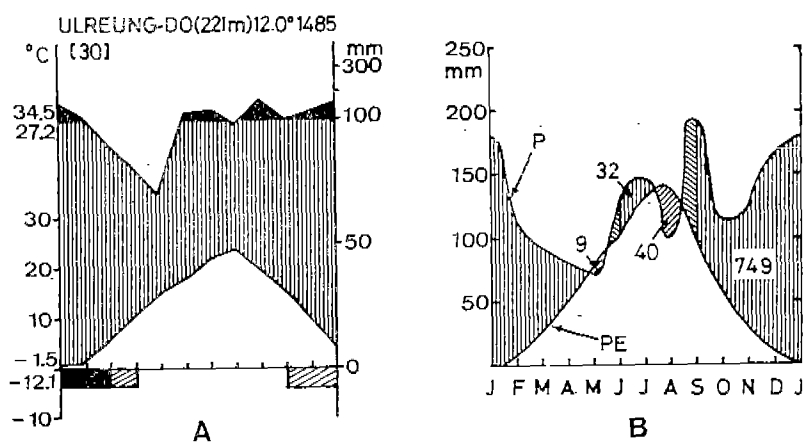

Fig. 2. Climatic diagram (A) and water balance diagram (B) of Todong (P: precipitation, PE: potential evapotranspiration).

because this island is under the influence of the Currents. Since the intersection of two Currents, the warm Tsushima Current and the cold Liman Current, is laid around the island, the mountainside of the island has frequent fogs. There are only 49 days of fine weather in a year.

Mean annual precipitation is 1,485 mm and the Thornthwaite's *Im* Index is 110.9. The precipitation of this island is higher in winter (mostly as snow, which often exceeds an overall depth of 2 m) than that of in growing-period of plants. Snowfall of this island is greater than any other area of Korean Peninsula, and it has a significant effect on the physiognomy, the distribution of the *Fagus multinervis* forest and the tree shape, since it protects the floor plants from freezing and affects soil formation.

As mentioned above, these features of climate make a mild and dampish weather on Ulreung Island, and make possible to grow and maintain the beech forest in this island.

The soil of the study area is characterized by the volcanic ejecta such as trachyte ash, pumice and lapilli, and a deep humic layer (A1 and A2 layers), which is generally about 15~25 cm deep in the beech forest soil, and a deep row humus layer (H layer of A0 layer) in the pine forest soil which is about 5~15 cm.

METHODS

The field survey was carried out according to the method of Braun-Blanquet(1964) in July-October, 1985. In the natural forests of the montane zone of Ulreung Island, twenty-four stands of the beech forest, fifteen stands of the pine forest were surveyed. In addition, total twenty stands in the secondary forests of the montane zone and of the evergreen broad-leaved zone were surveyed as the reference relevés for the comparison of the flora between the montane zone and the evergreen broad-leaved zone. The community data obtained were classified by the table comparison method. And lastly, to decide the upper vegetational units of the montane forests of this island, these community data were compared with those of Korean Peninsula (Kim, unpublished) and of Japan (Suzuki, 1952, 1966; Miyawaki *et al.*, 1964; Sasaki, 1970; Miyawaki *et al.*, 1978).

The identification of plants was carried out in the field, but most of the plants were reidentified by Eui-Shik Jeon, Yong-No Lee and Woo-Tchul Lee with the specimens in the laboratory. Especially, the ferns and the genus *Viola* were reidentified at the Makino Herbarium, Tokyo Metropolitan University, Japan. And the voucher specimens of the ferns and the genus *Viola* are deposited in the Makino Herbarium.

RESULTS AND DISCUSSION

The results of the present phytosociological study of the montane vegetation of Ulreung Island, Korea, revealed that it is composed of a beech forest and a pine forest.

① **Beech forest.** The beech forest in the montane zone of this island was classified as a new association, Hepatico-Fagetum multinervis, of a new alliance, Fagion multinervis, and of a new order, Fagetalia multinervis.

a. Hepatico-Fagetum multinervis ass. nov. (Table 1)

Character species: *Fagus multinervis, Acer takesimense, Acer okamotoanum, Prunus takesimensis, Hepatica maxima, Tilia insularis.*

All the character species are endemic species of Ulreung Island. This association is physiognomically characterized by the dominance of *Fagus multinervis*, which has many stump sprouts and big crown in the tree layer (Fig. 3). Especially, *Fagus multinervis* is one of the species which reproduces both by seed and by the production of sprouts from root collars (Kim, unpublished), as like as the case in American beech, *Fagus grandfolia* (Ward, 1961; Forcier, 1973).

Fig. 3. Physiognomy of *Fagus multinervis* forest. (Each stump of *Fagus multinervis* has many stump sprouts).

The tree species other than *Fagus multinervis* in the tree layer are *Acer takesimense, Acer okamotoanum, Prunus takesimensis, Tilia insularis, Sorbus commixta, Styrax obassia,* and *Cornus controversa,* etc.. Generally, these species have low cover value in canopy, but, in the tree-2 layer, they have high constancy and somewhat high cover value. The composition of the shrub layer is very simple. There are young trees and stump sprouts of the tall trees and some other shrubby trees such as *Ligustrum foliosum,* and *Rhododendron brachycarpum,* Cetc..over value of this layer is very low. The herb layer has more varied compositions and higher cover value than other layer. About twenty species of ferns are found and they are generally abundant in this layer. Ferns such as *Dryopteris crassirhizoma, Matteuccia orientalis, Polystichum retroso-paleaceum* var. *coraiense, Rumohra standishii, Adiantum pedatum* are constant. Sometimes *Rumohra standishii* makes an absolutely dominant stands in the lower part of slopes. In the forbs, there are some constant species, such as *Maianthemum dilatatum, Hepatica maxima, Viola takesimense, Viola hondoensis, Viola selkirkii,* and *Viola kusanoana,* etc.. *Smilax riparia* var. *asiatica, Diosporum sessile, Solidago vigra-aurea* var. *asiatica,* and *Phryma leptostachya* var. *asiatica* are often found. Typically, sedges and grasses are rare. *Sasa kurilensis* generally makes small patches on the gentle slopes and ridges.

Topography and elevation as environmental gradients have long been used to the determination of vegetation types in mountainous regions. This association, Hepatico-Fagetum multinervis, of Ulreung Island, is subdivided into several lower units depending on the topography and the composition of the species.

a-1. Subass. of *Sasa kurilensis*

Differential species: *Sasa kurilensis.*

This subassociation occurs as patches on the gentle slopes or the gentle ridges, and is differentiated from the other subassociations by the significant dominance of *Sasa kurilensis. Sasa kurilensis* which is typically tall (above about 1.5m) and thick, generally prevails in the upper herb layer. Herbaceous species, such as *Hydrangea petiolaris*, *Hepatica maxima*, *Arisaema amurense* var. *serratum*, and *Smilax riparia* var. *ussuriensis* are frequently found in the herb layer, but the cover value of these species are very low. Ferns with high constancy are *Polystichum restroso-paleaceum* var. *coraiense* and *Dryopteris crassirhizoma.* Among these species, *Hepatica maxima* and *Polystichum restroso-paleaceum* var. *coraiense* have relatively high constancy. This suggests that these species have a higher shade-tolerance than the other species.

a-2. Subass. of *Rumohra standishii*

Differential species: *Rumohra standishii*, *Ulmus laciniata*, *Cornus controversa*, *Gynostemma pentaphyllum.*

This subassociation occurs as patches along the small streams or on the lower part of slopes and somewhat moist places of slopes. It differs from another subassociations in the dominance of *Rumohra standishii* in the herb layer and in the relatively poor in number of species of shrub layer. There are some hygrophilous species, such as *Ulmus laciniata* and *Cornus controversa.* The other species which are frequently found than *Rumohra standishii* in the herb layer are *Gynostemma pentaphyllum*, *Hepatica maxima*, *Hydrangea petiolaris*, *Arisaema amurense* var. *serratum*, *Maianthemum dilatatum*, *Disporum sessile*, *Asperula odorata*, *Lilium hansonii* and *Smilax riparia* var. *ussuriensis.* Ferns with high constancy are *Dryopteris crassirhizoma*, *Athyrium brevifrons* var. *angustifron* and *Polystichum retroso-paleaceum* var. *coraiense.*

a-3. Subass. of typicum

This subassociation occupies a large part of the montane zone of the island and differentiated from the other subassociations by the significant presence of *Maianthemum dilatatum*, *Hepatica maxima*, *Matteuccia orientalis*, *Allium victorialis* var. *platyphyllum* and *Viola takeshimana.* The composition of the herb layer is the most varied and abundant. High constancy species other than the above mentioned are *Hydrangea petiolaris*, *Smilax riparia* var. *ussuriensis*, *Asperula odorata Phryma leptostachya* var. *asiatica*, *Solidago vigra-aurea* var. *asiatica*, *Pyrola japonica*, *Viola selkirkii*, *Aster glehni*, *Astilbe koreana*, *Dystaenia takeshimana*, *Saussurea grandifolia* and *Tiarella polyphylla.* Ferns are about 14 species in the herb layer. Among the ferns, *Dryopteris crassirhizoma*, *D. bissetiana*, *Adianthum pedatum*,

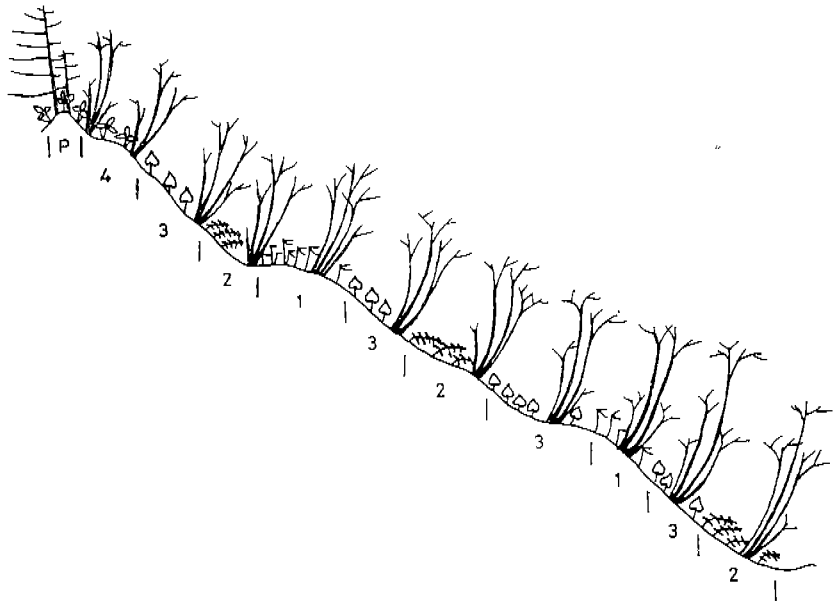

Fig. 4. Distribution of each subassociation of the beech forest on the northern slope of Mt. Seongin-bong.
Pine forest: P
Beech forest: 1. Subass. of *Sasa kurilensis*, 2. Subass. of *Rumohra standishii*, 3. Subass. of typicum, 4. Subass of *Rhododendron brachycarpum*.

Osmunda japonica, *Botrychium multifidum* var. *robustum*, and *Polystichum retroso-paleaceum* var. *coraiense* are constantly found. Most of these herb species are also often found in the somewhat open places of understory of the other subassociations. This fact enables to suggest that this subassociation is the basic type of the beech forest of Korea. The decline of distributed sites of each subassociation is as follow. Generally, on the base of typical subassociation, Subass. of *Rumohra standishii* occupies as patches on the somewhat moist sites such as the lower part of slopes, Subass. of *Rhododendron brachycarpum* occupies as narrow patches on somewhat xeric sites such as the narrow ridges or the upper part of slopes, and Subass. of *Sasa kurilensis* occupies as patches on the gentle slopes or the gentle ridges (Fig. 4). However, no significant difference is found in the soil profiles between the subassociations.

a-4. Subass. of *Rhododendron brachycarpum*

Differential species: *Rhododendron brachycarpum*, *Tsuga sieboldii*.

The subassociation occurs as narrow patches along the ridges of the upper part of slopes. It differs from the previous subassociations in the dominance of *Rhododendron brachycarpum* in the shrub layer and in the presence of somewhat xeric ferns such as *Polystichopsis miqueriana* and *Athyrium conilii* in the herb layer. *Styrax obassia*, *Sorbus commixta*, *Tsuga sieboldii* and *Taxus cuspidata* are often mixed with *Rhododendron brachycarpum* in the shrub

layer. These species are also component species of pine forest of this island. This fact suggests that this subassociation occurs as a transitional type between the beech forest and the pine forest. *Hepatica maxima*, *Smilax riparia* var. *ussuriensis*, *Maianthemum dilatatum*, *Solidago vigra-aurea* var. *asiatica* and *Schizophragma hydrangeoides* are constantly found in the herb layer. Ferns with high constancy are *Dryopteris crassirhizoma*, *Polystichopsis miqueriana* and *Athyrium conilii*.

b. Fagion multinervis all. nov.

Character species: the same as the association, Hepatico-Fagetum multinervis.

The phytosociological classification of the beech forest of Japan was made by several phytosociologists (Miyawaki, *et al.*, 1964; Suzuki, 1966; Sasaki, 1970,). In the phytosociological terms, these community types were first described by Suzuki as different associations, but later, both Sasaki and Miyawaki *et al.* raised them to the level of different alliances. Although their nomenclatures are somewhat different from each other, they agree that the beech forests of Japan are classified into two alliances, Saso kurilensis-Fagion crenatae in the East Sea (Sea of Japan) side of Honshu and Sasamorpho-Fagion crenatae in the Pacific Ocean side of Honshu, Shikoku and Kyushu. The beech forest of Japan is generally characterized best by the dense growths of *Sasa* spp. (*Sasa kurililensis* in the East Sea side and *Sasamophora purpurascens* or *Sasa nipponica* in the Pacific Ocean side). And further they are characterized by more or less constant complement of evergreen shrub species, such as *Aucuba japonica*, *A. japonica* var. *borealis*, *Daphniphyllum macropodum* var. *humile*, *Camellia rusticana*, and *Ilex leucoclada*. Especially, the beech forest of the Pacific Ocean side contains *Fagus japonica* in the tree layer, but this species occurs only in the lower part of the montane zone.

The Fagion multinervis has some species common to the montane forests of the Korean Peninsula and of Japan in spite of the remote geographical distance, but there are obvious difference in their floristic composition. Except for *Sorbus commixta*, *Styrax obassia* and *Cornus controversa*, all the main tree species, such as *Fagus multinervis*, *Acer takesimense*, *Acer okamotoanum*, *Tilia insularis*, and *Prunus takesimensis*, are endemic species of this island. And the above mentioned character species of the beech forest of Japan are not distributed in this island. Therefore, the beech forest of this island is described here as a new alliance.

c. Fagetalia multinervis ord. nov.

Character species: the same as the alliance, Fagion multinervis.

This order is characterized by the dominance of *Fagus multinervis* which is associated with the other character species as mentioned above. The *Fagus multinervis* forest is developed as a mesic climax forest in the montance zone of Ulreung Island which has heavy snowfall due to the cold winds blowing across the East Sea from the Asian Continant in winter.

The montane broad-leaved deciduous forests of Japan are characterized by the tree layer

contains (apart from *Fagus crenata*) other tree species such as *Quercus mongolica* var. *grosseserrata*, *Magnolia obovata*, *Acer mono*, *Acer micranthum*, and *Tilia japonica*. The upper shrub layer is conspicuous, and consists principally of diciduous shrubs such as *Viburnum furcatum*, *Acer japonicum*, *Magnolia salicifolia*, *Hamamelis japonica* var. *obtusa*, *Rhododendron albrechti*, and *Lindera membranacea*. This beech forest is further characterized

Table 2. Vegetation table of *Rhododendron brachycarpum-Pinus parviflora* community on Ulreung Island, Korea

Serial number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Relevé number		23	24	25	26	27	28	29	30	31	32	101	102	103	104	105
Altitute (m)		760	740	730	760	740	900	800	870	850	840	600	590	570	600	590
Slope aspect		S	SE	SW	S	NW	NE	N	SE	SW	SE	SW	W	SE	NE	NE
Slope degree (°)		L	5	L	10	L	45	10	50	5	5	L	5	L	10	L
Quadrat size (m^2)		105	60	60	60	40	40	40	150	140	60	75	60	40	60	40
Height of tree-1 layer (m)		9	10	7	7	7	8	9	12	14	10	12	10	10	9	10
Coverage of tree-1 layer (%)		30	60	70	50	70	30	40	40	60	40	50	50	60	40	50
Height of tree-2 layer (m)		6	7	5	5	4	3	6	5	8	7	8	8	7	6	7
Coverage of tree-2 layer (%)		60	60	40	40	20	30	40	30	40	50	30	20	15	30	60
Height of shrub layer (m)		2	2.5	1.5	1	2	1.5	2	2	3	1	1	2.5	2	1.5	1.5
Coverage of shrub layer (%)		65	70	50	70	40	40	50	40	30	60	60	65	70	60	60
Height of herb layer (m)		0.3	0.3	0.3	0.3	0.5	0.5	0.5	1	1	0.5	0.4	0.5	0.5	0.3	0.5
Coverage of herb layer (%)		5	10	40	15	40	10	5	40	60	20	10	20	20	10	15
Number of species		15	20	14	12	18	13	16	14	16	18	15	15	17	12	15
Differential species of community																
Pinus parviflora	T1	2·2	3·2	3·2	3·3	2·1	2·2	3·1	3·2	3·2	3·2	3·2	3·2	3·2	2·1	3·3
	T2	·	1·1	·	1·1	·	1·1	·	·	2·1	·	·	·	1·1	·	·
	S	+	·	·	·	·	·	·	·	·	·	·	+	·	·	·
	H	+	+·2	+	·	·	+	+	+	·	·	+	+	·	+	+
Tsuga sieboldii	T1	·	·	2·1	·	·	1·2	2·1	1·1	2·1	1·1	·	·	1·1	·	·
	T2	1·1	1·1	1·1	1·2	2·2	+·2	2·2	1·2	·	1·1	1·1	1·2	·	2·2	2·2
	S	·	+	·	·	+·2	+·2	+·2	+·2	2·2	+·2	+	+	·	+·2	+·2
	H	+	+	+	·	+	·	+·2	+	·	+	+	+	·	·	·
Rhododendron brachycarpum	S	4·4	4·4	3·3	4·4	2·2	3·3	+·2	3·3	·	3·2	3·3	3·3	4·4	3·3	4·4
	H	+·2	+	+·2	+·2	3·3	+·2	3·3	·	3·3	·	·	+·2	+	+·2	+
Goodyera Maximowicziana	H	+·2	+·2	+·2	+·2	+	·	+	+·2	+	+·2	+·2	+·2	+	+	+·2
Polystichopsis miqueriana	H	+	1·2	+	+	+	+	+·2	+	+·2	+	+	+	+	+	
Mitchella undulata	H	·	+	+·2	·	·	·	+·1	+	+	+	+·2	+	·	+	
Differential species of upper units																
Sorbus commixta	T1	·	1·1	1·1	·	2·2	·	·	·	·	·	1·1	·	1·1	·	·
	T2	2·2	2·2	1·1	1·2	·	1·2	1·2	2·2	1·2	1·2	·	1·2	·	1·2	2·2
	S	·	+	·	+·2	+·2	+·2	+	1·2	1·2	·	+·2	+·2	+·2	+·2	·
	H	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·
Acer takesimense	T1	·	·	·	·	1·1	·	·	·	·	·	·	·	·	1·1	·
	T2	2·2	+·2	·	1·1	·	·	1·1	1·2	1·2	1·2	1·1	1·2	·	·	1·1
	S	+	·	+·2	+	+·2	+·2	+·2	·	+·2	+	·	+·2	+·2	+·2	+
	H	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·
Styrax obassia	T2	1·2	1·2	+·2	·	1·1	·	1·1	1·1	1·1	·	1·1	1·1	1·1	1·1	·
	S	+·2	·	+	·	+	+	+	·	+·2	·	+	·	+	·	+
	H	+	+	+	+	·	·	+	·	+	+	·	·	+·2	+	·
Schizophragma hydrangeoides	T2	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·
	S	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·
	H	+	+·2	+	1·2	·	+	+	1·2	+·2	+·2	+	·	·	+	+
Taxus cuspidata	T2	·	·	1·1	·	1·2	·	·	·	·	1·1	·	·	·	·	·
	S	·	1·2	1·1	·	+·2	·	2·2	·	2·2	+·2	1·1	+·2	+·2	·	·
	H	·	+	·	·	2·2	·	·	·	·	·	·	·	·	·	·
Hydrangea petiolaris	H	+	+·2	·	·	·	·	·	+	+·2	·	+·2	+	+·2	+	·
Pteridium aquilinum v. latiusculum	H	+	·	+	+	·	+	·	·	·	·	·	+	+	·	·
Poa takeshimana	H	·	·	·	·	+	·	+	·	+	+	·	·	·	·	·
Kalopanax pictus	T1	·	1·1	·	·	·	·	·	·	·	·	·	·	·	·	·
	T2	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·
	S	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·
Viburnum furcatum	S	·	+	·	·	·	·	·	·	·	·	·	·	+	·	·
	H	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·
Companions																
Solidago vigra-aurea v. asiatica	H	+·2	+·2	+	+	+·2	+	+	+·2	+	+·2	+	+·2	+	+	+·2
Athyrium yokoscense	H	·	+	+	·	+	·	+	+	+	+	+	+	·	+	+
Alnus maximowiczii	T1	·	·	·	·	2·2	·	·	·	·	·	·	·	·	·	·
	T2	2·2	·	·	·	·	+·2	·	·	1·2	1·1	·	·	·	·	·
	S	·	·	·	·	·	·	·	·	·	·	·	·	+·2	·	·
Polypodium vulgare	H	·	·	·	+	·	·	·	·	·	·	·	+	·	·	+
Athyrium conilii	H	·	·	·	·	+	·	·	·	·	+	+	·	·	·	·
Dryopteris erythrosora	H	·	·	·	·	·	+	+	·	·	·	·	·	·	·	·
Lycopodium chinese	H	·	+	·	·	·	·	·	·	·	·	·	·	·	·	+
Maianthemum dilatatum	H	·	+	·	·	+	·	·	·	·	·	·	·	·	·	·
Sedum takesimense	H	·	·	·	·	+	·	·	·	·	·	·	·	·	·	+
Tripterospermum japonicum	H	·	·	·	·	·	·	+	+	·	·	·	·	+	·	·
Ligustrum foliosum	S	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·
	H	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·

Rare species: *Polystichopsis mutica*(1:H-+), *Acer okamotoanum*(2:S-+.2), *Pyrola japonica*(2:H-+), *Botrychium multifidum v. robustum*(5:H-+), *Paqus multinervis*(7:T2-1.1), *Carex sp.*(7:H-+), *Tilia insularis*(10:T2-1.1)

Date of survey: Relevé No.23-32 ; July 30 - Aug. 16, 1985; Relevé No. 101-105 ; Oct. 14 - Oct. 20, 1985.

by its constant complement of evergreen shrub species and *Sasa* species as mentioned above. The above mentioned two alliances, Saso kurilensis-Fagion crenatae and Sasamorpho-Fagion crenatae, belong to an order, Saso-Fagetalia crenatae.

The montane forests of the Korean Peninsula are characterized by the oak-maple forest, which contains *Quercus mongolica*, *Acer pseudo-sieboldianum*, *Acer truncatum*, and *Tilia amurensis*, in the tree layer, and having a deciduous azalea, *Rhododendron schlippenbachii* in the shrub layer. Beeches are completely absent in the Korean Peninsula. By Kim(unpublished), the montane forests of the Korean Peninsular were discribed as a new order, Acero-Quercetalia mongolicae, which has a new alliance, Rhododendro-Quercion mongolicae which has three associations and some communities.

The *Fagus multinervis* forest has corresponding species to the *Fagus crenata* forest of Japan and to the *Quercus mongolica* forest of the Korean Peninsula, such as character species in the canopy tree layer. Therefore, the montane forests of this island are discribed here as a new order, Fagetalia multinervis, as a corresponding order to Saso-Fagetalia crenatae of Japan and to Acero-Quercetalia mongolicae of the Korean Peninsula.

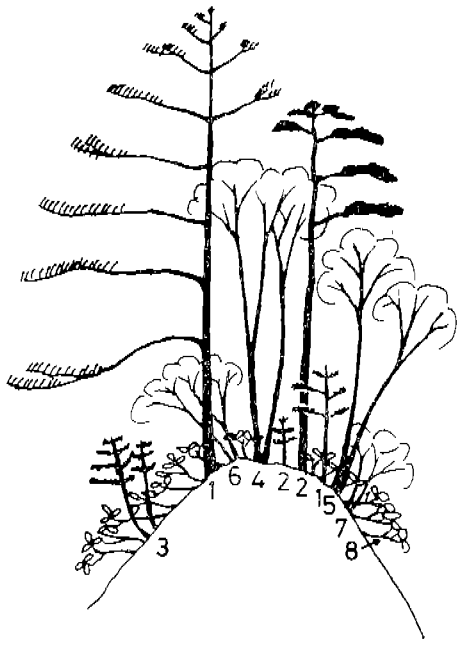

Fig. 5. Vegetational stratification of *Rhododendron brachycarpum-Pinus parviflora* community in relevé No. 32.
1; *Pinus parviflora* 2; *Tsuga sieboldii* 3; *Taxus cuspidata* 4; *Acer takesimense* 5; *Sorbus commixta* 6; *Alnus maximowiczii* 7; *Styrax obassia* 8; *Rhododendron brachycarpum*.

② **Pine forest** (Table 2, Fig. 5). On rocky ridges or steep slopes in the montane zone are found xerophytic forests which consist generally of *Pinus parviflora* and *Tsuga siebeldii*. This pine forest is classified as *Rhododendron brachycarpum-Pinus parviflora* community.

Differential species: *Pinus parviflora*, *Rhododendron brachycarpum*, *Tsuga sieboldii*, *Goodyera schlechtendaliana*, *Mitchella undulata*, *Polystichopsis miqueriana*.

The community is developed mainly on the steep ridges of Mt. Mireug, Mt. Al-bong and Mt. Cho-bong and also occurs on the narrow ridges near the Mt. Seongin-bong. As developed along the steep ridges, the shape of community is very narrow and long, and sometimes there are exposed rocks. Soils of the community are somewhat xeric and have a comparatively deep raw humus layer.

The tree species other than *Pinus parviflora* in the tree layer are *Tsuga sieboldii, Sorbus commixta, Acer takesimense, Styrax obassia* and *Alnus maximowiczii*. Generally, these species are frequently found, but their cover value is low. The shrub layer is characterized by the dominance of *Rhododendron brachycarpum, Tsuga sieboldii* and *Taxus cuspidata* (taxanomic treatment varies). It seems that *Rhododendron brachycarpum* occurs as a corresponding species to *Rhododendron mucronulatum* in the *Pinus densiflora* forest of the montane zone of Korean Peninsula. In the herb layer, such species as *Solidago vigra-aurea* var. *asiatica, Schizophragma hydrangeoides, Goodera schlechtendaliana, Mitchella undulata, Polystichopsis miqueriana* and *Athyrium yokoscense* are notably constant. But their cover value is low. Sedges and grasses are very rare. Only *Poa takeshimana* is found in some stands (relevé No. 27, 29, 31, 32) which has somewhat opened canopy.

摘 要

1985年 7月부터 10월에 걸쳐, 鬱陵島의 山地林에 發達되어있는 너도밤나무(*Fagus multinervis* Nakai) 林의 植生學的 位置를 決定하기 위하여 ZM學派의 方法으로 調査·硏究하였다. 그 結果, 同島의 落葉樹林帶에는 優占種인 너도밤나무를 비롯한 섬단풍나무, 우산고로쇠, 섬피나무, 섬벚나무, 섬노루귀 등의 固有種에 의하여 特徵지울 수 있는 섬노루귀—너도밤나무群集(群集 : association)이 발달되어 있는 외에, 좁은 稜線上에는 만병초—섬잣나무群落이 發達되어 있는 것이 밝혀졌다. 섬노루귀—너도밤나무群集은 種組成, 地形 및 土壤斷面等에 의하여 4個의 下位單位, 즉 섬조릿대亞群集, 일색고사리亞群集, 典型亞群集, 만병초亞群集으로 分類되었다. 또한, 冷溫帶의 多雪地域에 속하는 同島의 植生資料를 韓半島內의 落葉樹林帶의 植生體系(金·宋發表) 및 日本의 너도밤나무屬(*Fagus*)森林帶의 植生體系와 比較·檢討한 結果, 鬱陵島의 너도밤나무林은 독립된 植生體系—너도밤나무群目(Fagetalia multinervis ord. nov.), 너도밤나무群團(Fagion multinervis all. nov.), 섬노루귀—너도밤나무群集(Hepatico-Fagetum multinervis ass. nov.)—을 갖는 것으로 밝혀졌다.

REFERENCES

Braun-Blanquet, J. 1964. Pflanzensoziologie, 3. Aufl. Springer, Wien, New York. 865 pp.

Ellenberg, H. 1956. Grundlagen der Vegetationsgliederung, I. Aufgeben und Methoden der Vegetationskunde. Einführung in die Phytologie, IV. Eugen Ulmer, Stuttgarl. 136 pp.

Forcier, L.K. 1973. Seedling pattern and population dynamics, and the reproductive stratcgics of sugar maple, beech and yellow brich at Hubbard Brook. Univ. Microfilms, A Xerox Company, Ann Arbor, Michigan. 194 pp.

Harumoto, A. 1970. Volcanic rocks and associated rocks of Utsuryoto Island. Nippon Printing & Publising Co., Ltd., Osaka. 39 pp.

Lee, D.B. and S.U. Joo. 1958. Reinvestigation of the flora of Dagelet Island (in Korean). *Humanities and Science* (Nature Sciences), Korea Univ. 3: 223-295.

Machida, H., F. Arai, B.S. Lee, H. Moriwaki and T. Furuta. 1984. Late Quaternary Tephras in Ulreung-do Island, Korea. (in Japanese), *Journ. of Geography* (Tokyo Geographical Society)

93: 1-14.

Miyawaki, A., T. Ohba and N. Murase. 1964. Pflenzensoziologische Studien über die Vegetation in Tanzawa, Prov. Kanagawa, Sci. Res. Tanzawa Mts. (in Japanese), Kanagawa Prefectural Office, Yokohama. pp. 54-102.

Miyawaki, A., S. Okuda and R. Mochizuki. 1978. Handbook of Japanese vegetation. (in Japanese), Shibundo Co., LTD. Publisher. Tokyo. 850 pp.

Nakai, T. 1919. Report on the vegetation of the Island Ooryongto or Dagelet Island. (in Japanese), *The government of Chosen.* 87 pp.

Numata, M. 1974. The flora and vegetation of Japan. Kodansha Scientific books. Tokyo. 294 pp.

Oh, S.Y. Floral studies on the vascular plants of Dagelet Island. (in Korean), *Research rewiew of Kyungpook Univ.* 25: 131-201.

Sasaki, Y. 1970. Versuch zur systematischen und geographischen Gliederung der Japanischen Buchenwaldgesellschaften, *Vegetatio* 22: 214-249.

Suzuki, T. 1952. The vegetation of East Asia. (in Japanese), Kokin-Shoin, Tokyo. 137 pp.

Suzuki, T. 1966. Preliminary system of the Japanese natural forest communities. (in Japanese), *Shinrin Ritchi*, Tokyo. 8: 1-12.

Yang, I.S. 1956. The flora of Ulreung-do Island (or Dagelet Is.). (in Korean) *Kyungpook Univ. These Coll.* 1: 245-275.

Yim, Y.J. and T. Kira. 1975. Distribution of forest vegetation and climate in the Korean Peninsula. I. Distribution of forest vegetation of some indices of thermal climate. Jap. J. Ecol. 25; 77-88.

Yim, Y.J., K.S. Yoo and K.S. Paik. 1980. On the vegetation of Ulreung do. (in Korean), *Inst. Tech. Sci., Univ. of Chungang Bull.* 7: 1-12.

Yim, Y.J. 1983. On the distribution of beech (*Fagus, Fageceae*) and beech-dominated forest in the Northern Hemisphere. *Korean J. Ecol.* 6: 153-166.

Yim, Y.J. and S.D. Kim. 1983. Climate-diagram map of Korea. *Korean J. Ecol.* 6: 261-272.

Ward, R.T. 1961. Some aspects of the regeneration habits of the American beech. *Ecology* 42: 828-832.

Whiteaker, R.H. 1956. Vegetation of the Great Smoky Mountains. *Ecol. Monogr.* 26: 1-80.

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Table 1. Vegetation table of F a g e t a l i a m u l t i n e r v i s on Ulreung Island, Korea

F a g e t a l i a m u l t i n e r v i s ord. nov.

F a g i o n m u l t i n e r v i s all. nov.

H e p a t i c o - F a g e t u m m u l t i n e r v i s ass. nov.

A: Subass. of *Sasa kurilensis* B: Subass. of *Rumohra standishii*

C: Subass. of typicum D: Subass. of *Rhododendron brachycarpum*

Community type		A						B					C								D				
Serial number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Relevé number		7	3	6	21	18	15	107	11	5	14	33	12	34	17	16	110	10	106	8	9	108	13	109	22
Altitute (m)		800	760	840	950	680	740	760	610	850	840	720	780	700	820	720	680	540	480	550	560	810	850	710	910
Slope aspect		NE	SW	NE	NW	NW	SE	NE	NW	NE	N	E	NW	SE	SE	SW	SW	NE	N	NE	NW	NW	NW	N	SW
Slope degree (°)		15	10	20	5	10	5	20	35	20	25	30	35	30	35	25	30	40	20	35	5	30	5	30	5
Quadrat size (m^2)		400	400	400	225	400	400	400	400	625	400	400	400	225	400	400	500	300	225	400	100	500	150	225	300
Height of tree-1 layer (m)		18	16	10	12	14	14	12	17	19	18	15	16	14	18	17	19	20	15	16	10	12	12	11	12
Coverage of tree-1 layer (%)		80	70	85	70	75	80	80	70	80	70	75	65	70	70	80	85	80	70	60	70	60	70	70	60
Height of tree-2 layer (m)		12	10	6	8	8	8	7	10	12	13	10	10	8	11	14	15	15	11	12	5	8	7	7	8
Coverage of tree-2 layer (%)		40	30	30	30	20	40	30	25	40	40	30	40	40	30	40	40	35	40	50	40	30	40	45	35
Height of shrub layer (m)		5	5	3	4	3	4	2.5	4	4	3	3	4	3	3	5	4	6	4	3	2	3.5	2	1.5	1.2
Coverage of shrub layer (%)		20	10	10	10	15	10	15	20	20	20	25	30	30	35	25	10	20	35	40	40	40	80	60	80
Height of herb-1(H°) layer (m)		2	1.5	1.5	2	2	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coverage of herb-1 layer (%)		95	90	95	100	100	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Height of herb layer (m)		0.3	0.3	0.3	0.4	0.3	0.2	0.8	0.5	0.7	0.5	0.5	0.6	0.5	0.7	0.7	0.7	0.6	0.8	0.5	0.5	1	0.5	0.6	0.5
Coverage of herb layer (%)		10	10	5	5	5	5	95	90	90	95	95	80	85	80	80	70	60	60	40	30	40	30	30	30
Number of species		27	26	16	18	12	12	26	29	30	28	26	30	37	35	37	33	29	29	34	36	29	30	21	24
Character species of association and alliance																									
Fagus multinervis	T1	4·4	4·4	4·4	4·4	4·5	4·5	4·5	3·3	4·4	4·3	4·4	4·5	4·5	4·4	4·5	4·4	4·4	4·4	3·3	4·4	3·4	3·3	3·4	3·3
	T2	3·2	2·2	2·2	1·2	·	2·2	2·2	1·2	2·2	3·2	2·2	2·2	2·2	1·2	3·2	2·2	2·2	2·2	3·3	2·2	2·2	2·2	2·2	2·2
	S	2·2	1·2	+	+·2	+	+·2	2·2	2·2	2·2	2·2	1·2	2·2	2·2	2·2	2·2	+·2	1·2	2·2	2·2	+·2	2·2	2·2	+·2	·
	H	+·2	·	·	·	·	·	·	·	·	·	·	+·2	+·2	+·2	+	+	+	·	·	·	+	·	·	·
Acer takesimense	T1	2·1	1·2	·	·	1·2	1·1	·	1·1	1·2	·	1·1	·	·	·	1·1	·	·	1·1	1·1	·	·	2·2	1·2	·
	T2	2·2	2·2	1·1	1·1	·	2·1	·	·	2·2	·	·	2·2	1·1	1·1	1·1	1·1	1·2	1·2	1·2	1·1	1·2	1·2	1·2	·
	S	+	+·2	·	·	+·2	·	+	+·2	·	+·2	·	2·2	·	+	+·2	+·2	·	+·2	+·2	+	·	+·2	+·2	+·2	+·2
	H	·	·	·	·	·	·	·	·	·	·	·	·	+·2	+	+	·	·	+	·	·	+	+	·	·
Hepatica maxima	H	+·2	+	+	+	+	·	+	+·2	+·2	+·2	+·2	+·2	+·2	1·2	+·2	+·2	+	1·2	+·2	+·2	+	+	+	2·2
Acer okamotoanum	T1	1·1	·	1·1	1·1	·	1·1	·	1·2	·	1·1	·	2·1	1·2	2·1	1·1	1·1	·	1·1	1·1	1·1	·	·	·	1·1
	T2	·	·	·	+·2	1·1	·	·	1·2	·	1·1	1·2	2·2	1·2	·	+·2	1·2	·	·	·	·	·	1·1	·	·
	S	·	·	·	·	·	·	+·2	+·2	1·2	1·2	·	·	+	+	·	·	+	2	+	+	+	·	+·2	
	H	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	+	·	·	·	·	+	·
Prunus takesimensis	T1	·	1·1	1·1	1·2	·	·	1·1	·	·	·	·	·	1·1	·	·	1·1	·	1·1	1·1	1·1	1·1	1·1	·	·
	T2	·	·	·	1·1	1·1	·	·	·	·	·	·	·	·	1·1	·	·	·	·	1·1	·	·	·	·	·
	S	·	·	·	·	·	·	·	+	·	·	·	+	·	·	·	·	+	+	·	·	·	·	·	·
	H	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	+	·	·	·	·
Tilia insularis	T1	·	1·1	·	·	·	·	·	·	·	·	·	·	2·1	·	·	2·1	1·1	·	·	·	1·1	1·1	·	·
	T2	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
	S	+	·	·	·	·	·	+	+·2	·	+	+·2	·	·	+·2	+	·	+	·	+	·	·	·	·	·
	H	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	+	+	·	·	·	·	·	·	·
Differential species of subassociation																									
Sasa kurilensis	H°	5·5	5·5	5·5	5·5	5·5	5·5	5·5	5·5	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rumohra standishii	H	+	+·2	·	+	·	·	5·5	5·5	5·5	5·5	5·5	·	·	(+)	·	·	·	·	·	·	·	·	·	·
Cornus controversa	T1	·	1·1	·	·	·	·	·	·	1·2	1·1	1·1	·	·	·	·	·	·	1·2	·	·	·	·	·	1·1
	T2	·	·	·	·	·	·	·	·	1·2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
	S	·	·	·	·	·	·	+	+	·	+	+·2	·	·	+	·	·	·	·	·	·	·	·	·	·
	H	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ulmus laciniata	T2	·	1·1	·	·	·	·	·	·	+	1·1	·	·	·	·	·	·	·	·	·	·	·	·	·	·
	S	+	·	·	·	·	·	+	·	+	·	+·2	·	·	·	·	·	·	·	·	·	·	·	·	+
Gynostemma pentaphyllum	H	·	·	·	·	·	·	·	+	·	+	+·2	·	·	·	·	+	·	·	·	·	·	·	·	·
Rhododendron brachycarpum	H																				+·2	+·2	2·2	1·2	·
Tsuga sieboldii	T2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1·1	·	·	·	·
	S	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+·2	2·2	·	+	·
	H	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·
Differential species of upper units																									
Sorbus commixta	T1	1·1	2·2	1·1	1·2	1·1	·	1·1	·	1·2	·	·	·	1·1	·	1·2	1·1	1·2	·	1·1	1·2	2·2	1·2	1·2	1·1
	T2	2·2	1·2	1·2	1·2	·	1·2	1·1	1·1	1·2	·	1·2	2·2	·	1·2	1·2	·	1·2	·	1·2	+·2	1·2	+·2	2·2	1·2
	S	+·2	·	·	+·2	+	·	·	+	2·2	·	·	+·2	·	1·2	+	+	+	+·2	+·2	+·2	+·2	+·2	+·2	+·2	+·2
	H	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·
Smilax riparia v. ussuriensis	H	+	+	+	+	+	+	+·2	+·2	+·2	+·2	+·2	·	+	+	+·2	+	+	+·2	+·2	+	+	+·2	+	+
Dryopteris crassirhizoma	H	+	·	+	+	+	+	+	·	·	+	+	+	·	+	·	+	+	+·2	+	+	·	+·2	+	+
Hydrangea petiolaris	T2	+	·	·	·	·	+	+	+	+	·	+	·	+	+	·	·	·	+	+	·	·	+	·	·
	S	·	·	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	·	·	·	·
	H	+·2	+·2	+	+	+	+	+·2	+	1·2	+·2	+	+·2	1·2	2·2	2·2	+·2	+·2	+·2	2·2	2·2	·	1·2	·	·
Malanthemum dilatatum	H	+	+	·	·	·	+	+	1·2	+	·	2·2	3·3	3·3	1·2	2·2	2·2	1·2	+·2	+	+·2	+	+·2	+·2	+·2
Polystichum retroso-paleaceum v. co-	H	+·2	+·2	+	+	·	+·2	+	+	·	+	·	·	+	2·2	+	·	·	+	·	+	+	·	+·2	+
Asperula odorata raiense	H	+	·	+	·	·	+	+	+	+·2	+	+	+·2	+·2	+	+·2	+	·	1·2	1·2	+	·	·	·	·
Allium victorialis v. platyphyllum	H	+	·	+	·	·	·	·	·	·	+	·	+·2	1·2	1·2	+·2	1·2	2·2	2·2	1·2	+·2	·	1·2	·	·
Styrax obassia	T1	·	·	·	·	·	·	·	·	1·1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
	T2	·	·	·	·	·	·	·	·	·	·	·	·	·	1·2	·	·	1·1	·	·	1·2	·	1·1	·	·
	S	·	·	·	·	·	·	·	·	+·2	·	·	+·2	+·2	1·2	+	+	+·2	+	+	+	+·2	·	+	·
	H	·	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	+	+·2	+	+	·	·
Lilium hansonii	H	+	·	·	·	·	·	+	+	·	+	+	+	·	·	+	+	·	·	·	·	·	·	·	+
Viola takeshimana	H	+	·	·	·	·	·	·	+	·	·	+	+·2	2·2	+·2	+·2	+	·	·	+	·	·	·	·	+
Dystaenia takeshimana	H	·	·	·	·	·	·	·	·	+	+	·	+	+	+	+	+	+	·	+	·	·	+	·	·
Schizophragma hydrangeoides	T2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+
	H	·	·	·	·	·	+·2	+		·	·	·	2·2	·	·	·	·	2·2	·	+·2	+·2	+·2	+·2	+·2	·
Aster glehni	H	·	·	·	·	·	·	·	·	·	+	+	+	+	·	+·2	·	·	1·2	·	+	+	+·2	·	·
Adiantum pedatum	H	·	·	·	·	·	·	+	·	·	·	·	+·2	·	+	+·2	+	+	+·2	·	+	+	·	·	·
Viola hondoensis	H	·	·	·	·	·	·	·	·	·	+	·	+·2	+	·	·	+·2	·	+	+	·	·	+	+	+
Saussurea grandifolia	H	·	·	·	·	·	·	·	·	·	+	·	+	+·2	·	+·2	+·2	+	1·2	+	·	·	+·2	·	·
Polystichopsis miqueriana	H	·	·	·	·	·	·	·	·	+	·	·	·	+	+	·	+	·	·	·	1·2	+	+	+	·
Matteuccia orientalis	H	·	+	·	·	·	·	·	+	·	·	+	+	·	+	+·2	·	+	+	·	·	·	·	·	·
Tiarella polyphylla	H	·	·	·	·	·	·	·	·	·	·	·	+	+	+	+·2	+	+	+	·	·	·	·	+	·
Viola selkirkii	H	·	·	·	·	+	·	·	·	·	·	·	+	+	·	·	·	+	+	+	+	+	·	·	·
Taxus cuspidata	T2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1·1	·	1·1	·	·	·
	S	·	·	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·	+	·	+	+	+·2	+	·
	H	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	+	·	·
Viola kusanoana	H	+	+	·	+	·	·	·	+	+·2	+	·	·	+	·	·	·	·	·	·	·	·	·	·	+
Astilbe koreana	H	·	+	·	·	·	·	·	·	·	·	·	2·2	·	+	1·2	1·2	+	·	·	·	·	·	·	·
Trillium tschonoskii	H	+	+	·	+	·	·	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Mitchella undulata	H	·	·	·	+	·	+	·	·	·	·	·	·	·	+	·	·	·	·	+·2	·	1·2	·	·	·
Tripterospermum japonicum	H	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	+	·	·	+	+	·	+	·	·
Viburnum furcatum	S	+	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	+	+	·	·	·
	H	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·
Botrychium multifidum v. robustum	H	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	+	+	·	·	+	·	·
Kalopanax pictus	T1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1·1
	T2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1·1	·
	S	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·
Poa takeshimana	H	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+·2	+	·	·	·	+·2	·
Companions																									
Solidago vigra-aurea v. asiatica	H	+	+	·	·	·	·	·	·	·	·	·	+·2	+·2	+·2	2·2	+·2	2·2	+	+·2	+·2	1·2	1·2	+·2	·
Disporum sessile	H	+·2	+	+	+	·	·	+·2	1·2	+	+	+	·	1·2	+·2	2·2	+·2	+	·	·	·	·	+	·	·
Phryma leptostachya v. asiatica	H	+	+	·	·	·	·	+·2	+	+	·	+	+	+	+	+	+	·	·	·	+	·	·	·	·
Arisaema amurense v. serratum	H	+	+	+	+	+	·	+	·	+	·	+	·	+	+	+	·	·	·	·	·	·	·	·	+
Ligustrum foliosum	S	·	·	·	·	·	·	·	·	+	+	+·2	·	·	+	·	·	·	·	+	·	·	·	·	·
	H	·	·	·	·	·	·	+	·	·	·	·	·	+	·	+	+	+	·	·	+	·	·	·	+
Pyrola japonica	H	·	·	+	+	·	·	·	·	·	·	·	+·2	+	+·2	+	+	·	+	+	+	+·2	·	·	·
Euonymus fortunei v. radicans	T2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·
	H	+	·	·	·	·	·	·	+	+	·	·	·	·	·	+	·	+	+	+	+	+	·	·	+
Desmodium oxyphyllum	H	·	·	·	·	·	·	·	+	+	+	·	+	·	+	+	·	+	·	+	+	·	·	·	·
Osmunda japonica	H	·	+	·	·	·	·	+	·	·	·	·	·	·	+	+	·	+	+	·	·	·	·	·	·
Athyrium conilii	H	+	·	·	·	·	·	·	·	·	·	+	·	·	·	+	·	·	·	·	·	+	+	+	·
Athyrium brevifrons v. angustifron	H	·	·	·	·	·	+	·	+·2	+	·	·	·	·	+	2·2	+·2	·	·	·	·	·	·	·	·
Leptogramma mollissima	H	·	+·2	·	·	·	·	·	·	·	·	·	+	+·2	+	·	·	·	·	·	·	·	·	·	·
Athyrium yocoscense	H	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	+·2	·	·	1·2	+	·
Polygonatum falcatum	H	·	·	·	·	·	·	+	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vitis amurensis f. glabrescens	H	·	·	·	·	·	·	+	+	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·
Polystichum tripteron	H	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	+	·	·	·	·	·	·	·
Goodyera maximowicziana	H	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	+	+	·	·	·
Athyrium henryi	H	·	+·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dryopteris bissetiana	H	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·
Sambucus williamsii v. coreana	H	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·

Rare species: Isodon excisus(7:H-+), Circaea mollis(9:H-+), Valeriana officinalis v. latifolia(9,12:H-+), Saxifraga fortunei v. incisolobata(11:H-+), Viola dissecta(13:H-+), Vitis amurensis v. coignetiae(15:H-+), Cephalanthera longibracteata(17,24:H-+), Smilax nipponica(20:H-+), Ardicia japonica(19,20:H-+), Smilax sieboldii(20:H-+), Hedera rhombea (20:H-+), Callicarpa japonica(20,21:S-+), Pyrola renifolia(20,21:H-+), Alnus maximowiczii(21:T1-1.2,S-+, 22:T2-1.1) Carex siderosticta(24:H-+).

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