Chapter 8

Forest Vegetation of the Northern Korean Peninsula

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Abstract: North Korean forest and shrub vegetation data were obtained during several expeditions in 1984–1990. Field analyses were carried out using Braun-Blanquet methods. The resulting data-set of 244 phytocoenological relevés was processed by numerical techniques. Soil analyses were done for most vegetation types. Seven associations were distinguished in coniferous forests, including *Rhododendro aurei-Laricetum olgensis*, *Goodyero repentis-Piceetum jezoensis*, *Carici peiktusani-Abietetum nephrolepidis*, *Ledo decumbentis-Laricetum olgensis*, *Polysticho retroso-paleacei-Rhododendretum dahurici*, *Taxo-Pinetum pumilae*, and *Thujo koraiensis-Piceetum jezoensis*; 15 subassociations were described new. The following communities were found in semi-deciduous and deciduous forests: *Lychno-Quercetum mongolicae*, *Vaccinio-Quercetum mongolicae*, *Parthenocisso tricuspidati-Fraxinetum rhynchophyllae*, *Festuco ovinae-Pinetum densiflorae*, *Saso-Quercetum mongolicae*, *Artemisio-Quercetum mongolicae*, *Syneilesio palmatae-Carpinetum laxiflorae*, *Lilio lancifolii-Rhododendretum schlippenbachii*, and *Indigofera kirilowii-Securinega suffruticosa* community. Nine subassociations were newly described. Three new alliances were defined, a *Laricion olgensis* for coniferous forests of North Korea, a *Rhododendro dahurici-Acerion barbinervi* for shrub and mantle communities, and a *Weigelo floridae-Fagarion schinifoliae* for shrub vegetation. Zonation of forest vegetation in North Korea is briefly characterized.

Key words: Braun-Blanquet methodology, vegetation classification, floristic composition, NE Asia, plant communities, soil characteristics

1. INTRODUCTION

Botanically, the Korean Peninsula represents a highly noteworthy territory. Almost like in a schoolbook, it is possible here to demonstrate vegetation zonation on a detailed scale. Mountain ranges cover nearly two-thirds of the Korean Peninsula (Kong & Watts 1993). The northern part of the peninsula is covered by subarctic (boreal) forest and cool-temperate forest, especially in the north and interior (Yim 1968 sec. Yim & Kira 1975).

Vegetation zonation in North Korea was studied along an altitudinal transect on the slopes of Mt. Paektu-san (Šrůtek & Kolbek 1994), in particular causal relationships involving altitude, vegetation structure and species richness of the flora. The spatial pattern of stands of *Larix olgensis* and their variation in space and age was measured directly at the same locations (Šrůtek & Lepš 1994).

The altitudinal zonation of vegetation in the mountains of Myohyang-san and Kumgang-san was described by Neuhäusl & Neuhäuslová (1994). Their conception may be accepted only for the main forest formations based on domi-

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nant trees, such as *Quercus mongolica*, *Pinus densiflora*, *P. koraiensis*, *Acer pseudosieboldianum*, and *Abies nephrolepis*. The distribution of plant communities along an elevation gradient in these mountains and in the Sujang-san is much more complicated. No more detailed data about zonation were obtained during expeditions in other parts of the country, and most results are based on short observations only.

All available vegetation on the territory of North Korea was studied during the years 1984–1990 (Fig. 8.1). The results were synthesized, and most were prepared for publication while working on the project in 1992–1994. Other publications concerning this area and the same topics are not known.

The syntaxonomy of the following vegetation types was successfully worked out, partly or completely:

- forests (incl. characteristics of woody forest plants, spatial structure, zonation),
- alpine grasslands,
- vegetation of rocks and walls,
- vegetation of water bodies, nitrophilous ponds and river banks,
- salt marshes,
- rice paddies, soya bean fields,
- anthropogenic (ruderal) vegetation.

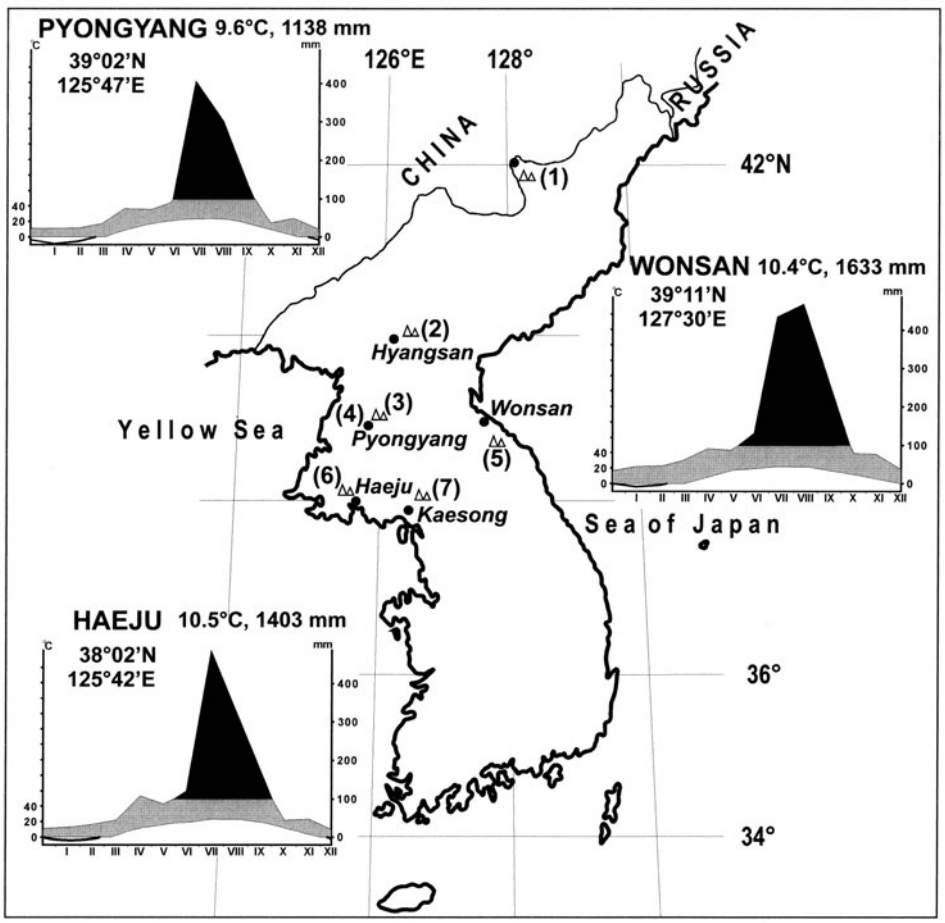

Figure 8.1. The location of the studied area in wider surrounding of Paektu-san in Changbai-shan (1), Myohyang-san (2), Taesong-san (3), Ljongak-san (4), Kumgang-san (5), Sujang-san (6), Chonma-san (7).

Also worked out were:
- an illustrated survey of the distribution of woody plants,
- newly found taxa,

taxonomy, phytosociology, and ecology of selected species.

In particular, the following were done:

1. The altitudinal zonation, vegetation types and vegetation pattern on two mountain ranges (Myohyang-san and Kumgang-san) were analyzed. While the vegetation of foothill areas is very similar, great differences were found in the flora and vegetation of the montane and subalpine belts (Neuhäusl & Neuhäuslová 1994).
2. A hitherto unknown type of forest with the epiphytic fern *Neoniphopsis linearifolia* was studied in the Kumgang-san. Similar types are not known, either from South Korea or from Japan. A list of species growing as epiphytes in North Korea was also prepared (Kolbek 1995).
3. In the highest mountains of North Korea (on the boundary with China) the vegetation structure of woody plants and alpine grasslands near the timberline was studied. Using TWINSPAN classification and CCA (canonical correspondence analysis) ordination of populations of *Larix olgensis*, the endemic species dominant in the taiga, the spatial and age structure, variability of stand density, trunk thickness, height, age and the numbers of seedlings of these woody plants were determined (Šrůtek & Lepš 1994; Šrůtek *et al.* 1994).
4. The spatial structure of herbaceous species in forest areas was also studied (Šrůtek & Kolbek 1994).
5. The vegetation of rocks was studied, based on 199 relevés. This hitherto unknown vegetation type of North Korea was processed by numerical methods and classified by the program NUMCLAS. Eleven units at the association level plus higher units, to the level of the class *Selaginello-Potentilletea*, were newly described. A complete survey of all relevant units of this vegetation and comparison with similar syntaxa elsewhere in East Asia was added (Kolbek *et al.* 1997, 1998).
6. The vegetation on old walls had not yet been studied in Korea (cf. Miyawaki in Japan). Four types of vegetation, namely the *Commelino communis-Sedetum sarmentosi*, and the communities *Camptosorus sibiricus-Pilea peploides*, *Oxalis stricta-Microlepia pilosella*, and *Saxifraga fortunaei-Boehmeria spicata*, were described for dry, sunny, moist and shady wall habitats (Kolbek & Valachovič 1996).
7. During the study of water vegetation, types dominated by *Azolla pinnata*, *Eichhornia crassipes* and communities dominated by *Nelumbo nucifera* were distinguished. This vegetation, too, was not known from this territory (Kolbek & Dostálek 1996).
8. Annual nitrophilous pond and riverbank communities were also studied. Eight communities were characterized, based on 77 relevés (Jarolímek *et al.* 1991).
9. Salt-marsh vegetation on the west coast of North Korea was studied, and six communities were distinguished by NUMCLAS. The population density of *Suaeda japonica* was examined, according to distance from the sea (Kolbek *et al.* 1989).
10. Detailed study of rice-paddy vegetation and its comparison with South Korean and Japanese rice-paddy vegetation resulted in description of three new syntaxa at the subassociation level. NUMCLAS analysis of 111 relevés showed that the communities are geographically well differentiated. South Korean rice-paddy vegetation is more similar to that of Japan, while the vegetation of North Korea is different (Kolbek *et al.* 1996).
11. Classification of the vegetation of soybean fields in North Korea was published (Dostálek *et al.* 1990).
12. In ruderal habitats, 299 relevés were synthesized and yielded, after revision, the new alliance *Cosmo-Humulion japonicae* and three new associations (Mucina *et al.* 1991, Kolbek & Sádlo 1996, Sádlo & Kolbek 1997).
13. Two new plant communities were described during the study of lawn vegetation. In par-

ticular the biology of *Zoysia japonica* was studied in semi-natural swards and managed lawns. Stands were classified, and species ecology and relations to 58 species growing together were studied using DCA ordination and Braun-Blanquet methods (Šrůtek & Kolbek 1992, Blažková 1993).

14. The first and second parts of the illustrated brief survey of 125 + 73 selected woody species were published, separately, in a volume of the Institute of Botany, Průhonice (Kolbek & Kučera 1989, 1999). The book summarized our knowledge of coenological relations, based on phytocoenological studies. The distribution of 398 woody species was also recently published (Kolbek *et al.* 2001).
15. A few taxa new to the flora of North Korea were published (Dostálek *et al.* 1989).
16. Taxonomy, phytosociology, and ecology of some Korean *Rhododendron* species were analysed (Dostálek *et al.* 1988).

2. MATERIAL AND METHODS

2.1 Phytocoenological data processing

Phytocoenological data on forest vegetation were obtained during expeditions to the northern Korean Peninsula in 1986, 1988, 1989 and 1990. In all, 244 relevés were made and processed following Braun-Blanquet methods (Braun-Blanquet 1964, cf. Westhoff & van der Maarel 1978). Except for some sporadic cases, a standard relevé plot size of 20×20 m was used. A modified 9-degree scale was used in the field (Barkman *et al.* 1964), with the level 2 divided into 2m (in tables = m), 2a (= a), and 2b (= b). All relevés were transformed into a 0–9 ordinal scale (van der Maarel 1979) before computation. Numerical classification by NCLAS (Podani 1993) was carried out separately for two sets of relevés: A) evergreen and *Larix olgensis*-dominated coniferous forests at higher altitude, and B) semi-deciduous and deciduous forests at lower altitude. Ružička's coefficient of similarity and β-flexible clustering method ($\beta = -0.25$) were applied on the adjusted data. All mosses and lichens of layer E_0 of data set A were combined into one „pseudospecies" with relevant abundance on the ordinal scale 0–9. Very different relevés of vegetation on ventarols and incomplete relevés of other communities (Dostálek *et al.* 1988) were excluded from analyses. The data matrix after modification contained 98 relevés and 209 species. Data-set B was reduced. All species with frequency lower than 1% were excluded. The data matrix computed contained 136 relevés and 373 species. Phytocoenological tables of associations and synoptic tables were arranged by the program FYTOPACK (Jarolímek & Schlosser 1997), based on resulting dendrograms and field experience. Plant communities of various syntaxonomic levels were characterised by character, differential, and constant diagnostic taxa.

Character taxa include taxa completely or almost completely confined to one syntaxon (exclusive taxa), and taxa occurring with a clear preference for one syntaxon but also minimally within the whole relevant class or wider, though with a considerably lower presence degree in other syntaxa (selective taxa) (*sensu* Westhoff & van der Maarel 1978). Differential taxa are taxa occurring only within or with a clear preference for one syntaxon in the framework of the first higher syntaxon. Constant taxa are taxa with constancy class III–V (61–100%). Diagnostic taxa consist of character, differential, and constant taxa.

Some taxa used in association tables as differential taxa for subassociations or variants also serve as diagnostic taxa of the association in the synoptic table. Synoptic tables contain all diagnostic taxa plus indifferent taxa ("others") with frequency higher than 20%, including mosses. A minus sign "-" indicates that mosses were not recorded in the field. Synoptic tables contain constancy in percent of species in the plant communities, based on five or more relevés. Italic numbers show frequency of species occurrence in community columns (Spalten) based on fewer than five relevés. Serial numbers of those relevés that represent nomenclature types of associations and subassocia-

tions are shown in boldface in the association tables.

2.2 Nomenclature

Names of the vascular plant taxa follow a checklist of plant species names by Ri & Hoang (1984), except those names completed by a full author's citation. The names of bryophytes are mostly according to Choe (1980), and those of lichens follow a checklist by Yoshimura (1994). Determination of vascular plants was based on Anonymous (1972–1976; 1979), Charkevicz (1985–1989), and Voroshilov (1982).

The following abbreviations were used in the tables:

Authors of relevés: B = Denisa Blažková, D = Jiří Dostálek, J = Ivan Jarolímek, K = Jiří Kolbek, Li = Sek-Ha Li, N = Robert Neuhäusl and Zdenka Neuhäuslová, S = Jiří Sádlo, Š = Miroslav Šrůtek, and V = Milan Valachovič.

Mountain ranges and other localities: C = Chonma-san, K = Kumgang-san, Ke = Kaesong, L = Ljongak-san (or Ryongak-san), M = Myohyang-san, S = Sujang-san, and T = Taesong-san.

Other abbreviations: bel = below, c = constancy, char. = characteristic species, ct = total constancy, diff. = differential species, fr = from, l = left, L = lower, M = middle, n = near, opp = opposite, P = peak, r = right, transgr. = transgresive species, un = under, V = valley, vis = visiting.

2.3 Soil analyses

According to a map of North Korean soils published in Pyongyang (1983, authors unknown, personal communication), soils were divided into seven groups (originally using Russian terminology, here freely translated):

1. brown forest soils, occurring in the northern and central parts of the country. These extend south to the Haedju-Won-san boundary and north to the Russian border; in the east they occur only along the shore of the Japan Sea;
2. red-brown forest soils, occurring in the south near Haedju and in the east near Wonsan;
3. podzolized soils, occurring in foothills and mountains above about 150 m. The soils are acidic, with pH values round 4. *Picea koraiensis* and *Abies nephrolepis* are dominant trees on these soils;
4. podzolized brown mountain soils, known from montane areas near the northern boundary of North Korea in areas typically with *Larix olgensis* forests;
5. skeletal soils, occurring in hills and lower mountains;
6. mountain meadow soils, occurring under alpine grasslands and mountain meadows from the north (e.g. Mt. Paektu-san) to the boundary with China;
7. yellow or yellow-red soils, known only from South Korea (e.g. Cheju Island).

According to our investigation, most soils in forests are skeletal or very skeletal soils (group 5), with A/C horizons, or brown soils with A/B horizons. Their chemical composition indicates acidic, humus-rich, nutrient-poor soils (especially poor in calcium and magnesium), but mostly with fresh, moist upper horizons richly overgrown by roots (see detailed description of horizons and chemical character in text).

Selected soil parameters were measured by chemical analyses:

- pH values – electrometricaly in distilled H_2O and in 0.1 M solution KCl;
- N-NH_4 – using calomel electrodes with Nessler reagent;
- total N – distilled by Kjeldahl method (Hraško *et al.* 1962);
- organic content C (Cox) – by oxidized mixture $K_2Cr_2O_7$ and H_2SO_4 following the Springer and Klee method (Thun *et al.* 1955);
- P-PO_4 – by extraction with sodium bicarbonate ($NaCO_3$) following the Olsen method plus reaction with Mo-reagent and H_2SO_4 (Olsen 1954, Murphy & Riley 1962);
- exchangeable ions – in solution of 1M CH_3COONH_4 (by pH 7);

- Ca^{2+}, K^{+}, Na^{+} – by the method of emissions;
- Mg^{2+} – by absorption using spectrometer AAN1 fy. Carl Zeiss (Jackson 1958);
- NO^{3-}, SO^{4-}, Cl^{-} – by capillary izotachophoresis method using ITP analyser ZKI-01 electrolyte fy. Villa-Labeco (Boček 1987).

3. RESULTS

3.1 Vegetation zonation

In the territory of North Korea, three vegetation zones with some altitudinal belts were distinguished as follows:

- coniferous taiga forests,
- mixed deciduous forests (coniferous and broad-leaved trees), and
- mixed semi-deciduous forests (coniferous and broad-leaved trees).

These are very different in physiognomy and in species composition, which reflects different microclimatic conditions along the north-south climatic gradient. The mountains on the northern border of the peninsula represent the southern limit of coniferous stands of the Siberian taiga (cf. Šrůtek et. al, chapter 10 of this volume).

1. In the northernmost and highest elevations of the Changbai Mountains, a large area is covered by larch forests. These are dominated by *Larix olgensis*, taxonomically a small species of the widely distributed *L. sibirica*. The taiga vegetation zonation in the Changbai-shan depicted by J. Kolbek in 1986 is shown in Fig. 8.2.

a) Light-taiga forests belong to the group of deciduous coniferous forests. The canopy is usually open, with cover ranging from 20% to 60%. Lower cover is typical for higher elevations, near the actual timberline, and higher cover for lower elevations. The understory is well-developed, with shrub layer (5–40% cover), herb layer (60–75%), and ground layer (50–95%). The vegetation is of natural floristic composition and, around Paektu-san (2744 m), reflects the secondary succession after the last volcanic eruption, in 1702. The human impact is relatively low, except near Samji Lake. These forests, together with the following types, are among the most natural, undisturbed forest communities in the country.

b) A smaller area is occupied by dark-taiga forest, i.e. evergreen coniferous forest. Higher air humidity (fog) is a typical feature of its sites. The dominant species in the closed forest canopy are *Picea jezoensis* and *P. koraiensis*, the cover of the shrub layer reaches 40%, and the herb layer is sparse. Physiognomically important are garlands of *Usnea* ssp., hanging on tree branches, and a compact moss carpet up to 60 cm thick. Broad-leaved woody species of the genera *Betula*, *Sorbus*, *Lonicera*, *Oxycoccus*, *Phyllodoce*, and *Vaccinium*, frequently occur in both taiga types, as well as various taxa of *Ledum palustre* agg., including the endemic shrub *Ledum palustre* var. *maximum*, and *Rhododendron aureum*. Characteristic in the herb layer are *Calypso bulbosa*, *Clintonia udensis*, *Linnaea borealis*, and species of the genera *Diphasiastrum*, *Pyrola*, *Lycopodium* and *Parnassia*.

c) Light taiga also occurs, with *Larix olgensis* and *Betula paishanensis* as dominant species and a similar floristic composition but different structure from type 1a.

2. Mixed forests of evergreen conifers and broad-leaved deciduous trees prevail further south, in the central and southern part of North Korea, in lower and less compact mountain ranges (Fig. 8.1). These differ markedly at different altitudes.

a) Small patches of shrub vegetation dominated by *Pinus pumila* and *Betula ermanii* occur on the highest summits, as in the northern Changbai-shan.

b) Steep, rocky slopes are covered by mixed forests with very open canopies. *Abies nephrolepis* and *Pinus koraiensis* prevail in tree layer, *Larix olgensis* occurs sparsely, and endemic *Thuja koraiensis* grows in the shrub layer.

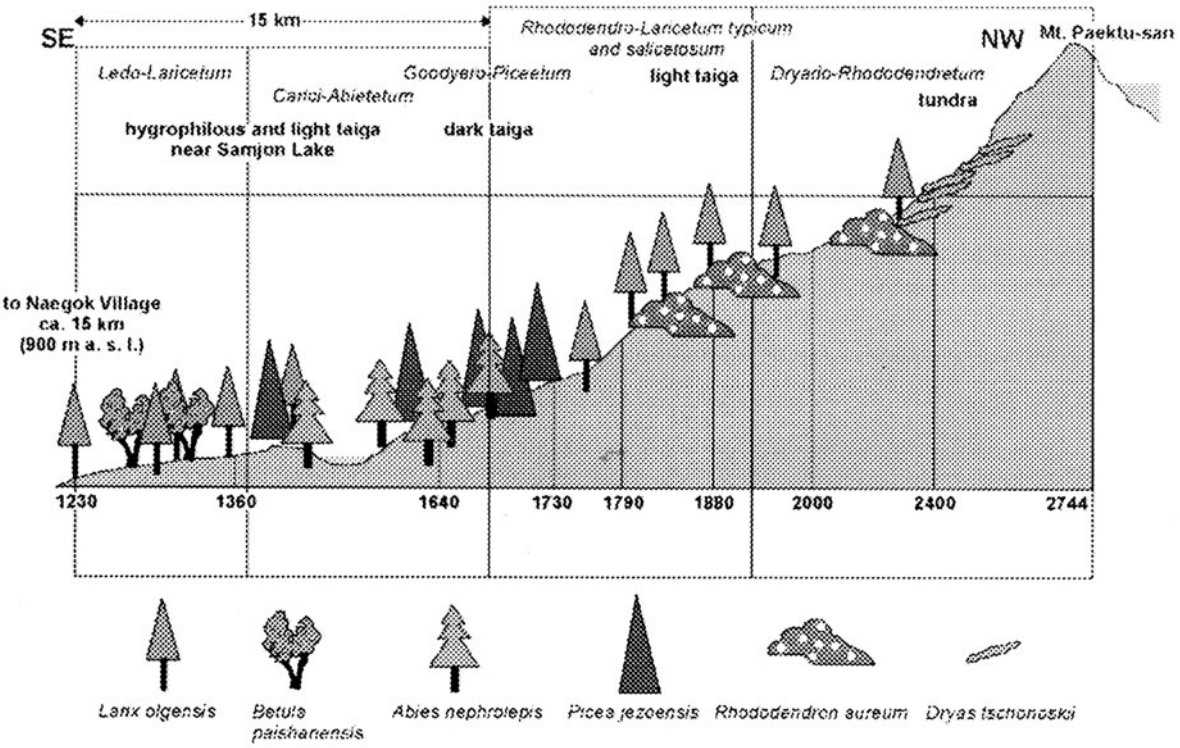

Figure 8.2. Zonality of vegetation in Changbai-shan Mts.

c) At lower elevations, the common woody forest species *Quercus mongolica* and *Pinus densiflora* predominate in various types of vegetation. These are accompanied by *Euonymus alata*, *Fagara schinifolia*, *Rhododendron mucronulatum*, *R. schlippenbachii*, *Styrax obassia* and *Aralia elata* in the drier and more acidophilous types. *Juniperus rigida* asserts itself in the light stands of the lower colline and submontane belts but is replaced by *Thuja koraiensis* at montane sites. The moist valley and scree forests are very rich in herbs and woody plants. Representative species include *Carpinus laxiflora*, *Fraxinus rhynchophylla*, and several species of maple (*Acer pseudosieboldianum*, *A. mono*, *A. palmatum*, *A. triflorum*, *A. tegmentosum* and *A. ukurundense*). The genus *Actinidia* asserts itself as a liana. The warmer forest provides habitat for species such as *Castanea crenata*, *Micromeles alnifolia* and *Carpinus cordata*. Species of *Tilia*, accompanied by *Pinus koraiensis*, *Prunus leveilleana*, *Cornus controversa*, *Magnolia sieboldii* and *Benzoin obtusilobum*, are also common. The shrub layer is usually very well developed.

3. In the south, along the border with South Korea, there are semi-deciduous forest types with *Zelkova serrata* and several species of *Quercus*, such as *Q. serrata*, *Q. variabilis*, *Q. mc-cormickii*, and *Q. acutissima*. Typical in the shrub layer are *Rhus javanica*, *R. verniciflura*, *Codonopsis lanceolata*, *Callicarpa dichotoma* and *Solenolantana carlesii*. Present also are *Rhododendron*, *Magnolia*, *Weigela*, *Lespedeza* and *Smilax* and numerous other genera rich in species. These are associated with species of Bambusaceae and some endemic species, e.g. *Pentactina rupicola*, *Clematis nobilis* and *Pinus koraiensis* (Kolbek & Kučera 1989). The southern part of North Korea is much more species-rich than the northern part.

The distribution of Korean forest communities is limited by different influences of the primary ecological factors:

1. climate (cf. climatic climaxes such as *Saso-Quercetum*, *Taxo-Pinetum*, *Rhododendro-Laricetum*, *Carici-Abietetum*);
2. soil characteristics (cf. edaphic climaxes such as *Parthenocisso-Fraxinetum*, *Lilio-Rhododendretum*, *Polysticho-Rhododendretum*); and
3. human influences (cf. communities such as *Artemisio-Quercetum* or *Indigofera kirilowii-Securinega suffruticosa*). Most lowland and upland forests have been exposed to strong human pressure for a long time. Consequently their floristic composition changed. The human impact also changed the proportions of dominant species: *Pinus densiflora* was preferred in forest management and *Quercus mongolica* was suppressed (cf. Nakagoshi 1995).

Only climatic-climax forest communities appear in significant vegetation zones or belts. The distribution of forest communities of groups 2 and 3 depends on soil conditions or human influences more than on natural zonation. The zonation of the main broad-leaved forests in the Myohyang-san, Kumgang-san, and Sujang-san, and a comparison with their distributions in South Korea (data by Kim J.-W. 1992), are depicted in Fig. 8.3–8.5. The warmer climate to the south means that the forest communities occur at higher elevation in the south than in the north.

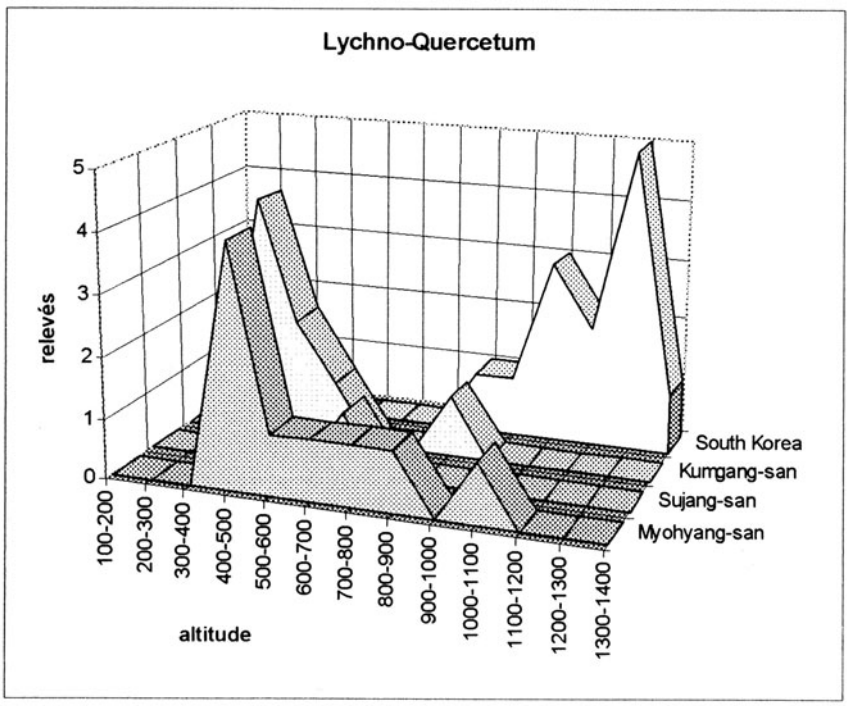

Figure 8.3. Comparison of distribution of *Lychno-Quercetum mongolicae* in relation to elevation in South Korea (Kim J.-W. 1992) and three North Korea mountain ranges.

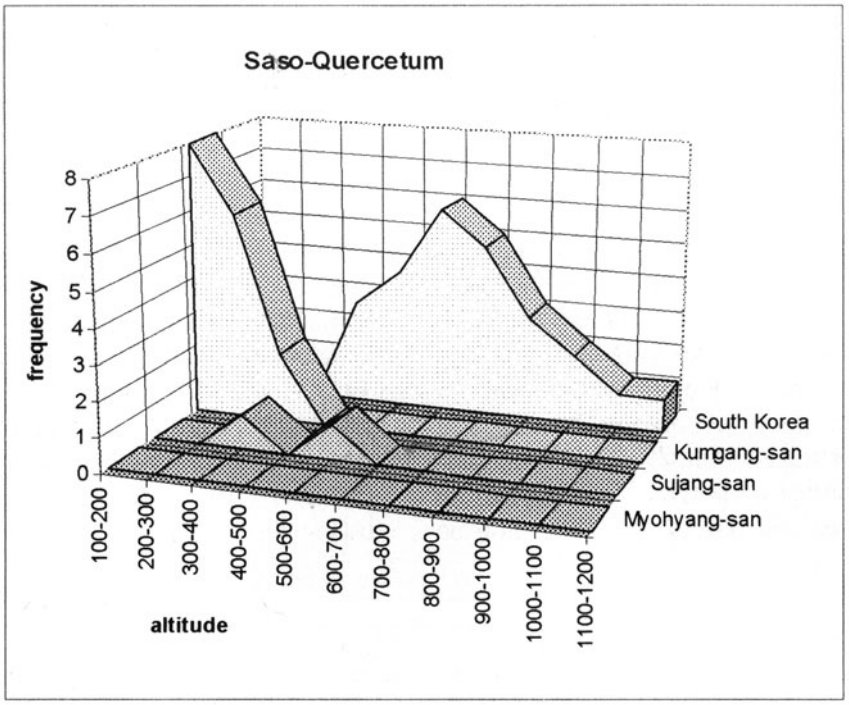

Figure 8.4. Comparison of distribution of *Saso-Quercetum mongolicae* in relation to elevation in South Korea (Kim J.-W. 1992) and three North Korea mountain ranges.

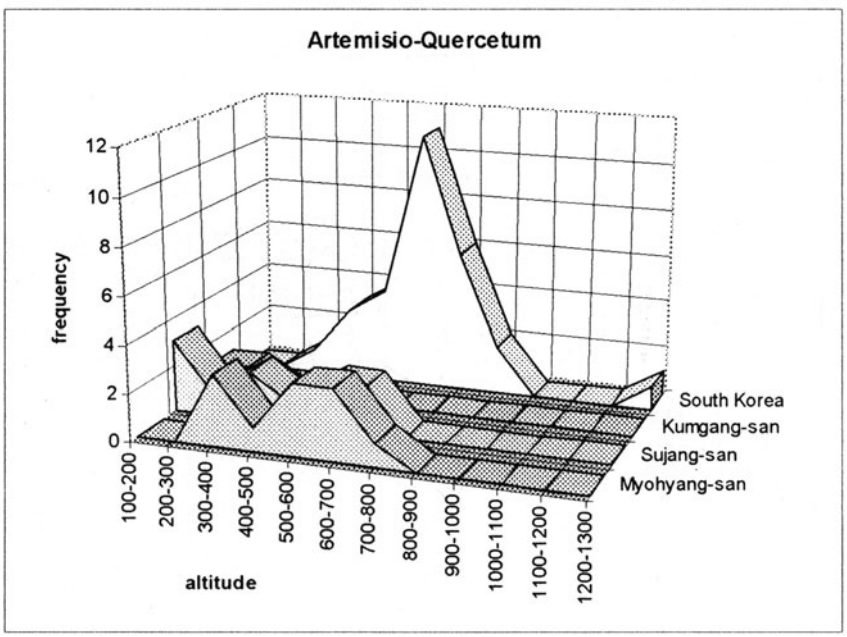

Figure 8.5. Comparison of distribution of *Artemisio-Quercetum mongolicae* in relation to elevation in South Korea (Kim J.-W. 1992) and three North Korea mountain ranges.

3.2 Numerical classification

The results of numerical classification are shown in Fig. 8.6 (data set A) and Fig. 8.7 (data set B). The four main clusters recognizable in the dendrogram (Fig. 8.6) were interpreted as four associations within the alliance *Laricion olgensis*. The structure within the clusters shows infra-association variability and has been explained at the level of subassociations or variants. Relevés 5 and 83, strongly differentiated by high dominance of *Rhododendron dahuricum* in the shrub layer, were characterised separately in the text. Clusters in the dendrogram (Fig. 8.7) were interpreted with regard to field experience and published information on the relevant plant communities. The resulting classification differs slightly from the results of the numerical classification. Clusters T4 and T6 are well characterised by character and differential species. Clusters T8.1 and T8.2 represent two communities with a common dominating life form; in these communities the tree layer is absent and the shrub layer dominates. In the relevés fused into the cluster T7, character and dominant species of the association represented by cluster T5 are completely absent. Clusters T1, T2, and T3 seem to be the most problematic. A large number of apparently unrelated species dominate the relevés of these clusters. Every of cluster was classified at the association level.

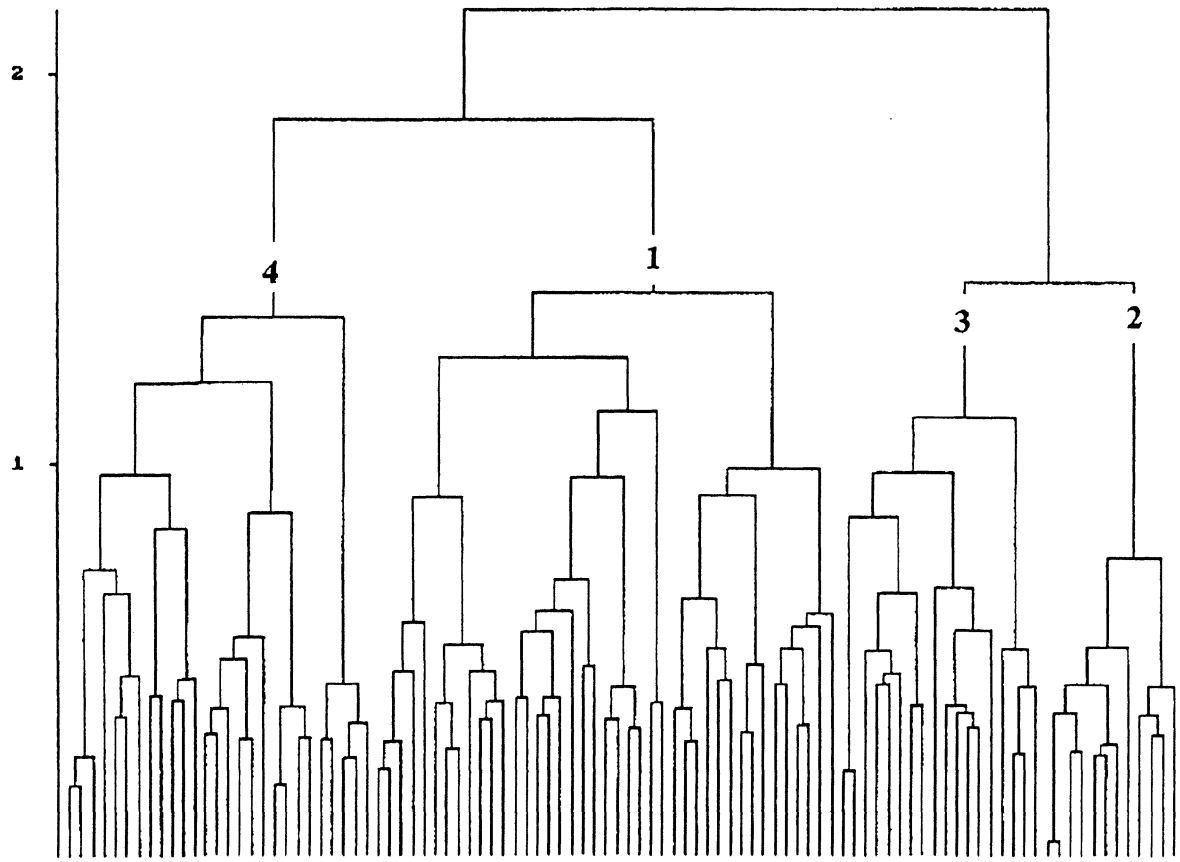

Figure 8.6. Dendrogram of β-flexible clustering of coniferous forests (β=−0.25). 1. *Rhododendro aurei-Laricetum olgensis*, 2. *Goodyero repentis-Piceetum jezoensis*, 3. *Carici peiktusani-Abietetum nephrolepidis*, 4. *Ledo decumbentis-Laricetum olgensis.*

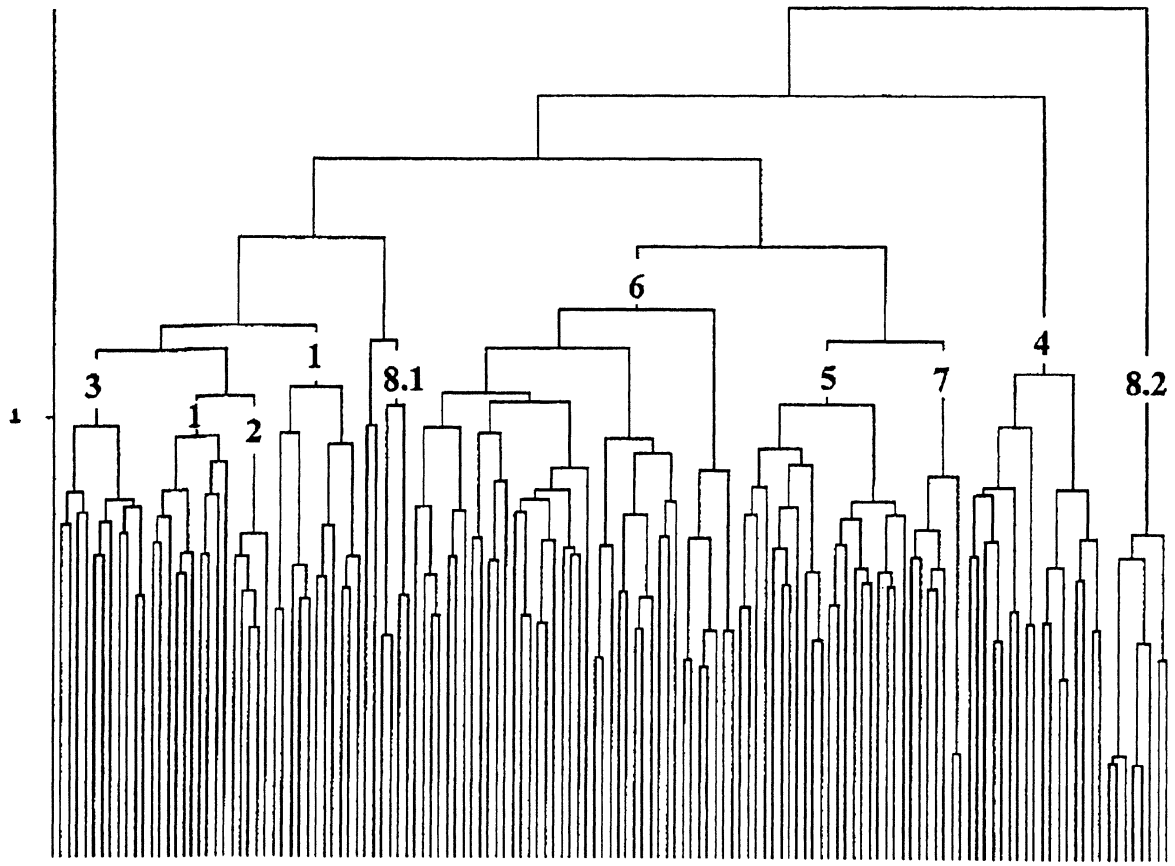

Figure 8.7. Dendrogram of β-flexible clustering of broad-leaved and mixed forests (β=−0.25). 1. *Lychno-Quercetum mongolicae*, 2. *Vaccinio-Quercetum mongolicae*, 3. *Parthenocisso tricuspidati-Fraxinetum rhynchophyllae*, 4. *Festuco ovinae-Pinetum densiflorae*, 5. *Saso-Quercetum mongolicae*, 6. *Artemisio-Quercetum mongolicae*, 7. *Syneilesio palmatae-Carpinetum laxiflorae*, 8.1 *Lilio lancifolii-Rhododendretum schlippenbachii*, 8.2 *Indigofera kirilowii-Securinega suffruticosa*.

These associations have great infra-association variability and relatively low differentiation between associations. Four of the most different relevés (T3.2) have been grouped in the cluster T3.1 (*Parthenocisso tricuspidati-Fraxinetum rhynchophyllae*). These probably represent degraded forest stands affected by human activities.

3.3 Description of plant communities

3.3.1 Coniferous forests

VACCINIO-PICEETEA Br.-Bl. 1939

Abieti nephrolepidis-Piceetalia jezoensis Song 1992

***Laricion olgensis* all. nova hoc loco**

Nomenclatural type: *Ledo decumbentis-Laricetum olgensis* Kolbek, Jarolímek et Valachovič ass. nova

Characteristic and differential species: *Bupleurum longeradiatum*, *Carex peiktusani*, *Iris dichotoma*, *Larix olgensis*, *Lonicera edulis*, *Malus baccata*, *Ostericum maximowiczii*, *Picea koraiensis*, *Populus davidiana*, *Prunus padus*, *Pseudostellaria heterophylla*, *Pyrola dahurica*, *Rhododendron parvifolium*, *Ribes horridum*, *Salix arctica*, *Sanguisorba parviflora*, *Saus-*

surea alpicola, *Sorbus sambucifolia*, *Spiraea ulmifolia*, *Viola sachalinensis*.

The alliance groups the larch-forest communities of the mountain taiga, with *Larix olgensis* or *Abies nephrolepis*, *Picea koraiensis* and *P. jezoensis* as dominant species. Occurrence of this alliance in eastern Asia coincides with the distribution area of *Larix olgensis*, i.e. the northern Korean Peninsula and adjacent mountain regions of northeastern China. Communities of the alliance are known from altitudes between 1190 and 1950 m in the Changbai-shan.

In the stands of "light taiga" the dominant species is *Larix olgensis*. In the "dark taiga" *Abies nephrolepis* and various *Picea* species are dominant, and the occurrence of *Larix olgensis* is suppressed. The habitats are favourable in terms of precipitation and are situated on gentle slopes or in plains.

The herb and moss layers are remarkably rich in species. Species of *Rhododendron*, *Ribes*, *Lonicera*, *Betula*, *Clematis* rather frequently occur in the shrub layer.

Rhododendro aurei-Laricetum olgensis
Dostálek *et al.* 1988 (Table 8.8, Fig. 8.8)

These are thin park-like larch forests with giant specimens of *Larix olgensis* in the tree layer and with *Rhododendron aureum* dominating in the shrub layer. The height of *Rhododendron aureum* depends on elevation, 1.5 m at the lowest elevations but hardly 0.5 m at the highest elevations. This species also occurs above treeline (tundra belt), to 10–15 cm in height, and it retains this small size if grown also at low elevations.

Stands of this association are species-rich, and subassociations are well connected with specific elevations. The dominant species of the tree layer is *Larix olgensis*, with cover (10)20–60%. *Picea jezoensis* and *P. koraiensis* are subdominant species at the highest situated locations. *Rhododendron aureum*, with cover 5–

Figure 8.8. Rhododendro aurei-Laricetum olgensis, Paektu-san (photo by J. Kolbek).

40%, dominates the shrub layer. *Picea jezoensis*, *Dasiphora fruticosa* and more rarely other woody species accompany it. The herb layer (50–80%) is composed of *Juniperus sibirica*, *Phyllodoce coerulea*, *Vaccinium vitis-idaea*, *V. uliginosum*, *Linnaea borealis*, *Festuca ovina*, *Calamagrostis langsdorfii*, *Solidago japonica*, *Sanguisorba parviflora*, *Gentiana jamesii* etc. Within the association four subassociations were distinguished:

1. *Rhododendro aurei-Laricetum olgensis salicetosum arcticae* subass. nova hoc loco

Nomenclatural type: Table 8.8, relevé 8

Cover varies from 30 to 55% in the tree layer, from 5 to 40% in the shrub layer, from 60 to 75% in the herb layer, and from 50 to 95% in the moss layer. Moss-layer cover is highest in this subassociation. The community was found at 1740–1800 m on moist substrate of volcanic origin. Besides numerous differential species (Table 8.8), *Dianthus superbus*, *Bistorta vulgaris* agg., and *Campanula cephalotes* also show a weaker relation to the subassociation.

2. *Rhododendro aurei-Laricetum olgensis gentianetosum algidae* subass. nova hoc loco

Nomenclatural type: Table 8.8, relevé 10

Only three species positively differentiate this subassociation, namely *Hieracium umbellatum*, *Gentiana algida*, and *Cephalanthera longibracteata*. It is very well distinguished, however, by the absence of differential species such as *Sanguisorba parviflora*, *Viola sachalinensis*, *Linnaea borealis* and *Lonicera edulis*. Stands occur between 1730 and 1870 m. The cover of the tree layer varies from 40 to 60%, the cover of the shrub layer is low (0–20%), the herb layer has 50–80% cover, and moss-layer cover is 45–95%.

3. *Rhododendro aurei-Laricetum olgensis typicum* subass. nova hoc loco

Nomenclatural type: identical with the nomenclatural type of the association name (see Dostálek *et al.* 1988: Table 2, relevé 1)

Lonicera edulis, *Ribes horridum*, *Veratrum album* and *Trifolium lupinaster* are differential species of this subassociation. *Saussurea alpicola*, *Gentiana jamesii* and *Bupleurum euphorbioides* negatively differentiate it. Stands were found at 1830–1950 m. The tree layer has relatively low cover (10–50%), and that of the shrub layer is even lower (0–15%). The herb layer varies from 50 to 85% cover, and the moss layer 40–90%. The community was described by Dostálek *et al.* (1988), based on only three relevés. Our data originate from the same locations, but the samples are more species-rich.

4. *Rhododendro aurei-Laricetum olgensis pyroletosum dahuricae* subass. nova hoc loco

Nomenclatural type: Table 8.8, relevé 41

Stands of this subassociation were found at 1880–1940 m and represent some of the highest-situated forest communities in the wide surroundings of Paektu-san volcano. Contrary to the preceding subassociations, this one occurs on eastern and southern slopes rather than north slopes. *Abies nephrolepis*, *Picea koraiensis* and *P. jezoensis* are typical companions of *Larix olgensis* in the tree layer. A relatively rich group of differential species is shown in Table 8.8. Tree-layer cover varies from (10)20% to 50(60)%, that of the shrub layer reaches at most 25%, herb-layer cover is lower than in the other subassociations, and moss-layer cover varies strongly, from 10% to 80%.

The association consists of larch forest at the highest elevations of all coniferous forests found in the Changbai-shan. It reaches a timberline and then continues in thin, patchy forms (krummholz) continuously changing into low shrub tundra of the association *Dryado tschonoskii-Rhododendretum aurei* Dostálek *et al.* 1988.

The substrate of of the raw soils is volcanic tuff and ash, with good mineral content. This substrate is also well aerated and has well-balanced moisture. The soil of *Rhododendro aurei-Laricetum olgensis* (Fig. 8.9) is poor, very to moderately acidic (pH 3.3–5.2), and lacking in nitrates (Table 8.17). It is covered by an acid litter and acidic humus layer. The lower

layer of the horizon is more basic, probably due to contact with the volcanic tuff.

Soil profiles:

Fig. 8.9, upper left, Table 8.8, relevé 3

A_{00} 0–1 cm – undecomposed dead moss,
A 1–6 – moderately humic soil without skeleton, brown, granular, sandy-loamy, slightly through-rooted, with sharp transition to C_1,
C_1 6–40 – soft, airy tuff, in the upper layer finely granular (about 2 mm in diameter) and disintegrating into fine tuff sand; downwards its size increases, reaching 2–4 cm at the base.

Table 8.8, relevé 6

A_{00} 0–5 cm – undecomposed dead leaves litter,
A_1 5–13(15) – blackish grey, moist, humic, richly through-rooted soil without skeleton,
A_2 13(15)–20 – clayey-loamy, beige soil mixed with weathered tuff,
C 20 and deeper – volcanic tuff.

Table 8.8, relevé 15

A_{00} 0–1 cm – undecomposed dead moss,
A_1 1–20 – loamy-sandy, granular, moist, brown, moderately through-rooted (rhododendron) soil, almost without skeleton,
C_1 20–40 – volcanic tuff of average size 2 cm (from sand to 5 cm), airy, moist and soft.

Table 8.8, relevé 27

A_{00} 0–1 cm – undecomposed grass,
A_1 1–11 – loamy-sandy, humic moderately through-rooted, freshly moist, granular soil with little humus,
C_1 11–23(25) – airy volcanic tuff of 1–3 cm in diameter,
A_2 23(25)–33(35) – loamy-sandy, humic granular, brown soil with little humus,
C_2 33(35) and deeper – airy volcanic tuff of 1–3 cm in diameter.

***Goodyero repentis-Piceetum jezoensis* ass. nova hoc loco** (Table 8.2, Fig. 8.10)
Nomenclatural type: Table 8.2, relevé 2

The association represents dark taiga, stands of which were found only in the mountains along the boundary between North Korea and China. Their distribution is probably wider in other high mountains of North Korea and in closed parts of China and Russia.

Picea jezoensis is the main tree-layer dominant, accompanied by *Abies nephrolepis*, *Picea koraiensis*, and *Larix olgensis*. The tree layer has no deciduous woody species, and only *Lonicera edulis*, penetrating from surrounding less closed stands, occurs sporadically in the shrub layer. The tree layer, with cover from 70 to 90% (exceptionally 60%), is very dense and creates very dark shade for lower layers. Similarly the shrub layer, with cover 35–60%, restricts the light needed by the for herb layer. Its cover is consequently low, only 15–35% (rarely 50%); *Linnaea borealis* and *Phyllodoce coerulea* are the most frequent herbs, though *Goodyera repens*, *Lycopodium complanatum*, *Vaccinium vitis-idaea*, and *Pyrola incarnata* also occur regularly in stands of this association. Moss cushions up to 60 cm thick cover at least 90% of the ground surface, and the herbs are rooted in this mat. *Ptilium crista-castrensis* and *Pleurozium schreberi* are dominants of the moss layer. Lichen cover is low. The association was divided into two subassociations:

1. *Goodyero repentis-Piceetum jezoensis usneetosum longissimae* subass. nova hoc loco

Nomenclatural type: identical with the nomenclatural type of the association name

Stands of this subassociation are decorated with dense garlands of the lichen *Usnea longissima*, hanging from branches of trees and shrubs. Three other good differential herb species were found, *Potentilla coreana*, *Saussurea alpicola*, and *Gentiana jamesii*, as well as four mosses (cf. Table 8.2).

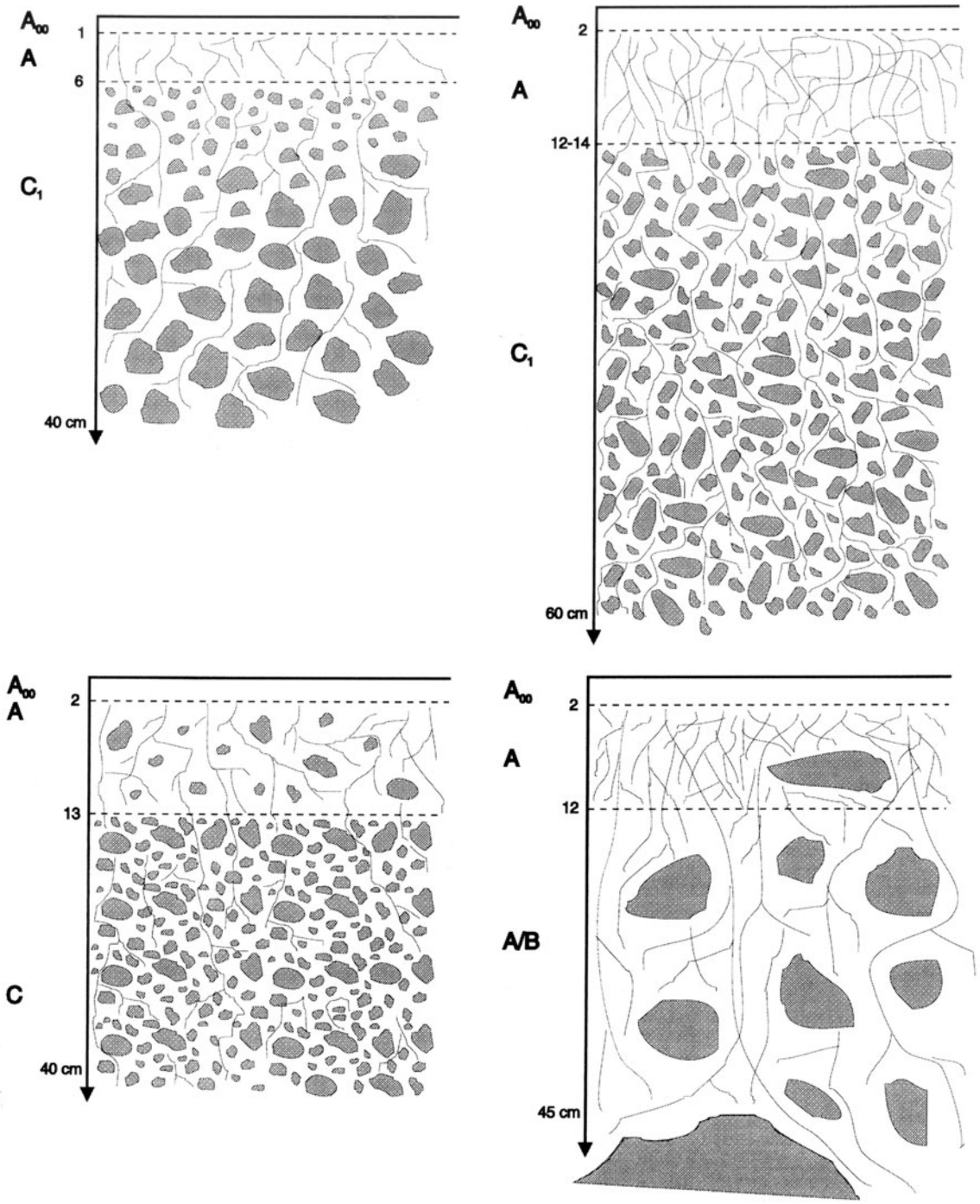

Figure 8.9. Soil profiles of *Rhododendro aurei-Laricetum olgensis* (upper left), *Ledo decumbentis-Laricetum olgensis* (upper right, lower left), and *Taxo-Pinetum pumilae* (lower right).

2. *Goodyero repentis-Piceetum jezoensis listeretosum nipponicae* subass. nova hoc loco

Nomenclatural type: Table 8.2, relevé 10

This community is differentiated by six species. Among them, the high constancy (100%) of the orchid *Calypso bulbosa* is syntaxonomically important. There are fewer moss species than in the other subassociation. *Ptilium crista-castrensis* is dominant in the moss layer.

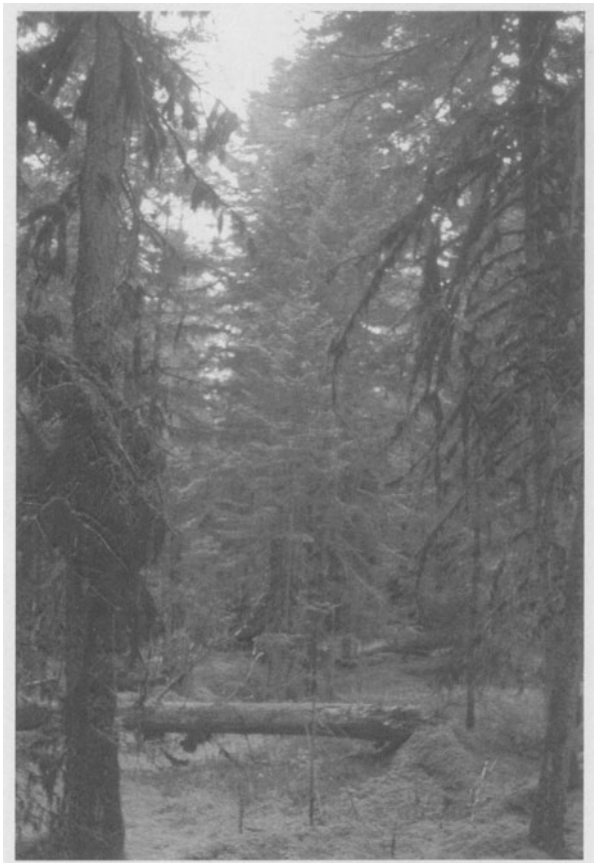

Figure 8.10. Goodyero repentis-Piceetum jezoensis, Paektu-san (photo by J. Kolbek).

The association was found in the Changbai-shan, in a wide area around Mt. Paektu-san, on gentle slopes with east or northeast orientation. Low cover in the herb layer, with few species, is typical for these stands. The physiognomy is determined by the nearly 100% cover by a thick moss layer and the dense shrub and tree layers, consisting of coniferous species shading lower layers. Small fluctuations in soil moisture would be expected, due to the densely closed moss layer.

Soil profile:

Table 8.2, relevé 8

A_{00} 0–3 cm – undecomposed dead moss,

A_1 3–9 – dark brown, humic to peaty, sandy-loamy to loamy-sandy crumbly soil without skeleton, slightly through-rooted, moist, indistinctly passing into A/C,

A/C 9–23 – sandy, grey mineral soil of grain size 1–2 mm, without coarser skeleton,

C_1 23–34 – beige to light grey tuff sand of grain diameter 2–4 mm,

C_2 34 and deeper – rusty brown tuff sand of grain diameter 1–10 mm.

The soils are acidic, with pH values about 4.0, and covered by a thick layer of mosses. Nitrates are essentially absent, and amounts of other anions, including phosphates, are very low (Table 8.18).

***Carici peiktusani-Abietetum nephrolepidis* ass. nova hoc loco** (Table 8.3, Fig. 8.11)

Nomenclatural type: Table 8.3, relevé 13

This association combines coniferous forests with various proportions of *Larix olgensis* and *Abies nephrolepis* in both tree and shrub layers. *Abies nephrolepis* penetrates into various communities of coniferous forest but in this association plays the role of dominant or subdominant. The dominant tree species determines the floristic composition and cover of the herb layer. Within the association three subassociations were distinguished:

1. *Carici peiktusani-Abietetum nephrolepidis iridetosum dichotomae* subass. nova hoc loco

Nomenclatural type: Table 8.3, relevé 5

Larix olgensis dominates, with *Abies nephrolepis* as subdominant. The stands are relatively more open than those of the other two subassociations. This is reflected in the presence of heliophytes among the differential species (*Dasiphora fruticosa*, *Iris dichotoma*, *Juniperus sibirica*, *Trollius ledebourii*) and in the

fact that herb-layer cover is the highest. *Ledum palustre* var. *maximum* also has high constancy in this subassociation and dominates the shrub layer.

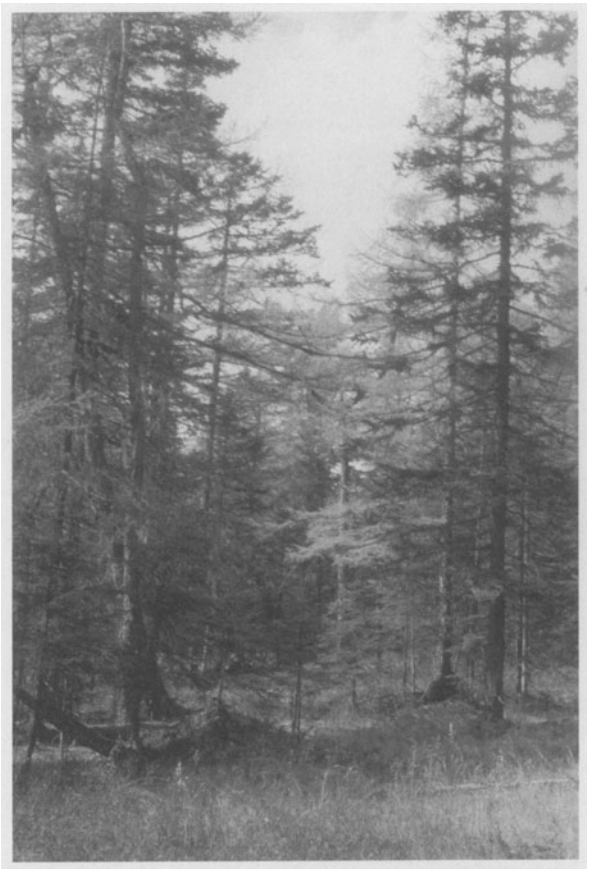

Figure 8.11. Carici peiktusani-Abietetum nephrolepidis, Paektu-san (photo by J. Kolbek).

2. *Carici peiktusani-Abietetum nephrolepidis phegopteridetosum polypodioidis* subass. nova hoc loco

Nomenclatural type: identical with the nomenclatural type of the association name

The cover by *Larix olgensis* and *Abies nephrolepis* is relatively balanced. *Picea jezoensis* is more frequent. The differential species tolerate more shade and higher cover in the tree layer.

3. *Carici peiktusani-Abietetum nephrolepidis lycopodietosum complanati* subass. nova hoc loco

Nomenclatural type: Table 8.3, relevé 16

Abies nephrolepis dominates in both the tree and shrub layers. Its densely branched crowns occasion deep shading of the herb layer, its consequent low cover (20–40%), and the occurrence there of shade-tolerant species such as *Lycopodium complanatum* and *Ribes horridum*. Stands of this subassociation lack the heliophilic species of the previous two subassociations (*Clintonia udensis*, *Prunus padus*, *Bupleurum longeradiatum*, *Clematis ochotensis*, *Ligularia fischeri*, *Lonicera edulis*, *Rosa davurica*, *Calamagrostis langsdorfii* etc.).

This association is a transitional unit between the light larch forests and dark taiga (represented in North Korea by *Goodyero-Piceetum jezoensis*, see above). This association was found at 1360–1450 m, on plains or slightly sloping relief. It is relatively species-rich and well differentiated from the other associations.

The soils of *Carici-Abietetum* are rather acidic (pH ± 3.8), poor in carbon and calcium. Anion content is low (Table 8.19).

Soil profile:

Table 8.3, relevé 10

A_{00} 0–5 cm – undecomposed fallen leaves litter,

A_1 5–20 – dark brown, very humic, moist, richly through-rooted soil,

A/C 20 and deeper – volcanic tuff, rusty brown, with moderate rooting.

***Ledo decumbentis-Laricetum olgensis* ass. nova hoc loco** (Table 8.4, Fig. 8.12)

Nomenclatural type: Table 8.4, relevé 6

The lowest belt of forests dominated by *Larix olgensis* in the high mountains near Paektu-san volcano was placed in this association. It occurs usually on plateaus or very gentle slopes, including regularly on slightly undulating terrain and in depressions with higher groundwater levels. Stands of this association occupy large areas near Samji Lake, which naturally keeps a higher groundwater level. This community develops typically at 1190–

Figure 8.12. Ledo decumbentis-Laricetum olgensis, Paektu-san (photo by J. Kolbek).

1400 m. Only smaller stands were found on plains or in depressions at higher elevation. The most important role in the floristic composition of this community is played by species adapted to higher groundwater levels and species growing on repeatedly wet substrates, such as *Ledum decumbens*, *L. palustre* var. *maximum*, *Betula platyphylla*, *Dianthus superbus*, *Salix arctica*, *Achillea ptarmica*, *Sanguisorba parviflora*, *Rhododendron parvifolium*, and *Vaccinium uliginosum*.

Larix olgensis dominates in the tree layer, with a high constancy also of *Betula platyphylla*. Tree cover varies between (5)20% and 75%. The stands are thin and light. The same species, together with *Lonicera edulis*, thus constitute a rich shrub layer with cover of (5)20–75%.

Within the association four subassociations were distinguished:

1. *Ledo decumbentis-Laricetum olgensis linnaeetosum borealis* subass. nova hoc loco

Nomenclatural type: Table 8.4, relevé 2

There are two differential species, *Linnaea borealis* and *Allium thunbergii*. *Ledum palustre* var. *maximum* and *Juniperus sibirica* are very frequent. The unit is strongly negatively differentiated by the absence of *Artemisia stolonifera*, *Rosa davurica*, *Dasiphora fruticosa*, *Festuca ovina*, *Sanguisorba parviflora* and *Fragaria orientalis*. This subassociation occupies wetter habitats than the others, at elevations near 1190 m. Herb-layer cover varies widely from 30 to 85%, broken by thick moss cushions. Shrub-layer cover is 45–70%. The tree layer is thin (30–70%), sometimes with gaps.

2. *Ledo decumbentis-Laricetum olgensis potentilletosum cryptotaeniae* subass. nova hoc loco

Nomenclatural type: identical with the nomenclatural type of the association name

This subassociation has 8 differential species (see Table 8.4). *Ledum palustre* var. *maximum* occurs at lower abundance but with high constancy, being completely lacking in the following two subassociations. Stands of this type occupy alternately wet and dry, well lighted habitats with wandering shade, at elevation 1190–1400 m.

3. *Ledo decumbentis-Laricetum olgensis brometosum jezoensis* subass. nova hoc loco

Nomenclatural type: Table 8.4, relevé 19

This subassociation with three weakly differential species (*Rhododendron dahuricum*, *Bromus jezoensis*, *Cladonia stellaris*) is however very well differentiated negatively. Thin stands of this subassociation are remarkable in that they have the lowest tree-layer and shrub-layer cover of all four subassociations. The differential species are heliophilic and are missing in the other coniferous communities studied. This more thermophilous, xerophilous wing of the association occupies plains and is characterized by lower frequency and abundance of *Ledum palustre* and *Vaccinium uliginosum*.

4. *Ledo decumbentis-Laricetum olgensis betuletosum paishanensis* subass. nova hoc loco

Nomenclatural type: Table 8.4, relevé 21

This subassociation occurs at highest elevation, 1400–1600 m, on flat areas and gentle slopes with regularly undulating terrain. Undulating surfaces permit the simultaneous occurrence of more mesic species (such as *Rhododendron parvifolium*, *Iris dichotoma* and *Betula paishanensis*) and more xeric species (such as *Potentilla coreana*, *Majanthemum dilatatum*, and *Thalictrum contortum*). Cover is relatively low in the tree layer (20–60%) and shrub layer (20–45%). All diagnostic taxa, including *Lonicera edulis* in the shrub layer, are heliophilic species. The occurrence of *Carex peiktusani* suggests that the subassociation is transitional to the association *Carici peiktusani-Abietetum*, which occupies connected neighbouring habitats at lower elevations.

The stands of *Ledo-Laricetum* at the lowest elevations of the *Larix olgensis*-dominated forest are probably affected significantly by human activities. People systematically cut some tree species, mainly *Larix olgensis*. The resulting canopy gaps permit greater development of the shrub layer. It is curious, however, that lumbering does not affect the structure and floristic composition of the community so much. Reconstruction of the community, up to the subassociation level, is possible even at heavily impacted locations around villages.

The soils of the *Ledo-Laricetum* (Fig. 8.9) are rather acidic (pH 4.2–4.8) and poor in carbon and calcium. Both the C:N and Ca:Mg ratios are balanced. Anion content is low (Table 8.20).

Soil profiles:

Fig. 8.9, upper right, Table 8.4, relevé 1

A_{00} 0–2 cm – undecomposed litter larch litter,

A2–12(14) – humic, densely rooted, grey, sandy-loamy, granular to slightly crumbly soil,

C_1 12(14)–60 – dark yellow, very pervious volcanic tuff, without the humus component and with moderate rooting.

Fig. 8.9, lower left, Table 8.4, relevé 19

A_{00} 0–2 cm – undecomposed dead moss,

A2–13 – blackish gray, humic, sandy-loamy to loamy-sandy, crumbly, freshly moist soil, moderately rooted, with small tuff pieces of 1 cm (10%), distinctly passing into the C horizon,

C 13–40 – tuff gravel 1–2 cm in diameter, with admixture of sand.

Rhododendro dahurici-Acerion barbinervi all. nova hoc loco

Nomenclatural type: *Polysticho retroso-paleacei-Rhododendretum dahurici*

Characteristic and differential species: *Acer barbinerve*, *Cladonia amaurocraea*, *Oncophorus wahlenbergii*, *Polypodium virginianum* L., *Polystichum retroso-paleaceum*, *Rhododendron*

dahuricum, *Sedum middendorffianum*, *Sphagnum girgensohnii*

This alliance includes the shrub and mantle communities of coniferous and deciduous forests at higher altitudes of eastern Asia. Tree-layer species are present only sporadically and with low cover usually not exceeding 30%. The shrub layer has often a high cover, but there are also stands with low shrub-layer cover, which can physiognomically be called mantle communities. Due to regular soil cultivation for agriculture, natural shrub and mantle communities occur only sporadically in the landscape. Such communities develop regularly as forest mantles, however, in less accessible mountains and higher hill country, on sites rather remote from settlements, or in habitats where forests are hindered edaphicaly. Their occurrence around talus and rocks is conditioned edaphically and represents disclimax stages of primary succession.

In the northern part of the Korean Peninsula, this alliance is represented recently by only one identified association occurring in the mountains along the boundary with China.

***Polysticho retroso-paleacei-Rhododendretum dahurici* ass. nova hoc loco** (Table 8.5)

Nomenclatural type: Table 8.5, relevé 3

This is a synecologically conditioned shrub community related exclusively to ventarol cracks at the margins of lava flows in the Changbai-shan. Stands of this community are dense shrub thickets mainly of *Rhododendron dahuricum* accompanied by *Betula platyphylla*, *Acer barbinerve*, etc. Shrub-layer cover can reach 90%. Trees occur only occasionally (*Larix olgensis*, *Betula platyphylla*, rarely *Sorbus amurensis* and *Abies nephrolepis*), with low canopy (0–30%, maximum 45%). The herb layer consists of *Ledum palustre* var. *maximum*, *Polystichum retroso-paleaceum*, *Polypodium virginianum*, *Lycopodium clavatum*, *L. chinensis*, *Camptosorus sibiricus* and *Lepisorus ussuriensis*. Physiognomically important are the moss and lichen layers, with regularly high cover of around 95%. *Sphagnum girgensohnii*, *Pleurozium schreberi*, *Ptilium crista-castrensis* and *Hylocomium splendens* are the most abundant species. *Cladonia rangiferina* var. *grisea*, *C. amarocraea* and *Oncophorus wahlenbergii* occur with high constancy. The association was divided into two subassociations:

1. *Polysticho retroso-paleacei-Rhododendretum dahurici ledetosum maximi* subass. nova hoc loco

Nomenclatural type: identical with the nomenclatural type of the association name

This subassociation is differentiated by the high abundance and constancy of *Ledum palustre* var. *maximum*, mosses *Sphagnum girgensohnii*, *Dicranum polysetum*, and *Rhytidium rugosum*, and the lichen *Peltigera scabra*. The stands represent an earlier successional stage, on rocky volcanic tuff, with lower cover by the shrub layer and higher cover by the herb layer.

2. *Polysticho retroso-paleacei-Rhododendretum dahurici sorbetosum amurensis* subass. nova hoc loco

Nomenclatural type: Table 8.5, relevé 13

Stands of this subassociation are characterised by high constancy of *Sorbus amurensis* in shrub layer, of *Daphne kamtschatica* in the herb layer, and of *Anastrophyllum minutum* and *Cladonia stellaris* in the moss layer. These stands represent a later, more developed successional stage with higher shrub-layer cover and lower cover by trees and herbs.

All stands of this association were found around Naegok Village, at about 950–1000 m, on 30–40° slopes with north, northeast or northwest orientation. This association would be expected all along lava flows at the foot of volcanos in North Korea and China.

The soil in one sample was very acidic (pH 3.8), as can be expected in the volcanic vapours containing sulphur dioxide and from the acidic humus (Table 8.21).

Soil profile:

Table 8.5, relevé 6

A_{00} 0–1 cm – undecomposed dead moss and lichens,

A 1–6 – richly rooted, sandy-loamy humic peaty soil without skeleton,

A/C 6–15 – tuff sand.

***Abieti nephrolepidis-Piceion jezoensis* Song 1991**

This alliance was described for isolated subalpine coniferous forests in northeastern Asia (cf. Song 1991, 1992a). In Korea these communities occur in highest summits in central and southern part of country. More northern are developed the continental coniferous forests, described here as new alliance *Laricion olgensis.*

The *Abieti nephrolepidis-Piceion jezoensis* is determined by the presence of species such as *Acer ukurundense*, *A. tschonoskii*, *Lonicera sachalinensis*, *Rhododendron schlippenbachii*, *Syringa wolfi*, *Thuja koraiensis*, *Tripterygium regelii*, and *Vaccinium koreanum*, whereas typical boreal species of the *Vaccinio-Piceetea* are almost absent.

***Taxo-Pinetum pumilae* Song et Nakanishi 1985** (Table 8.6, rels. 1–3)

Pinus pumila, a dwarf pine, represents a Siberian boreal element that immigrated into the Korean Peninsula during Pleistocene.

The stands are open and occupy windy, cold, dry habitats, typical of the highest mountain ridges and summits. In North Korea the community was recorded only on SW slopes and on the tops of Mt. Wonmanbong and Mt. Pirobong (Myohyang-san), from 1750 to the 1870 m. According to Korean colleagues from Pyongyang similar stands were observed near the Chinese boundary. This association was described by Song & Nakanishi (1985) from similar ecological conditions on Mt. Sulak (= Sorak, Soelag) of South Korea. They characterize the dominant dwarf pine as a cold-resistant, cryophilic, but chionophobic taxon with very narrow ecological amplitude.

Generally, *Pinus pumila* stands do not correspond to the krummholz belt of Europe, despite the physiognomic similarity and frequent occurrence at treeline. Okitsu & Ito (1984, 1989) and Okitsu (1998) consider *Pinus pumila* to be a unique species growing well in habitats with sufficient snow cover during long winters. At lower elevation and in more protected places, *Pinus pumila* is slowly replaced by growth with isolated stunted *Betula ermanii* and open forest dominated by *Picea jezoensis*. *Betula ermanii* might have been the only competitor for the niche of *Pinus pumila* (Okitsu & Ito 1989) especially on substrates with a layer of fine soil. *Pinus pumila* dominates strongly on rocky sustrates. Chytrý *et al.* (1995) described the *Pleurozio schreberi-Pinetum pumilae* from the subalpine belt of the Barguzinskiy range in eastern Siberia. It is not similar to the *Taxo-Pinetum.* A different association *Vaccinio-Pinetum pumilae* Maeda et Shimazaki 1951, as well as higher syntaxa, are known from Japan (Miyawaki 1986, 1987).

The rare endemic *Taxus caespitosa* does not occur in North Korea, but the whole physiognomy of this community is very similar. In monodominant stands *Pinus pumila* grows with *Thuja koraiensis*, *Rhododendron aureum*, solitary individuals of *Betula ermanii*, *Syringa wolfi*, and rarely *Abies nephrolepis*. Characteristic species of higher syntaxa are *Thuja koraiensis*, *Tripterygium regelii*, *Lonicera sachalinensis*, and *Acer tschonoskii*. As on Mt. Sulak, typical *Vaccinio-Piceetea* species are missing or are very scarce. According to Okitsu & Ito (1989), the *Pinus pumila* scrub on windswept ridges represents relict thickets. The canopy is a densely closed shrub layer of dwarf-pine, around 50–120 cm high. The herb layer is poor, frequently with only *Calamagrostis arundinacea* var. *hirsuta.* Well developed moss layer was not determined.

The soil (Fig. 8.9) is moderately acidic (pH 4.5–5.1) and apparently possesses a good buffering capacity, which is manifested in the small difference between the actual and exchangeable acidity (Table 8.22). The upper soil horizon is richer in nutrients of organic origin, especially potassium, phosphorus, nitrogen and nitrates. The ratio of calcium to magnesium is favourable, even in the lower layers of the profile.

Soil profiles:

Table 8.6, relevé 2

A_{00} 0–3 cm – undecomposed fallen leaf litter,

A3–12 – dark brown, loamy, moist soil with dense rooting,

A_1 12–25 – brown, loamy, densely rooted soil with admixture of small gravel,

A/C 25 and deeper – weathered bedrock mixed with the upper horizon.

Fig. 8.9, lower right, Table 8.6, relevé 3

The depth of the soil profile depends on the relief, i. e. on outcrops, with soil pockets of variable depth

A_{00} 0–2 cm – undecomposed leaf litter,

A2–12 – dark brown, loamy, crumbly, very strongly rooted soil, practically without skeleton or with coarse skeleton fallen from the walls,

A/B 12–45 – loamy to clayey-loamy, crumbly soil, lighter brown than the upper layer, moderately rooted, freshly moist.

***Thujo koraiensis-Piceetum jezoensis* ass. nova hoc loco** (Table 8.6, rels. 4–7)

Nomenclatural type: Table 8.6, relevé 5

This community represents a transition zone between *Pinus pumila* thickets and the forests below. Characteristic stands occur above treeline or closely below it, where the tree layer is not closed but forms open stands with good light conditions for the lower layers. This association has been found below the main mountain ridge of the Myohyang-san, at altitudes between 1630 and 1755 m, on sites with shallow soil and on slopes from 15 to 55°. This is analogous to the stands of *Pinus pumila* at higher elevation.

Typical stands are characterized by a canopy of *Picea jezoensis*, sometimes also with *Abies nephrolepis* and with a maximum tree-layer coverage of 50%. The shrub layer (cover 30–60%) is constituted by spruce and *Betula ermanii*, with *Thuja koraiensis* common in the lower layer. The alliance species, such as *Acer ukurundense* and *Rhododendron schlippenbachii* are present in with higher quantity. The herb layer is richer and more diverse, formed partly by heliophilic grasses and partly by elements of subalpine meadows, such as *Scabiosa japonica* var. *alpina*, *Ligularia fischeri*, *Anemone narcissiflora*, *Calamagrostis arundinacea* var. *hirsuta*, or *Clintonia udensis*.

The soil (Fig. 8.13) is acidic (pH 3.9–4.9) and relatively poor, with a distinct decrease of nitrogen, nitrates, calcium and magnesium in the lower layer (Table 8.23). The deeper part of the horizon is more alkaline; acidification of the upper soil results from decomposition of the acidic leaf litter.

Song (1991) published a new association *Thujo-Abietetum nephrolepidis* from Mt. Sulak and Taebaek in central Korea. *Rhododendron brachycarpum* var. *roseum*, *Alnus fruticosa* var. *mandshurica*, and high constancy of *Abies nephrolepis* differentiate this association, while *Picea jezoensis* is not present.

Soil profiles:

Table 8.6, relevé 5

A_{00} 0–2 cm – undecomposed leaf litter,

A2–10 – crumbly, (sandy-) loamy, very strongly rooted, airy, humic soil with angular skeleton (10–20%),

A/C 10 and deeper – transition to the geological substrate.

Fig. 8.13, upper left; Table 8.6, relevé 7

A_{00} 0–1 cm – litter mixed with moss,

A1–10(12) – very humic, dark brown, strongly rooted, crumbly, loamy, freshly moist soil with twig fragments,

A/C 10(12)–30 – brown crumbly soil, lighter than the upper layer, humic, with moderate rooting.

3.3.2 Broad-leaved and mixed forests

QUERCO-FAGETEA CRENATAE Miyawaki et al. 1968 em. Kim J.-W. (1990) 1992

Rhododendro-Quercetalia mongolicae Kim J.-W. 1992

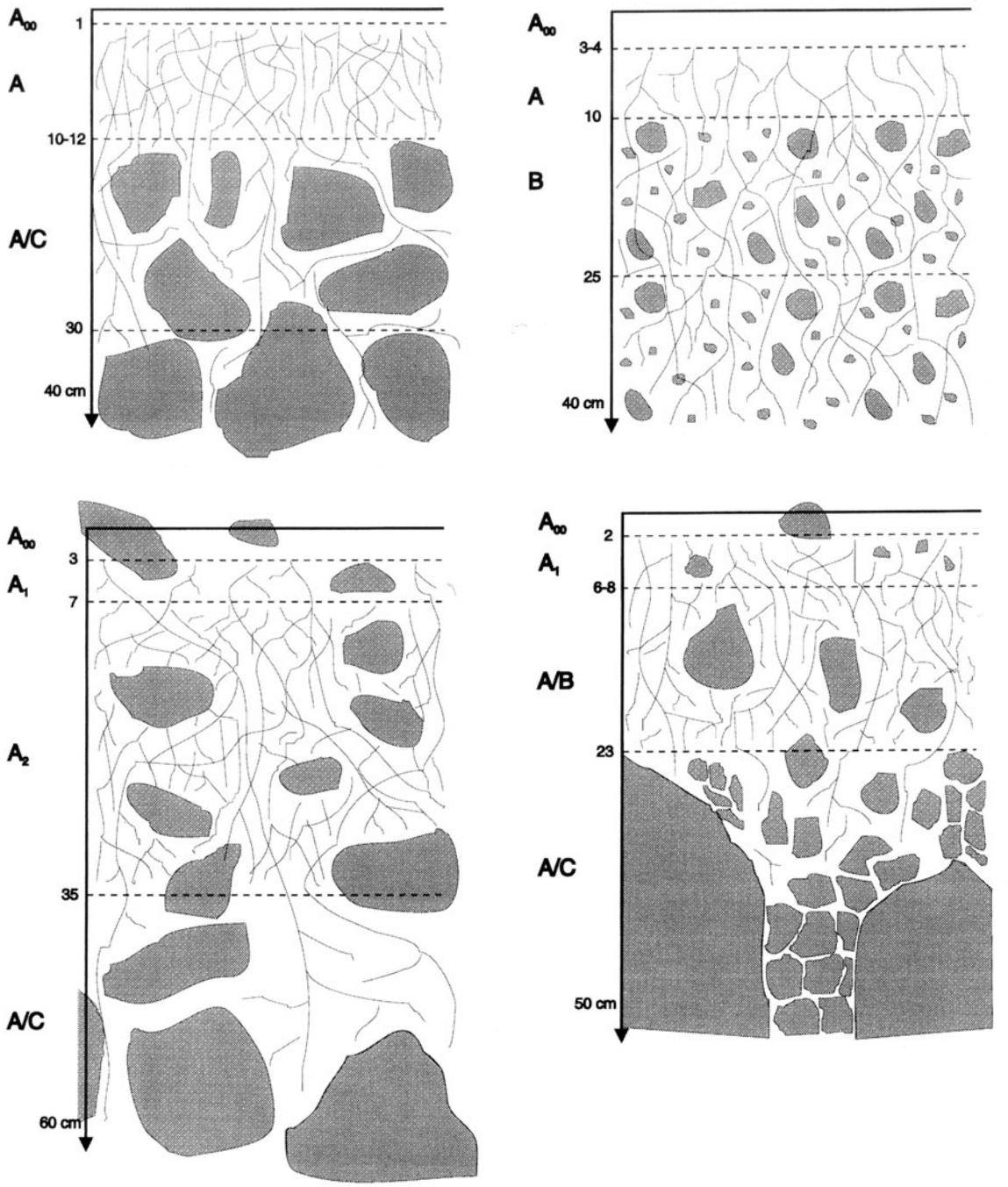

Figure 8.13. Soil profiles of *Thujo koraiensis-Piceetum jezoensis* (upper left) and *Vaccinio-Quercetum mongolicae* (others).

***Pino koraiensis-Quercion mongolicae* Kim J.-W. 1990**

Syn.: *Rhododendro-Quercion mongolicae* Song 1988 em. Takeda *et al.* 1994

Continental, typical Korean mixed and deciduous oak forests occur mainly at higher elevation in the central part of the Korean Peninsula. Similar formations are known from southern Manchuria and Primorye (eastern Siberia). These represent a natural connection between subalpine coniferous forests to the north and temperate broad-leaved forests to the south. Typical features of these forests include higher abundance of various fern species, such as *Athyrium coreanum*, *Dryopteris crassirhizoma*, *Polystichum tripteron*, and frequent occurrence of conifers, *Abies nephrolepis* and most commonly *Pinus koraiensis*. The alliance *Pino koraiensis-Abietion nephrolepidis* described from the mountains of Sikhote-Alin by Gumarova (1993) has roughly the same floristic composition. The dominant trees there are also *Pinus koraiensis* and *Abies nephrolepis*, along with some species of *Acer* and *Euonymus*, and numerous ferns.

Kim J.-W. (1990, 1996), in his floristic characterisation of the alliance *Pino koraiensis-Quercion mongolicae*, also mentioned *Euonymus*, *Saussurea*, *Tilia*, and *Ligularia* as typical genera of this unit (all present also in our relevés). The tree and shrub layers very often contain trees of scree forests, such as various *Acer* and *Tilia* species, *Cornus controversa*, and *Magnolia sieboldii*. All these species differentiate this vegetation from the alliance *Lindero-Quercion mongolicae*, which comprises the associations occurring in the southern part of the Korean Peninsula, mainly at lower altitudes.

***Lychno-Quercetum mongolicae* Kim J.-W. 1990** (Table 8.7, Fig. 8.14)

Syn.: *Fraxino-Abietetum koreanae* Song 1988

This community groups mesic pine-oak mixed forests of montane belts. The soils are nutrient-rich and humid. The frequent mist and high air humidity in the mountain valleys and on northwestern slopes are the most typical physical features of these habitats in central North Korea. The best developed stands of this community, practically with a complete set of diagnostic taxa, occurred below Mt. Pobwang-bong in the Myohyang-san, on west-facing slopes at altitudes between 1050 and 1130 m. Only one atypical relevé (Table 8.7, rel. 21) was recorded, in the Sujang-san at lower altitude.

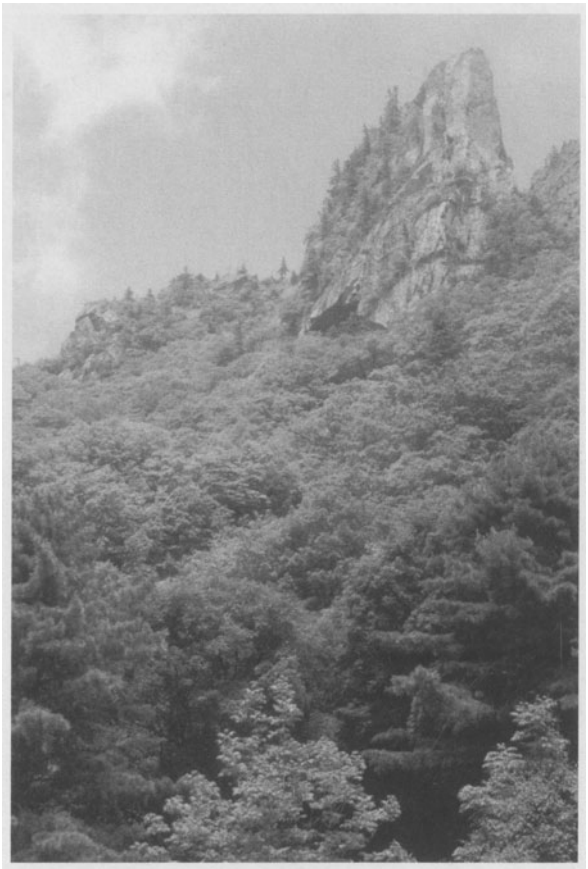

Figure 8.14. Lychno-Quercetum mongolicae, Myohyang-san (photo by J. Kolbek).

Kim J.-W. (1990) characterises the optimal conditions for this community similarly, namely altitudes from 900 to 1300 m and humid climate. He paid particular attention to the occurrence of rare or Korean-endemic taxa such as *Primula jezoana* and *Viola diamantica*, which have a close affinity to this association. These species were found in North Korea, but another species, *Ajuga spectabilis*, is endemic to South Korea only. Some other species also

seem to be weakly characteristic of this association, such as *Angelica gigas*, *Lychnis cognata*, *Pseudostellaria palibiniana*, and *Tripterygium regelii*. The author divided the association into two subassociations, a *Lychno-Quercetum mongolicae disporetosum ovalae* and a *Lychno-Quercetum mongolicae galietosum kamtschaticum*. Some differential species, such as *Disporum ovale*, *Melampyrum roseum*, *Polygonatum odoratum* var. *pluriflorum*, and *Smilax nipponica*, occur in North Korea in a somewhat different combination. The delimitation of both units after combining our relevés is as follows.

1. *Lychno-Quercetum mongolicae disporetosum ovalae* Kim J.-W. 1992

This subassociation includes species-rich stands differentiated by *Acer mono*, *Carpinus cordata*, *Magnolia sieboldii* in the tree layer, and by *Rubus crataegifolius* and *Viola collina* in understories. *Disporum ovale* also occurs but is missing in the next unit.

2. *Lychno-Quercetum mongolicae astilbetosum thunbergii* subass. nova hoc loco

Nomenclatural type: Table 8.7, relevé 13

This subassociation is not as species-rich. It occurs in the Myohyang-san and Kumgang-san, at 500–1230 m. *Lespedeza hedysaroides*, *Rhododendron mucronulatum*, name-giving *Astilbe thunbergii*, as well as *Pinus koraiensis*, which occurs some in all layers, can be indicated as differential species.

The relevés (Table 8.7, rels 18–21) represent managed woodlots in various stages after afforestation, some of which can better be described as stunted scrub or brush. If the tree layer is present (Table 8.7, rels 18–19), all etages are species-poor in comparison with „optimally" developed stands.

The soils are acidic to moderately acidic (pH 4.6–5.6), rather poor in lower layers of the horizon. The A_0 layer is richest, with a higher content of nitrates (Table 8.24). The whole profile is characterized by a higher ratio of magnesium to calcium.

Soil profiles:

Table 8.7, relevé 4

A_{00} 0–3 cm – undecomposed leaf litter,
A3–15 – dark brown, loamy, well rooted soil, on debris substrate with big boulders.

Table 8.7, relevé 5

A_{00} 0–2 cm – undecomposed leaf litter,
A_1 2–8 – very humic, dark brown, crumbly, loamy, moist soil with dense rooting,
B_1 8–20 – sandy-loamy, lighter brown, well rooted soil with admixture of small gravel,
B 20–40 – loamy soil without gravel but otherwise with similar properties to B_1.

Table 8.7, relevé 6

A_{00} 0–2 cm – undecomposed leaf litter,
A_0 2–4 – brown, moist layer rich in humus,
A_1 4–15 – light brown, loamy soil with admixture of sand and gravel up to 5 cm in diameter,
A/C 15 and deeper – rock blocks with admixture of soil from the upper layers.

***Vaccinio-Quercetum mongolicae* Kim J.-W. 1990** (Table 8.8, Fig. 8.15)

Syn.: *Corylo-Quercetum mongolicae* Song 1988, *Quercus mongolica-Pinus koraiensis* community Nakanishi et Choi 1986 p.p. min.

This community occurs on southern and western 16 to 40° slopes. In North Korea it was considered only at higher elevations (820–1210 m) in the Myohyang-san, but in mountains of South Korea (Taebaek Mts, Sobaek Mts, and others ranges), well developed forests were re-evaluated and described as a new association by Kim J.-W. (1990).

Quercus mongolica is the dominant tree; the most abundant shrubs are broad-leaved *Rhododendron schlippenbachii* and young individuals of *Acer pseudosieboldianum*. The herb layer is not rich and is composed mainly of acidophilous species such as *Vaccinium koreanum* and *Melampyrum roseum*, and relatively humus-loving *Ainsliaea acerifolia*, *Astilbe koreana*,

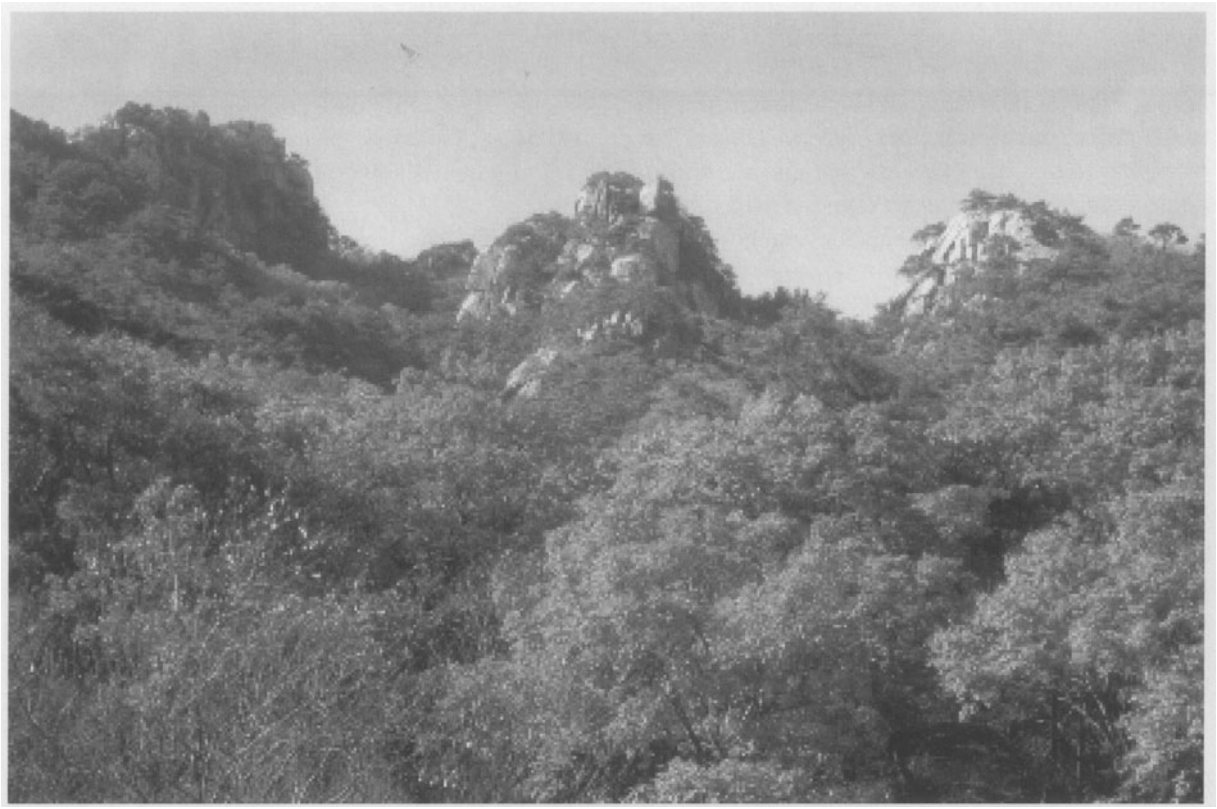

Figure 8.15. Vaccinio-Quercetum mongolicae, Myohyang-san (photo by J. Kolbek).

and *Hepatica asiatica*. The woody species composition and structure of these stands are in some cases affected by farming activities, so the stands are considered to be degraded forest stages. This community is occasionally established as a secondary community of the *Lychno-Quercetum mongolicae* on upper slopes (Kim J.-W. 1990). Kim recognized two subassociations. According to diagnostic species such as *Abies holophylla*, *Betula ermanii*, *Carpinus cordata*, only the last relevé shows an affinity to the subassociation *Vaccinio-Quercetum mongolicae abietetosum holophyllae*. Other relevés (1–4 rels in Table 8.8) are floristically and ecologically more or less related to the subassociation *Vaccinio-Quercetum mongolicae hostetosum longipes*. *Melampyrum roseum*, *Hosta longipes*, and *Saussurea grandiflora* are differential species of the subassociation. The last relevé also appears to have an intermediate character, but we placed all phytocoenoses at the association level, based on our material.

This association has been described from southern Korea at around 1000 m. The altitudes in the Myohyang-san are comparable and vary between 600 and 1250 m. Large granite boulders with little moist soils between them represent typical ecological conditions of this community, which occupies rocky granite plates on open, extremely sunny slopes with shallow, nutrient-poor soils. The dryness and acidity of the soils result in low cover by lichens and mosses.

The soil (Fig. 8.13) is acidic to moderately acidic (pH 3.9–4.9). The upper layer is rich in organic nitrogen and nitrates, whereas the lower layer is markedly poorer, especially in magnesium; the content of nitrogen and carbon also decreases downward (Table 8.25).

Soil profiles:

Fig. 8.13, upper right; Table 8.8, relevé 1

A_{00} 0–3(4) cm – undecomposed litter from oak and rhododendron leaves,

A3(4)–10 – half-decomposed humus layer, blackish grey, without skeleton, with fine roots, frequent concretions, and a sharp transition to,

B 10–25 – clayey-loamy, freshly moist soil with small gravel 0.5–5 cm in size (20%), richly rooted, rusty brown, moderately crumbly.

Fig. 8.13, lower left; Table 8.8, relevé 2

A_{00} 0–3 cm – layer of undecomposed litter,

A_1 3–7 – layer of decomposed litter of dark brown colour, freshly moist with coarser skeleton,

A_2 7–35 – loamy, rusty brown, freshly moist, crumbly and richly through-rooted soil with coarse skeleton (40%),

A/C 35–60 – rusty brown, crumbly, clayey-loamy, slightly through-rooted soil with coarse skeleton (60%).

Fig. 8.13, lower right; Table 8.8, relevé 5

A_{00} 0–2 cm – layer of undecomposed litter,

A_1 2–6(8) – sandy-loamy humic soil, crumbly, dark brown, freshly moist, strongly penetrated by tiny roots,

A/B 6(8)–23 – rusty brown, clayey-loamy soil with coarse skeleton (25%), crumbly, very richly penetrated by roots of herbs and woody plants,

A/C 23–50 – weathered rock substrate (granodiorite) with infiltration from the A/B horizon of soil with the same properties but little rooting.

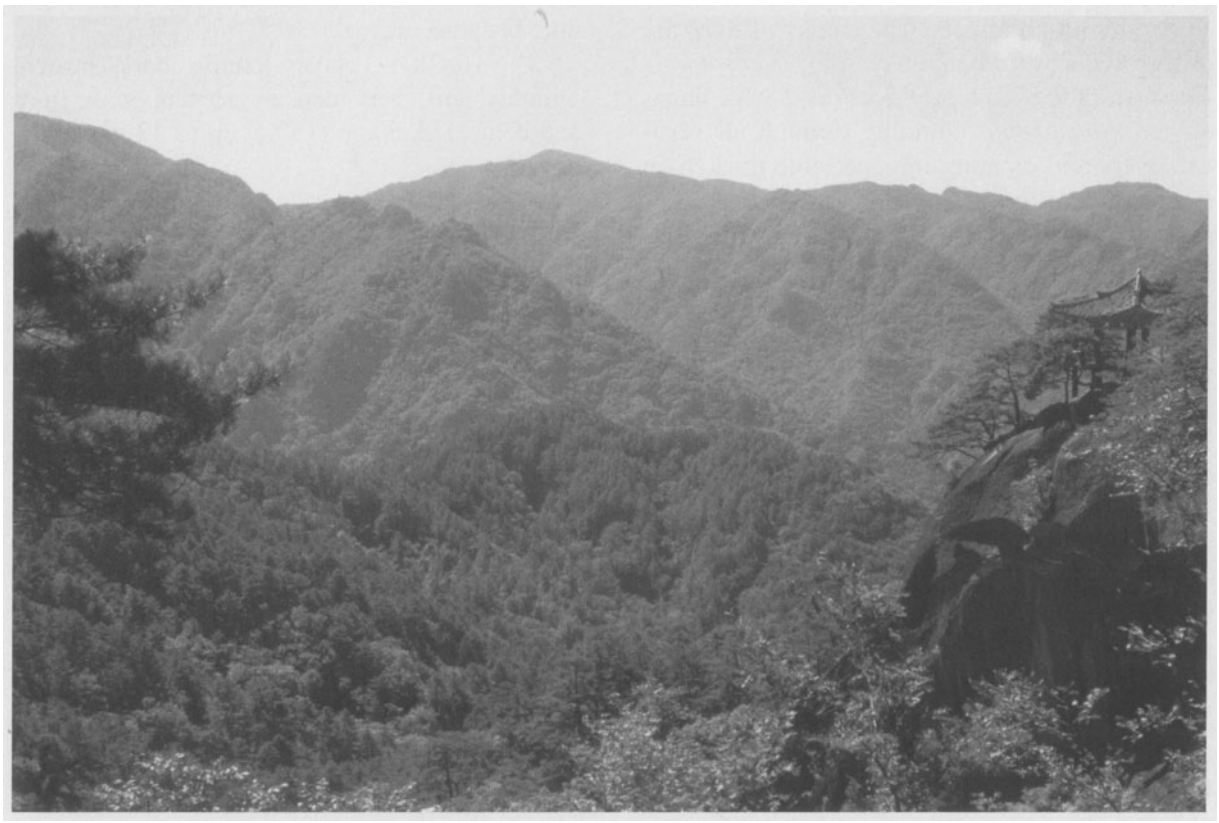

Figure 8.16. Parthenocisso tricuspidati-Fraxinetum rhynchophyllae, Myohyang-san (photo by J. Kolbek).

***Parthenocisso tricuspidati-Fraxinetum rhynchophyllae* ass. nova hoc loco** (Table 8.9, Fig. 8.16)

Nomenclatural type: Table 8.9, relevé 7

North-exposed rocky slopes and shattered rocky crests in the Myohyang-san provide optimum humid conditions for development of mesic forests dominated by ashes (*Fraxinus* spp.). The community has been recorded at altitudes between 303 and 700 m, but distribution is limited in particular areas by shallow soil. In addition to *Fraxinus rhynchophylla*, *Pinus densiflora* and *Micromeles alnifolia* also occur in the tree layer, with oaks (*Quercus mongolica*, *Q. dentata*) less important. Typical for the shrub layer is a dense growth of *Acer pseudosieboldianum* and other maple species which, together with other woody species, such as *Magnolia sieboldii*, are able to grow on the shallow but fresh, nutrient-rich soil scattered among granite boulders. The trunks of trees are overgrown by *Parthenocissus tricuspidata*. Trees are also frequently decorated with lianas of *Actinidia arguta* climbing through all vertical layers and creating impenetrable thickets in some places. *Rhododendron* species are practically absent. In the herb layer herbs are less frequent than tree seedlings.

Some of the relevés (Table 8.9, rels 8–11) were recorded near Habiro Monastery, and these are probably under long-term pressure of human activities. Changes in the tree layer are a result of deforestation together with introduction of conifers such as *Pinus koraiensis* and *Larix olgensis*, or preference of *Pinus densiflora* and *Quercus mongolica*.

The soils (Fig. 8.17, 8.18) are acidic to moderately acidic (pH 3.8–5.9), and the exchangeable acidity is very high (Table 8.26). The upper humus layer differs markedly by its higher nutrient content, some samples showing a higher content of nitrates. The debris character of the soil, with a higher content of humus and moisture, is completed by the higher content of calcium (Table 8.9, rel. 7) that may come from snail shells. It is among the richest soils analysed from the region.

Soil profiles:

Fig. 8.17, upper right; Table 8.9, relevé 1

A_{00} 0–5(6) cm – undecomposed leaf and needle litter,

A_0 5(6)–9 – decomposed leaf and needle litter,

A_1 9–12 – freshly moist, humic, crumbly soil, richly rooted, with humus intrusions into deeper subhorizons,

A/C 12–25 – loamy-sandy, crumbly soil with fine skeleton (40%), uneven transition to bedrock.

Fig. 8.17, upper left; Table 8.9, relevé 2

A_{00} 0–5 cm – undecomposed litter, very moist, needles and leaves,

A_0 5–8 – half-decomposed dark brown humus,

A_1 8–16 – sandy-loamy to loamy, crumbly soil with many concretions, richly rooted, humic, blackish grey,

A_2 16–28 – clayey-loamy, dark brown, crumbly soil, very densely rooted, with finer and coarser skeleton (15%), up to 12 cm in diameter,

A/C 28–50 – clayey-loamy, brown, crumbly, freshly moist soil with finer and coarser skeleton (25%) and with increasing content of coarser skeleton below 50 cm.

Fig. 8.18, upper right; Table 8.9, relevé 3

A_{00} 0–2 cm – undecomposed litter,

A_0 2–4 – humus layer of decomposed litter, freshly moist, with dense growths of fine roots and with coarse skeleton (60%),

A/C 4–45 – dark brown, loamy, crumbly, freshly moist soil with coarse skeleton (70–80%), very densely rooted.

Fig. 8.18, upper left; Table 8.9, relevé 4

A_{00} 0–4 cm – undecomposed moist layer of leaves,

A_0 4–8 – humic layer of undecomposed leaves, slightly rooted, dark brown,

A_1 8–20 – clayey-loamy, slightly rooted, moist, crumbly, brown soil with skeleton to 3 cm in size (20%),

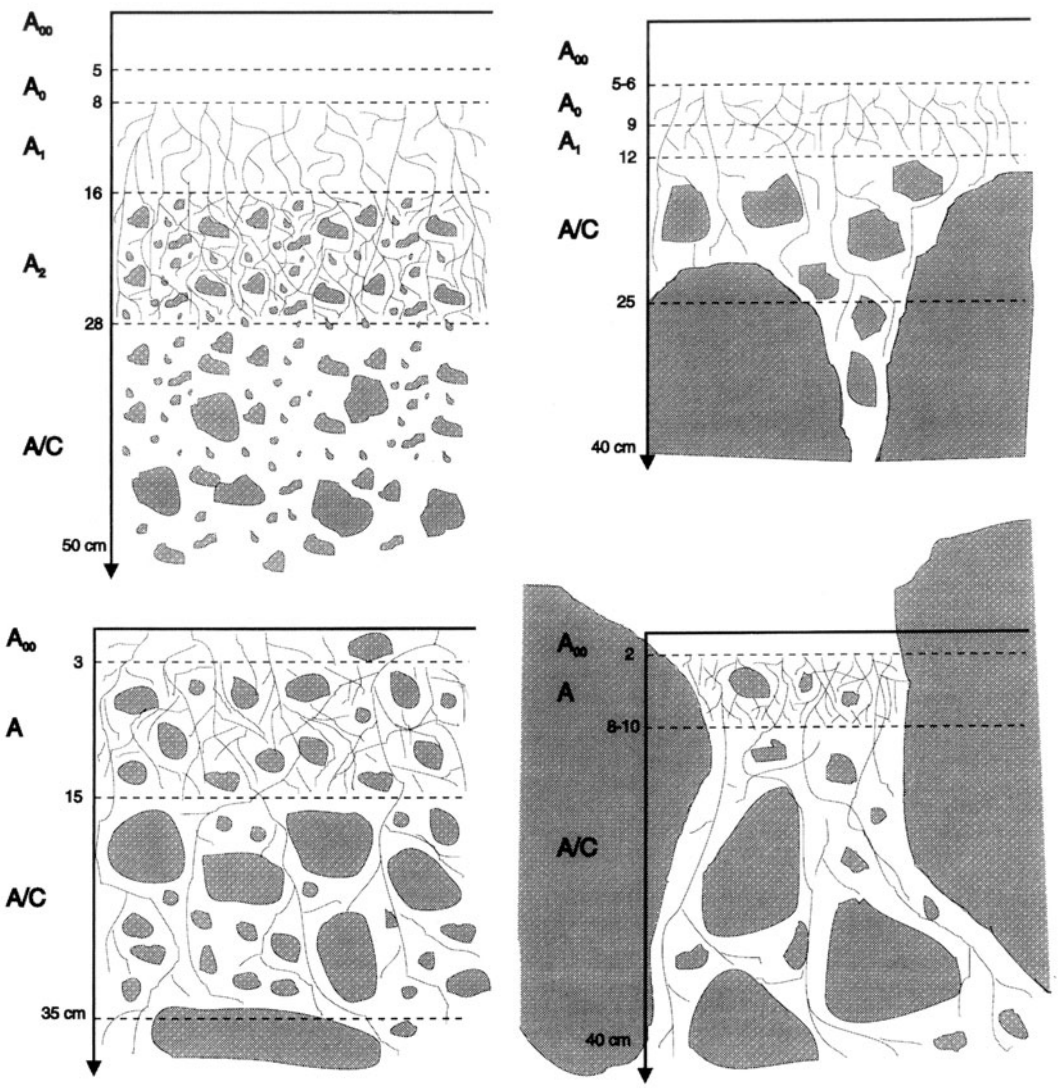

Figure 8.17. Soil profiles of *Parthenocisso tricuspidati-Fraxinetum rhynchophyllae*.

A/B 20–40 – clayey-loamy, crumbly to granular soil, more rooted than the upper layer, moist, skeleton content up to 50%,

C_1 40 cm and deeper – increasing content and size of skeletal material.

Fig. 8.18, lower left; Table 8.9, relevé 5

A_{00} 0–3 cm – undecomposed leaves and other litter,

A_1 3–6 – humus-rich, dark brown, freshly moist, crumbly soil, densely penetrated by fine roots with mull,

B 6–37 – loamy, brown, crumbly, slightly moist soil with skeleton (30%), lighter brown than A_1, richly rooted,

C_1 37–45 – greyish black layer of overlapping humus horizon, crumbly, sandy-loamy with abundant skeletal material (up to 90%).

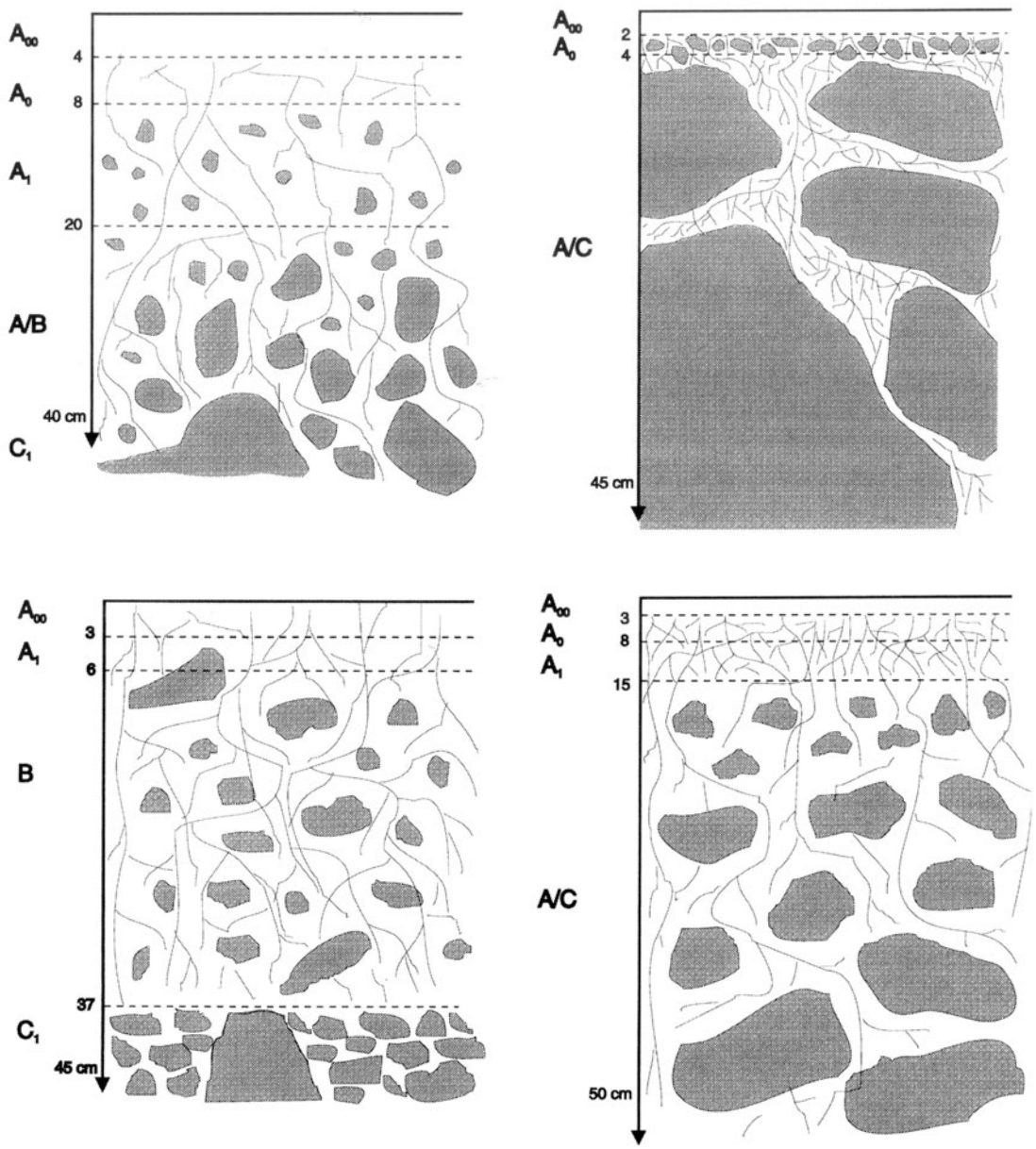

Figure 8.18. Soil profiles of *Parthenocisso tricuspidati-Fraxinetum rhynchophyllae* and *Saso-Quercetum mongolicae* (lower right).

Fig. 8.17, lower left; Table 8.9, relevé 6

A_{00} 0–3 cm – moist undecomposed litter,

A 3–15 – very strongly root-penetrated, dark brown, very humic, crumbly, freshly moist soil, sandy-loamy,

A/C 15–35 – brown, sandy-loamy, crumbly soil with a high skeletal content (80%), only slightly rooted, freshly moist, lying immediately on granite bedrock.

Fig. 8.17, lower right; Table 8.9, relevé 7

A_{00} 0–2 cm – quickly decomposing moist leaf litter,

A2–8(10) – dark brown, very moist, crumbly, humus-rich soil with skeleton (20%), loamy, richly rooted,

A/C 8(10)–40 – brown, loamy, crumbly soil with coarse skeletal material 3–10 cm in diameter (about 40% content), deeper on sites with big boulders, which sometimes rise to the surface.

***Rhododendro mucronulati-Pinion densiflorae* Kim et Yim 1988**

These forests of Japanese red pine (*Pinus densiflora*) occur on lower hill slopes on various disturbed habitats with dry sandy soils. This alliance groups secondary forests under human influence and remains of pine forests on poor soils of rocky ridges. A similar but not identical unit was described from Japan as *Pinion densiflorae* Suz.-Tak. 1966. The alliance is characterised by *Pinus densiflora*, *Juniperus rigida*, and *Rhododendron mucronulatum* in the tree and shrub layers and by *Festuca ovina* as the typical grass. The association *Rhododendro-Pinetum densiflorae* Suz.-Tak. et Usui 1952 is one unit of this alliance (Miyawaki 1986, 1987).

Associations such as the *Rhododendro mucronulati-Pinetum densiflorae* Kim et Yim 1986, a *Juniperus rigida-Pinus densiflora* community known from the periphery of Seoul (Kim J.-W. & Kim J.-H. 1988), and the *Festuco ovinae-Pinetum densiflorae* Song 1992, are subordinate units of this alliance (Kim J.-U. & Yim 1988).

***Festuco ovinae-Pinetum densiflorae* Song J.-S. 1992** (Table 8.10, Fig. 8.19)

Syn.: *Juniperus rigida-Pinus densiflora* community p.p.

Figure 8.19. Festuco ovinae-Pinetum densiflorae, Ljongak-san (photo by J. Kolbek).

The *Pinus densiflora* forests are a common vegetation type in the whole Korean Peninsula, except the high mountain ranges in the north. Pollen analysis (Uh 1991) showed that deciduous forests were replaced by pine forest about 3000 years ago. Farmers later accelerated the destruction of oak forest, and now most pine forests are secondary anthropogenic forests, occurring mostly around settlements (Nakagashi 1995, Hong 1998).

This association has been described in southern Korea (northern Kyongsang Province) during a study of vegetation changes around the Andong Dam area (Song 1992b). Forest communities dominated by *Pinus densiflora* in the tree layer and *Juniperus rigida* in the shrub layer, from the Imha Dam area, were also described Kim J.-W. *et al.* (1995). In North Korea this association was found on gentle slopes (10–33°) at the base of the mountains of Ljongaksan and Taesong-san, at altitudes from 140 to 250 m.

These forests are more acidophilous but species-rich communities with elements related to fine-grained sandy soils with higher content of nutrients, humus and moisture, as opposed to the association *Vaccinio-Quercetum mongolicae.*

Pinus densiflora is the dominant tree, and *Quercus mongolica* occurs mainly at low frequency or is missing entirely. Song (1992b) and Kim J.-W. *et al.* (1995) also noted the occurrence of *Quercus variabilis* in South Korean pine forests. In northern Korea this species is more or less related to communities of the *Lindero-Quercion*. The other oak species, *Q. dentata* and *Q. acutissima*, are also regularly present in relevés from North Korea.

Juniperus rigida, *Quercus mongolica*, *Q. dentata*, *Rhododendron mucronulatum*, and *Benzoin obtusilobum* are common in the shrub layer. Several other, smaller woody species are in the herb layer, such as *Fagara schinifolia*, and *Lespedeza bicolor.* The herb layer is characterised by the presence of sedges like *Carex lanceolata*, and grasses such as *Festuca ovina*, *Miscanthus sinensis*, and *Spodiopogon sibiricus.* Character species, such as *Atractylodes koreana*, *Iris rossi*, *Lilium concolor* var. *parthenenion*, *Rhaponticum uniflorum*, *Sophora flavescens*, and *Platycodon grandiflorus*, occur in our relevés only in this association. These connect our relevés with phytocoenoses described from South Korea. The structure and main floristic elements in all layers occur also in human-affected pine forests, where oaks are exploited and substituted by *Pinus densiflora.*

The *Festuco-Pinetum* was divided into two subunits:

1. *Festuco ovinae-Pinetum densiflorae peucedanetosum terebintacei* subass. nova hoc loco

Nomenclatural type: identical with the nomenclatural type of the association name (see Song 1992b: Table 2, relevé 7)

In comparison with the second subassociation these are open stands with low canopy and denser shrub and herb layers. Heliophilic plants, such as *Peucedanum terebintaceum*, *Prunella asiatica*, *Smilax sieboldii*, and *Lespedeza bicolor*, differentiate this subassociation from the next one.

2. *Festuco ovinae-Pinetum densiflorae lilietosum parthenenioni* subass. nova hoc loco

Nomenclatural type: Table 8.10, relevé 12

These are denser pine forests with sciophilous plants. Soil moisture is evidently higher and results in the presence of the nemoral species *Polystichum polyblepharon*, *Lilium concolor* var. *parthenenion*, *Rubia cordifolia* agg., *Pueraria lobata*, and *Thalictrum aquilegifolium.*

The soils are moderately acidic, acidic to almost neutral (pH 4.7–6.2), relatively poor, and with low mineral content. The calcium content is low, corresponds to the organic content, and is of organic origin (Table 8.27).

Soil profiles:

Table 8.10, relevé 4

A_{00} 0–2 cm – undecomposed leaf litter,

A_0 2–12 – dark brown, rich humus layer with mull and concretions,

A_1 12–25 – clayey-loamy, light brown soil with abundant skeletal material,

A/C 25 and deeper – debris mixed with soil.

Table 8.10, relevé 8

A_{00} 0–2 cm – undecomposed dry needles,

A_0 2–5 – half-decomposed greyish black humus,

A_1 5–15 – loamy, moist brown soil,

A_2 15–25 – sandy-loamy, brown, moist soil,

A/C 25 and deeper – debris mixed with soil.

***Lindero-Quercion mongolicae* Kim J.-W. 1990**

Syn.: *Carpinion laxiflorae* Kim et Yim 1986, *Acero-Quercion mongolicae* Kim et Yim 1988, *Rhododendro-Quercion mongolicae* Kim S.-D. 1988, *Callicarpo-Quercion serratae* Kim J.-W. 1990

This is the central alliance of the order comprising communities with frequently occurring *Quercus*, *Rhododendron*, *Lespedeza*, and name-giving *Benzoin obtusilobum* (syn.: *Lindera obtusiloba*). Other differential species, such as *Callicarpa dichotoma*, *Carpinus laxiflora*, *Rhus javanica*, *R. verniciflura* and other taxa of these genera, differentiate this alliance from the *Pino-Quercion*.

Phytogeographically this alliance occupies lower elevations (submontane belt) of South Korea; in North Korea it is restricted to the foothills of the Kumgang-san. Associations of this alliance are more closely related to the southern woodlands the suballiance *Callicarpo-Quercenion* Kim J.-W. 1992. Coniferous trees are absent, and dwarf bamboo (*Sasamorpha purpurascens* var. *borealis*), *Disporum smilacinum*, and other species with subtropical character are found. Dominating oaks, e.g. *Quercus acutissima*, *Q. aliena*, *Q. mccormickii*, *Q. serrata*, and *Q. variabilis*, are not as abundant as *Q. mongolica* but are more characteristic for this vegetation type. *Oplismenus undulatifolius*, *Syneilesis palmata*, *Codonopsis lanceolata*, and *Lysimachia deltoides* (known in South Korea) appear to have found optimum conditions in this alliance. Each of these represents a genus mentioned by Kim J.-W. (1996) as typical.

The associations *Ainsliaeo-Quercetum mongolicae* Song *et al.* 1999 and *Syneilesio-Quercetum serratae* Song *et al.* 1999, described from South Korea, are typical representatives of the alliance. As opposed to the North Korean forests, these associations regularly contain species such as *Carpinus tschonoskii*, *Corylus sieboldiana*, *Fraxinus sieboldiana*, *Isodon inflexus*, *Saussurea gracilis*, *Viola albida*, *V. rossii* and many others (Song *et al.* 1999). On the other hand, many species occurring frequently in North Korean units, such as *Asperula maximowiczii*, *Carpinus laxiflora*, *Quercus dentata*, *Rhus javanica*, *Saussurea nivea* and *Solenolantana carlesii*, are not found in these southern syntaxa.

The forests of humid, mesic conditions in the southern part of the peninsula are under strong human impact (Kim J.-W. 1992).

***Saso-Quercetum mongolicae* Kim J.-W. 1990**

(Table 8.11, Fig. 8.20)

Syn.: *Rhododendro-Quercetum mongolicae* Kim et Yim 1988, *Quercetum variabilis* Kim et Yim 1988

Saso-Quercetum mongolicae comprises mesic bamboo-oak woodlands of the Korean Peninsula, which reach their northern limit in the Kumgang-san and of which only some related subunits occur also in the Chonma-san and Sujang-san ranges. These represent the most thermophilous forests in North Korea.

Quercus serrata and *Q. variabilis* are the tree-layer dominants but can be replaced by *Q. mongolica* in more northern regions. Canopy cover varies from 60 to 90%, and shrub-layer cover can also be high, up to 75%. *Acer pseudosieboldianum*, *Benzoin obtusilobum*, *Styrax obassia*, *Stephanandra incisa*, and *Callicarpa dichotoma* are the main shrub species. The cover of the herb layer is not more than 75%, with *Sasamorpha purpurascens* var. *borealis* (syn.: *Sasa borealis*) dominant in typical stands.

Figure 8.20. Saso-Quercetum mongolicae, Kumgang-san (photo by J. Kolbek).

It is accompanied by species with lower cover, such as *Carex lanceolata*, *C. siderosticta*, *Ainsliaea acerifolia*, *Syneilesis palmata* or *Astilbe koreana*. The moss layer is mostly absent or achieves only low cover.

This community occurs at lower altitudes, usually up to 300 m, exceptionally up to 600 m. It may occur on slopes up to 40° but seems not to prefer any particular orientation.

This association was described by Kim J.-W. (1990) and divided into two subassociations. The *Saso-Quercetum mongolicae pinetosum koraiensis* Kim J.-W. 1990 is typical only for southern Korea. The other, *Saso-Quercetum mongolicae quercetosum variabilis* Kim J.-W. 1992, occurs in our study area, where it reaches its northern limit. It can be divided into two variants:

- var. *typicum* var. nova represents forests with several oaks in addition to dominant *Quercus serrata* and *Q. variabilis*, also the rare *Q. mc-cormickii*. The dwarf bamboo *Sasamorpha purpurascens* var. *borealis* dominates the ground layer. These forests are species-rich in all layers, and young trees are common as shrubs and seedlings. Other species in the herb layer are not so frequent. The moss cover is minimal, only rarely reaching 20%. Typical stands of this variant were found in the Kumgang-san, at low altitudes of 160–400 m, mostly on steep slopes with various exposures. The soils are rocky, mixed with coarse gravel and fine-grained clay. The thick mull horizon is a characteristic feature of the habitat. It is moist due to persistent precipitation and morning hazes.
- var. *potentillosum fragarioidis* var. nova represents a marginal type of this community, transitional to the mixed oak forests. Besides bamboo, *Astilbe koreana* and *Palura paniculata* no longer occur. The other species composition is similar, however, which is why this community was

classified within the frame of this association. This variant was found in the Kumgang-san but also in the more continental conditions of the Sujang-san and Chonma-san, at altitudes of 200–600 m. All parameters of the community show more xeric character than var. *typicum*. This community is defined by the absence of mosses, the sparse herb layer and occurrence of some taxa typical oak-hornbeam forests.

Soils (Fig. 8.18) are dry, and slopes are usually oriented toward the south or southwest. The soil is acidic to moderately acidic (pH 4.2–5.2) and poor in nutrients. The larger difference between the actual and exchangeable acidity suggests that these soils are also vulnerable to leaching. The soils are poor in carbon and calcium but richer in magnesium relative to calcium (Table 8.28).

Soil profiles:

Table 8.11, relevé 1

A_{00} 0–3 cm – undecomposed leaf litter,
A3–9 – dark brown, loamy sandy, densely rooted soil,
A/B 9–25 – light brown, sandy-loamy soil with admixture of 3–5 cm gravel.

Table 8.11, relevé 3

A_{00} 0–1 cm – undecomposed leaf litter,
A 1–25 – sandy, dark grey, veined soil with infiltration of pure sand among the boulders,
C 25 and deeper – rock blocks.

Fig. 8.18, lower right; Table 8.11, relevé 20

A_{00} 0–3 cm – undecomposed leaf litter,
A_0 3–8 – humus-rich, very strongly rooted soil without skeleton, dark brown, crumbly, airy with many concretions,
A_1 8–15 – dark brown, humic, crumbly, strongly rooted soil, sandy-loamy, with many concretions,
A/C 15–20 – soil of similar properties, but with coarse skeletal material up to 30 cm in diameter (50%).

***Artemisio-Quercetum mongolicae* Kim J.-W. 1990** (Table 8.12)

Syn.: *Lindero-Quercetum mongolicae* Song J.-S. *et al.* 1995

Xerophytic oak forests occur commonly throughout the Korean Peninsula at altitudes of 400–1200 m (cf. Kim J.-W. 1992). Both subassociations described by Kim J.-W. (1992) occur in the central part of the peninsula; a third subassociation is described as new and is unknown in South Korea (see below).

Pinus densiflora is the dominant tree, mostly as a result of long-term, intensive human impact. *Quercus mongolica* grows with lower density in man-influenced forests near settlements. Apparently it occurred there more before, but now young oaks are important only in the shrub layer. In this way both the vertical and horizontal structure of community was sometimes changed, but the herb-layer composition remains typical. Under local light and soil conditions, various sciophilous plants can increase (rels 35–40). This association seems to be very heterogeneous floristically.

Three subassociations were found in North Korea:

1. *Artemisio-Quercetum mongolicae juniperetosum rigidae* Kim J.-W. 1992

This unit occurs on the most unfavourable habitats with acidic, really shallow dry soil directly among granite rocks. The main locations are near the southern border of North Korea, called the Midland Mountain Region III by Kong & Watts (1993). This includes areas at low altitude with relatively steep slopes on the periphery of Pyongyang and Kaesong, as well as mountains such as the Chonma-san, Sujang-san and Kumgang-san. Within this subassociation two new variants were distinguished:

- var. *typicum* var. nova – differentiated by a thin tree canopy, and
- var. *calamagrostiosum arundinacei* var. nova – characterised by a dense canopy of oaks and by shrub species such as *Corylus heterophylla* and *Rhamnus davurica*.

2. *Artemisio-Quercetum mongolicae deutzietosum prunifoliae* subass. nova hoc loco

Nomenclatural type: Table 8.12, relevé 18

This unit is differentiated more or less negatively and partly also geographically. It was found only in the northern Myohyang-san at 300–790 m. Also, the soil conditions on moderate slopes are more pleasant.

3. *Artemisio-Quercetum mongolicae styracetosum obassiae* Kim J.-W. 1992

This is a southern type found only below 300 m in the Kumgang-san, on various expositions and inclinations. Many strongly acidophilous species occur in the herb layer, such as *Styrax obassia*, *Pteridium aquilinum*, and *Pyrola japonica*. *Atractylodes ovata*, *Aster scaber*, *Benzoin obtusilobum*, and *Lespedeza maximowiczii* reach higher constancy. This subassociation prefers moist, rocky sites, similar to those of the Southern Mountain Region IV of Kong & Watts (1993).

The soils (Fig. 8.21) of the *Artemisio-Quercetum* are acidic to moderately acidic (pH 3.9–5.2) and mostly devoid of nitrates (Table 8.29). The soil can contain organic substances in the form of undecomposed leaves and higher amounts of calcium, potassium, and magnesium. If the soils are too dry, there is no decomposition of organic substances and leaching into deeper soil layers.

Soil profiles:

Fig. 8.21, left; Table 8.12, relevé 22

A_{00} 0–2 cm – undecomposed litter without skeletal material,

A_1 2–7 – very humic, blackish grey, sandy-loamy, crumbly soil, moist,

A 7–32 – light brown, loamy-sandy, granular soil, dry, with finer skeleton (50%), moderately rooted,

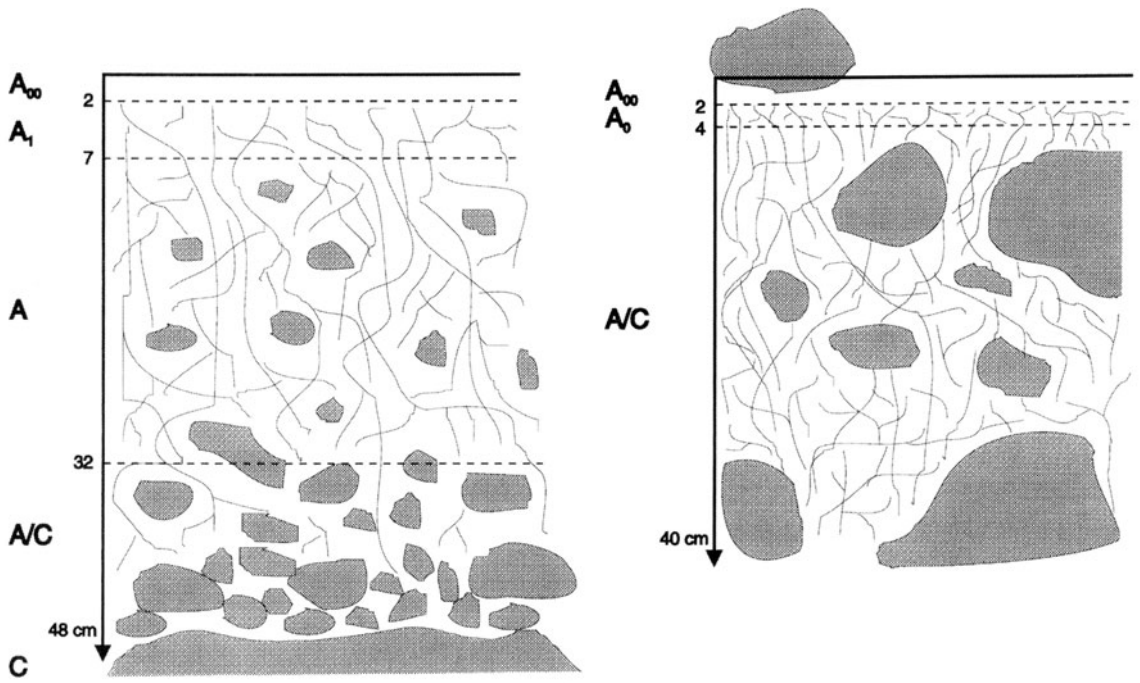

Figure 8.21. Soil profiles of *Artemisio-Quercetum mongolicae* (left) and *Syneilesio palmatae-Carpinetum laxiflorae* (right).

A/C 32–48 – soil of similar properties, increasing coarser skeleton increasing downward,

C (48 cm and deeper) – bedrock: granodiorite.

Table 8.12, relevé 28

A_{00} 0–1 cm – undecomposed pine needles,

A 1–15 – sandy, greyish brown, moderately rooted soil with fine skeleton of up to 1 cm,

B 15–30 – loamy to sandy, moist, slightly rooted ochraceous soil with fine skeleton (about 1 cm in size), lying immediately on the geological substrate.

***Syneilesio palmatae-Carpinetum laxiflorae* ass. nova hoc loco** (Table 8.13)

Nomenclatural type: Table 8.13, relevé 3

This association comprises oak-hornbeam forests of moderate species richness, with dense shrub layers composed largely of rhododendrons. *Quercus mongolica* and *Carpinus laxiflora* dominate in the tree layer, and both species are present in all layers. *Pinus densiflora* occurs regularly at low abundance. Besides *Rhododendron schlippenbachii* and *R. mucronulatum*, the well-developed shrub layer also includes species such as *Viburnum wrightii*, *Stephanandra incisa* and *Weigela florida*. On the other hand, the herb layer has not as dense is represented by a group of typical diagnostic species of shady habitats: *Syneilesis palmata*, a characteristic species of the association, plus graminoids and herbs such as *Carex lanceolata*, *C. siderosticta*, *Spodiopogon sibiricus*, *Aster scaber*, *Artemisia keiskeana*, etc. The cover of the herb layer does not exceed 50%, due to the shade cast by the trees and shrubs.

The only seven relevés recorded in the Sujang-san cannot reflect the whole variability of this unit. This association represents forest vegetation transitional between the South Korean alliance *Lindero-Quercion mongolicae* and northern types of deciduous oak forest. *Saso-Quercetum mongolicae quercetosum variabilis* (variant without *Sasamorpha purpurascens* var. *borealis*) is the contact community. Song *et al.* (1995) described a related unit *Lindero-Quercetum mongolicae* from Mt. Sobaek. This association is differentiated by the absence of *Pinus densiflora*, low constancy of *Carpinus laxiflora*, and presence of *Sasamorpha purpurascens* var. *borealis*.

This community appears to prefer north-facing slopes of around 30°. The soil is shallow and rocky (Fig. 8.21), with a thin layer of decomposing litter. It is acidic (pH 4.2) and poor in nutrients, showing minimal organic content and a higher proportion of clayey components than in the other soils analysed (Table 8.30).

Soil profile:

Fig. 8.21, right; Table 8.13, relevé 2

A_{00} 0–2 cm – undecomposed leaf litter,

A_0 2–4 – thin layer of brown (sandy-) loamy, crumbly, slightly humic eroding soil,

A/C 4–40 – rusty brown, loamy, crumbly, moderately moist, richly rooted soil with coarse skeletal material of 5–30 cm (50%).

***Weigelo floridae-Fagarion schinifoliae* all. nova hoc loco**

Nomenclatural type: *Lilio lancifolii-Rhododendretum schlippenbachii*

Characteristic and differential species: *Asplenium sarelii*, *Chrysanthemum coreanum*, *Fagara schinifolia*, *Hemerocallis minor*, *Lilium lancifolium*, *Polygonatum humile*, *Weigela florida*

This alliance includes shrub and other open communities around deciduous broad-leaved forests in Korea. Most woody plants are therefore species of forest communities dominated by *Quercus mongolica* or *Pinus densiflora*. These occur with high stability in the order *Rhododendro-Quercetalia mongolicae*. Miyawaki (1986) notes three similar associations in the order *Weigelo-Alnetalia firmae* Ohba et Sugawara 1979, from similar situations in Japan.

A formation of large shrubs but without a true tree layer was analysed from the mountains of Sujang-san. This edaphically conditioned community occurs naturally on sites where development of a deep soil profile is hampered. Such conditions usually occur on slab-like substrates of a certain inclination, such as stratified

plates of granodiorites, partly compact, and partly disintegrated.

The shrubs are anchored in the fissures and weathering furrows of the substrate, resulting in open stands with relatively species-rich shrub and herb layers. These stands usually do not exceed 3–4 m in height and physiognomically resemble stunted Central European scrub stands on slopes. Since succession is blocked, however, these communities are stable for a long time. Similar stands form also in deforested areas, where shrubs and coppice forms of trees, as well as a thriving development of heliophilic grasses, sedges, sometimes geophytes, is stimulated by the light available after felling. The direct human impact was not investigated, but evidence of selective tree felling was found (e.g. *Castanea sativa*).

Until now this alliance is represented by only two units, though others probably could be distinguished after study of the mantles of broad-leaved forests.

***Lilio lancifolii-Rhododendretum schlippenbachii* ass. nova hoc loco** (Table 8.14, Fig. 8.22)

Nomenclatural type: Table 8.14, relevé 1,

This shrub community frequently occurs on extremely steep northern slopes (30 to 48°). Cover is appreciable in the shrub layer (60–90%) but is less in the herb layer (30 to 60%); the moss layer is sparse or missing. The dominant woody plants are dwarf *Quercus mongolica*, in combination with *Lespedeza bicolor* and rhododendrons such as *Rhododendron schlippenbachii* and *R. mucronulatum*. *Vaccinium koreanum* (blueberry) is present in the shrub layer but even more in the herb layer. Light-demanding heliophytes such as *Carex nanella*, *Artemisia keiskeana*, *Hemerocallis minor*, *Chrysanthemum coreanum* and some geophytes such as *Lilium lancifolium*, *Polygonatum humile*, *Allium komarovianum* and rarely also *Scilla scilloides* describe this community.

Figure 8.22. Lilio lancifolii-Rhododendretum schlippenbachii, Sujang-san (photo by J. Kolbek).

Their growth is possible due to the humid microclimate under the shrubs and in open gaps among rock steps.

The soil is obviously fresh and moist. The only soil sample available suggests very acidic soils (pH 3.8) and points to very poor soil from which the alkaline cations were washed out (Table 8.31).

Soil profile:
Table 8.14, relevé 1
A_{00} 0–3(4) cm – undecomposed leaf litter,
A3(4)–10 – very humic, brown, very densely rooted, dry, crumbly, loamy-sandy soil,
A/C 10–20(50) – stony debris on slopes, with big granodiorite blocks.

***Indigofera kirilowii-Securinega suffruticosa* community** (Table 8.14)

The community occurs in stands of widely varying density. Many sites are bare rocky substrates without even any mosses or lichens. Shrubs such as *Indigofera kirilowii*, *Securinega suffruticosa*, *Stephanandra incisa* and some others may occur, on rock surfaces wetted by runoff water. Atypical conditions provide opportunities for the development of unique combinations of plant species. Some species are very rare in forest communities but are more characteristic of wetlands, e.g. *Miscanthus sinensis*, *Phragmites communis*, *Sanguisorba officinalis*, *Thalictrum contortum*. Xerophytic taxa such as *Carex nanella* or *Artemisia keiskeana*, so typical for *Lilio lancifolii-Rhododendretum schlippenbachii*, are absent and negatively differentiate both units.

4. CONCLUSION

Knowledge of the forest vegetation, and of vegetation in general in northern Korea, is rather poor. This region is a blank place on world vegetation maps, and vegetation data are only sparsely found. Only one Korean paper known to us describes the forests of the Myohyang mountains (Li S.-H. & Li K.-Ch. 1986), describing the floristic composition of forests dominated by *Pinus densiflora* and *Quercus mongolica*. This situation results from an information vacuum, partly saturated by the abundance of vegetation data from South Korea, Japan, and recently also from China and easternmost Russia. Comparison of our vegetation data, obtained in North Korea, with relevant data from these surrounding territories enabled us to create a proposal for surveying forest vegetation, even though our limited set of phytocoenological relevés covers North Korea unevenly.

The natural forest vegetation of the northern Korean Peninsula can generally be divided into two groups:

a) coniferous forests of high mountains (taiga), located in the north along the boundary of China and Russia, dominated by *Larix olgensis* in a tree layer and *Rhododendron aureum*, *Ledum palustre* agg., and *Dasiphora fruticosa* in the understory. Dwarf-shrub tundra, with species such as *Rhododendron parvifolium* var. *alpinum*, *Oxytropis anertii*, *Dryas tschonoskii* etc., occurs at higher elevation (Šrůtek & Kolbek 1994).
b) mixed forests of coniferous and broad-leaved trees in the central and southern part of the peninsula. *Pinus densiflora* is the dominant conifer from the lowlands to the (sub)montane belt; *Abies nephrolepis* is a major representative conifer at higher elevation. The diversity of broad-leaved species increases southward. Increasing numbers of species of *Quercus* and *Acer*, penetrating bamboo-like graminoids, and abundant occurrence of *Rhododendron mucronulatum* and *R. schlippenbachii* are characteristic for the natural forests in these more southern regions.

The vegetation cover of North Korea has been changed by man. Measures of vegetation synanthropization (including forest vegetation) increase from higher mountains to the lowlands. At the highest elevations the floristic composition of the vegetation is the most natural. The forest is managed differently in mountains with younger relief (high elevation and steep slopes) and in lower highlands. Selective forest man-

agement in high mountains (choice of individual trees) probably reflects actual needs by the people (use for heating and building). In the foothills and near settlements the land is deforested and converted for cultivation of crops (soya beans, oats, and rye). Soybean fields are established frequently on steep slopes (Kong & Watts 1993), while large fields with cabbage and other kinds of vegetables extend over the foothills.

Highlands with older relief (lower elevation and gentle slopes) are usually more densely settled, and the forest exploitation is more intensive. Historically the forest cutting had a selective character, favouring woody species with better characteristics for heating: in the beginning oaks with calorific wood, later pines with faster growth. In the last century large areas were deforested and reforested with Japanese red pine (*Pinus densiflora*). This pine of loamy soils produces wood of low quality for construction or industry and is mostly used only for heating. The oaks (predominately *Quercus mongolica*) are managed for coppice, but their growth is generally suppressed in favour of pine. Felling of mostly semi-cultivated trees was also recognized, trees such as *Castanea crenata* (chestnut), *Pinus koraiensis*, and species of *Juglans*, *Malus*, *Morus*, *Prunus*, *Pyrus*, *Rhus*, and various plants for medical use and fodder (cf. Baik *et al.* 1986).

In the lowlands of North Korea, secondary *Pinus densiflora* forests develop commonly in spite of heavy human impact (Nakagoshi 1995). For a long time these pine forests were closely connected with daily life and agriculture. The twigs, branches, and coppice were used as a fuel for the traditional Korean floor-heating system. Litter on the forest floor was collected and used as compost for paddy and upland fields, and as fodder for working cows. Another traditional use of pine forest was for construction of graveyard tombs having an oval form of various sizes (Hong 1998). In lowlands with sufficient reserves of water, forest stands were mostly converted to rice paddies or other agriculture land.

4.1 Survey of syntaxa

Survey of forest vegetation includes verified vegetation units, based on phytocoenological relevés, measured synecological parameters and field observations. The following checklist of units and their distribution is surely not complete and is restricted to the locations visited (Fig. 8.1). The forest vegetation of the northern Korean Peninsula is classified into the following two main classes, with 16 associations and other plant communities:

Vaccinio-Piceetea Br.-Bl. 1939
Abieti nephrolepidis-Piceetalia jezoensis Song 1992
Laricion olgensis all. nova
Rhododendro aurei-Laricetum olgensis Dostálek *et al.* 1988
salicetosum arcticae subass. nova
gentianetosum algidae subass. nova
typicum subass. nova
pyroletosum dahuricae subass. nova
Goodyero repentis-Piceetum jezoensis ass. nova
usneetosum longissimae subass. nova
listeretosum nipponicae subass. nova
Carici peiktusani-Abietetum nephrolepidis ass. nova
iridetosum dichotomae subass. nova
phegopteridetosum polypodioidis subass. nova
lycopodietosum complanati subass. nova

Ledo decumbentis-Laricetum olgensis ass. nova
linnaeetosum borealis subass. nova
potentilletosum cryptotaeniae subass. nova
brometosum jezoensis subass. nova
betuletosum paishanensis subass. nova
Rhododendro dahurici-Acerion barbinervi all. nova
Polysticho retroso-paleacei-Rhododendretum dahurici ass. nova
ledetosum maximi subass. nova
sorbetosum amurensis subass. nova
Abieti nephrolepidis-Piceion jezoensis Song 1991
Taxo-Pinetum pumilae Song et Nakanishi 1985
Thujo koraiensis-Piceetum jezoensis ass. nova
Querco-Fagetea crenatae Miyawaki *et al.* 1968 em. Kim J.-W. (1990) 1992
Rhododendro-Quercetalia mongolicae Kim J.-W. 1992
Pino koraiensis-Quercion mongolicae Kim J.-W. 1990
Lychno-Quercetum mongolicae Kim J.-W. 1990
disporetosum ovalae Kim J.-W. 1992
astilbetosum thunbergii subass. nova
Vaccinio-Quercetum mongolicae Kim J.-W. 1990
Parthenocisso tricuspidati-Fraxinetum rhynchophyllae ass. nova
Rhododendro mucronulati-Pinion densiflorae Kim et Yim 1988
Festuco ovinae-Pinetum densiflorae Song J.-S. 1992
peucedanetosum terebintacei subass. nova
lilietosum parthenenioni subass. nova
Lindero-Quercion mongolicae Kim J.-W. 1990
Saso-Quercetum mongolicae Kim J.-W 1990
(*pinetosum koraiensis* Kim J.-W. 1990)
quercetosum variabilis Kim J.-W. 1992
Artemisio-Quercetum mongolicae Kim J.-W. 1990
juniperetosum rigidae Kim J.-W. 1992
deutzietosum prunifoliae subass. nova
styracetosum obassiae Kim J.-W. 1992
Syneilesio palmatae-Carpinetum laxiflorae ass. nova
Weigelo floridae-Fagarion schinifoliae all. nova
Lilio lancifolii-Rhododendretum schlippenbachii ass. nova
Indigofera kirilowii-Securinega suffruticosa community

The floristic composition and comparison of associations and higher units is shown in the synthetic tables (Tables 8.15 and 8.16). Phytocoenological data and data from the soil analyses, despite their incompleteness, probably represent the first large, important data base on the forest vegetation of North Korea. The value of this information rises in the context of vegetation knowledge from the surrounding countries. The data presented bring evidence of the amazing richness of the Korean flora and vegetation, which deserve protection and more reasonable use by man. The continuing occurrence of generally endangered species in some regions of Korea up to now still provides the opportunity to preserve this high species and community diversity. It is an invitation to subsequent study.

5. ACKNOWLEDGEMENTS

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7. APPENDIX

Serial numbers of those relevés that represent nomenclature types of associations and subassociations are shown in **boldface** in the association tables.

The following abbreviations were used in the tables:

Authors of relevés: B = Denisa Blažková, D = Jiří Dostálek, J = Ivan Jarolímek, K = Jiří Kolbek, Li = Sek-Ha Li, N = Robert Neuhäusl and Zdenka Neuhäuslová, S = Jiří Sádlo, Š = Miroslav Šrůtek, and V = Milan Valachovič.

Cover values of modified 9-degree scale: r, +, 2m (in tables = m), 2a (= a), 2b (= b), 3, 4, 5 (Barkman *et al.* 1964).

Mountain systems (MS) and other localities: C = Chonma-san, K = Kumgang-san, Ke = Kaesong, L = Ljongak-san (or Ryongak-san), M = Myohyang-san, S = Sujang-san, and T = Taesong-san.

Other abbreviations: bel = below, c = constancy, char. = characteristic species, ct = total constancy, diff. = differential species, fr = from, l = left, L = lower, M = middle, n = near, opp = opposite, P = peak, r = right, transgr. = transgresive species, un = under, V = valley, vis = visiting.

Table 8.1. Rhododendro aurei-Laricetum olgensis.

Relevé number	123456789	c	11111111 01234567	c	112222222222 890123456789	c	333333333344 012345678901	c	ct
Char. and dif. - *Rhododendro aurei-Laricetum olgensis*									
E_2									
Rhododendron aureum (AP)	+1aa.13ba	89	a1a1aaba	100	34434a444333	100	++.rb...a1+3	67	88
E_1									
Aquilegia japonica	++111111+	100	.....	0	.....+.++	25	.....11+11++	58	46
Allium thunbergii	rr+11111+	100	.....+.	13	.....+..	8	+.++..1+++.+	67	46
Parnassia palustris	11111++11	100	..1+1+11	75	.....	0	.....+.+	17	41
Agrostis flaccida	1.....+.	22	1b....1a	50	....1.++....	25	1aa11.....	42	34
Anthoxanthum nipponicum	...a1111.	56	.....1+	25	.....	0	.....+1+11+m	58	34
Tofieldia nuda	11+++..+1	78	..1+++1.	63	.....	0	.....	0	29
E_0									
Cladonia uncialis	.....	0	.....11.	25	.111a.....	33	aa+a.....	33	24
Dif. - subass. *salicetosum arcticae*									
E_1									
Carex rupestris	11++1++r.	89	.....	0	.....	0	.....	0	20
Adenophora polyantha	r..1111+1	78	.....	0	.....	0	.....	0	17
Adenophora tetraphylla	.+..+1+11	67	.....	0	1	8	.....	0	17
Oxytropis anertii	++++...rr	67	.....	0	.....	0	.....	0	15
Bistorta vivipara	r...r+.++	56	.....	0	.....	0	.....	0	12
Salix arctica Pall.	.r+.r1.+.	56	.....	0	.....	0	.....	0	12
Pyrola japonica	...1+1.+a	56	.....	0	.....	0	.....	0	12
Bupleurum scorzoneraefolium	...+++1.+	56	.....	0	.....	0	.....	0	12
Botrychium lunaria	....r+++.	44	.....	0	.....	0	.....r...	8	12
Zygadenus sibiricus	11+....+.	44	.....	0	.....	0	.....	0	10
Luzula nipponica Kirschner	+11....1.	44	.....	0	.....	0	.....	0	10
Bistorta incana	+1+....1.	44	.....	0	.....	0	.....	0	10
Erigeron thunbergii	+++....+.	44	.....	0	.....	0	.....	0	10
Callistephus chinensis	...+11..r	44	.....	0	.....	0	.....	0	10
Dif. - subass. *gentianetosum algidae*									
E_1									
Hieracium umbellatum (VP)	.....+.+.	22	11...111	63	.....	0	....+.....	8	20
Gentiana algida	.....	0	+++.....	38	.....	0	....+.....	8	10
Cephalanthera longibracteata	.....	0	++....+.	38	.....	0	...+.....	8	10
Dif. - subass. *typicum*									
E_2									
Lonicera edulis (AP)	.....r.	11	.....	0	+.+1+a..+m1a	75	...+..++++..	42	37
Ribes horridum (Lo)	.....	0	.....	0	.....++1+	33	.....	0	10
E_1									
Lonicera edulis (AP)	.r.....	11	.....	0	+++++1.+++11	92	.....r.r.	17	34
Ribes horridum (Lo)	.....	0	.....	0	++++++.+1a11	92	....+.....	8	29
Veratrum album	.....	0	.....	0	.....r..r.++	33	.....	0	10
Trifolium lupinaster	.....	0	.....	0	.....++++	33	.....	0	10
Dif. - subass. *pyroletosum dahuricae*									
E_3									
Picea koraiensis (Lo)	.....	0	.....	0	...1r.....	17	1a+1a..+a.1a	75	27

Table 8.1. Continued.

Relevé number	123456789	c	11111111 01234567	c	112222222222 890123456789	c	333333333344 012345678901	c	ct
Abies nephrolepis (AP)	.....	0	.....	0	....+.....	8	**+++.....+11a**	**58**	20
E_2									
Picea koraiensis (AP)	a.....	11	..+.....	13	.....	0	**aamab.++r.1a**	**83**	29
Abies nephrolepis (AP)	.....	0	.....	0	..11a.....	25	**111ab+...a1a**	**75**	29
E_1									
Abies nephrolepis (AP)	.....	0	.....	0	....+.....	8	**1+11+111+111**	**100**	32
Lycopodium complanatum (VP)	..+.....	11	1.....	13	..+1m.1.....	33	**a1aa.aaaaaaa**	**92**	41
Geranium eriostemon	.....+.	11	.....	0	.....+1	17	**...+.11+111+**	**67**	27
Pyrola dahurica (Lo)	.....	0	+.....	13	.....	0	**11++...+.11+**	**67**	22
Prunella vulgaris	.....	0	.....	0	.....	0	**++.++...++.1**	**58**	17
Picea koraiensis (Lo)	.r.....	11	.....	0	.....	0	**+1++.+...+..**	**50**	17
Clematis ochotensis (AP)	.....	0	.....	0	.....	0	**.....+++++++**	**58**	17
Ligusticum tenuissimum	....+....	11	.....	0	.....	0	**......+.++++**	**42**	15
Galeorchis cyclochila	.....	0	.....	0	.....	0	**.....+++11**	**42**	12
***Laricion olgensis* (Lo), *Abieti nephrolepidis-Piceetalia jezoensis* (AP)**									
E_3									
Larix olgensis	ab3333344	100	3aa3aaaa	100	333b33baa3a3	100	3aa3b33333aa	100	100
Picea jezoensis	.....	0	++.....	25	...11.+.....	25	11a33++..aa3	83	37
E_2									
Larix olgensis	aba.+..+.	56	..+11.+a	63	..1111a+....	50	...+1...r.+1	42	51
Picea jezoensis	.1.....	11	....r+++	50	...+r..+....	25	maa1a+++.11a	92	46
Clematis ochotensis	.....	0	.....	0	.....	0	.....r...	8	2
E_1									
Picea jezoensis	.....rr.r	33	...r+++.	50	....+..+....	17	+1+1++11.11+	92	49
Viola sachalinensis	.....	0	.....	0	+++++...+.1+	67	1+++.11+111+	92	46
Clintonia udensis	.....	0	.....	0	....+.++11+1	58	1++.11+m11++	92	44
Larix olgensis	11..+..+.	44	..+11..+	50	.++++.....r	42	...+.....+..	17	37
Carex peiktusani	.....1...	11	.....	0	+...+.....	17	.....1+1.	25	15
Bupleurum longeradiatum	.....	0	.....	0	.....+.....	8	.....+1++	33	12
Carex nanella	.....11..	22	.....	0	.....	0	.....	0	5
Ledum decumbens	.+.....	11	.....	0	.....1.....	8	.....	0	5
Iris dichotoma	.....	0	.....	0	.....+..+	17	.....	0	5
Rhododendron parvifolium	.....	0	.....+..	13	.....	0	.....	0	2
Ledum palustre var. *maximum* Nakai	.....	0	.....	0	.....a....	8	.....	0	2
Sorbus amurensis	.....	0	.....	0	.....	0	.....r...	8	2
***Vaccinio-Piceetea* (VP)**									
E_2									
Vaccinium uliginosum	.....	0	.....	0	.....	0	**.....++r1a1**	**50**	15
Juniperus sibirica	.....	0	.....	0	.....+11+	33	.....	0	10
E_1									
Juniperus sibirica	a1aaaaaa1	100	a1aaba1+	100	+1+1a3a1aaaa	100	arabaaaaa1aa	100	100
Phyllodoce coerulea	r1aaa1+a1	100	..111aaa	75	+33a33b3+1a1	100	33a1b1aaaaaa	100	95
Vaccinium vitis-idaea	aa111+1a1	100	+.+a++++	88	aBa1a1..1aaa	83	aaaa1a11111a	100	93
Vaccinium uliginosum	bb+....+.	44	1111+111	100	.+ba1+aa....	58	11+11+.....	50	61

Table 8.1. Continued.

Relevé number	123456789	c	11111111 01234567	c	112222222222 890123456789	c	333333333344 012345678901	c	ct
Linnaea borealis	.......1.	11	....	0	a11ama..aa1a	83	aa1mma11a1a1	100	56
Orthilia secunda	1	11	....	0	.....+....1.	17	.....+1+.+1+	50	22
Majanthemum dilatatum	....	0	....	0	.....1..1++.	33	.....+1.+...	25	17
Lycopodium clavatum var. *nipponicum* Nakai	....	0	....	0	.......1+...	17	....1.......	8	7
Lycopodium selago	.......+r	22	....	0	....	0	....	0	5
Goodyera repens	....	0	....	0	....+.......	8	+..........	8	5
Ligularia jamesii	....	0	....	0	..........++	17	....	0	5
Chimaphila japonica	.+.......	11	....	0	....	0	....	0	2
Lycopodium cryptomerianum	....	0	....	0	.....+......	8	....	0	2
Lycopodium alpinum	....	0	....	0	....	0	....+.......	8	2
Lycopodium annotinum	....	0	....	0	....	0	....+.......	8	2
Calypso bulbosa	....	0	....	0	....	0	..........+	8	2
Others									
E_2									
Dasiphora fruticosa	....a1aa.	44	....	0	.....1..+m++	42	..........+.	8	24
Rosa davurica	.......+.	11	....	0	...++.......	17	..........r.	8	10
E_1									
Festuca ovina	aabalaaaa	100	..333+ba	75	.+.++1+.....	42	11aa1+m111a+	100	78
Calamagrostis langsdorfii	.r.a1..1.	44	3b.1..11	63	3a+a11+1a333	100	aamm.a+aaaa1	92	78
Solidago japonica	....++.1+	44	...++...	25	a1++11.+111a	92	1+11+1m1a111	100	71
Sanguisorba parviflora	r.r.+111.	67	.......+	13	11.+++++1111	92	...++1++11++	75	66
Dasiphora fruticosa	rr+1++1++	100	+a11+a.4	88	+.+1+.+a....	50	...+1....r.+	33	63
Gentiana jamesii	r.+11.11.	67	+.1++..+	63	.....r......	8	...+++111+++	75	51
Gymnadenia conopsea	...111111+	67	..1....+	25	....+.+.++..	33	+.+..++.++++	67	49
Potentilla coreana Soják	....	0	++...+..	38	+..++....+.+	42	++++..++++++	83	44
Saussurea alpicola	11+.+r++.	78	..1++...	38	....	0	...+.+1++1+.	58	41
Taraxacum sp.	rrr++111.	89	....	0	....	0	.....+++1+++	58	37
Bupleurum euphorbioides	11+....1.	44	1+.....1	38	....	0	+++++.......	42	29
Dianthus superbus	**...1+a1a+**	**67**	....+...	13	.........++..	17	.........r..	8	24
Bistorta vulgaris agg.	**...++11.1**	**56**	....	0	....	0	........rr+.	25	20
Chamaenerion angustifolium	.....++..	22	....	0	....	0	.....++++++.	50	20
Dryas tschonoskii	ba+....rr	56	....++..	25	....	0	....	0	17
Orostachys malacophylla	+++.....	33	..+.+++.	50	....	0	....	0	17
Campanula cephalotes	**..r.1111.**	**56**	....	0	....	0	.....+...+..	17	17
Bromus jezoensis	...1...r.	22	aa......	25	....	0	...1m+......	25	17
Aconitum coreanum	....	0	+a......	25	+.......11+1	42	....	0	17
Artemisia stolonifera	...1+1..1	44	....	0	....	0	...+....r...	17	15
Astragalus uliginosus	......r.r	22	....	0	....	0	.....+.1++..	33	15
Luzula sudetica	.....1+.1	33	....	0	..........+	8	..........+	8	12
Pedicularis resupinata	....	0	1.......	13	++.+........	25	....+.......	8	12
Chrysanthemum zawadskii	111....1.	44	....	0	....	0	....	0	10
Rosa davurica	....	0	.....+..	13	.....+.+....	17	......r.....	8	10
Astragalus sp.	....	0	....	0	....	0	........1+++	33	10
Potentilla nivea	11+.....	33	....	0	....	0	....	0	7
Androsace lehmanniana Spreng.	1+.....r.	33	....	0	....	0	....	0	7

Table 8.1. Continued.

Relevé number	123456789	c	11111111 01234567	c	112222222222 890123456789	c	333333333344 012345678901	c	ct
Saxifraga laciniata	++1.....	33	.....	0	.....	0	.....	0	7
Senecio kawakami	++r.....	33	.....	0	.....	0	.....	0	7
Tilingia tachiroei	++.....+.	33	.....	0	.....	0	.....	0	7
Anemone narcissiflora	.....++..	22	.....	0	.....	0	.....1...	8	7
Epilobium sp.	.....	0	.....	0	.....+1+.	25	.....	0	7
Pseudostellaria sylvatica	.....	0	.....	0	.....++.1	25	.....	0	7
Gentiana scabra	.....	0	.....	0	.....	0	+++.....	25	7
Lloydia serotina	++.....	22	.....	0	.....	0	.....	0	5
Minuartia arctica	+r.....	22	.....	0	.....	0	.....	0	5
Papaver radicatum	+r.....	22	.....	0	.....	0	.....	0	5
Silene oliganthella	r.r.....	22	.....	0	.....	0	.....	0	5
Hedysarum alpinum	r.....+.	22	.....	0	.....	0	.....	0	5
Petasites saxatilis	.r.....	11	.....	0	.....+..	8	.....	0	5
Scilla sibirica	.....+..	11	.....	0	.....	0	.....r..	8	5
Agropyron amurense	.....	0	13.....	25	.....	0	.....	0	5
Botrychium ternatum	.....	0	...rr...	25	.....	0	.....	0	5
Ostericum maximowiczii	.....	0	.....	0	+.....	8	...+.....	8	5
Thalictrum spirostigmum	.....	0	.....	0	.....+...+..	17	.....	0	5
Trollius ledebourii	.....	0	.....	0	.....++..	17	.....	0	5
E_0									
Ptilium crista-castrensis	1+1313313	100	3a....a1	50	3a4333434333	100	...a33333a..	58	78
Pleurozium schreberi	.....	0	..333.+.	50	a33343..a3a3	83	4443.3333455	92	61
Cladonia rangiformis	aaaa1aaaa	100	...33...	25	11.a+.....	33	.....	0	37
Hylocomium splendens	3a3aa1a3a	100	.....	0	11111.....	42	.....	0	34
Rhytidium rugosum	11aa1aaaa	100	.....	0	.....1..aa1.	33	.....1..	8	34
Cladonia stellaris	.....	0	1a...aa3	63	.....b.....	8	...+1.....	17	20
Cetraria laevigata Rass.	.....	0	+1...111	63	.....a+....	17	...+.....	8	20
Cladonia mitis	.....	0	..3+a.+.	50	.....1.....	8	...+.....	8	15
Cladonia rangiferina subsp. *grisea*	.....	0	+1...1a.	50	.....	0	.....	0	10
Cetraria islandica	.....	0	.....Ra	25	.....	0	...+1.....	17	10
Cladonia rangiformis subsp. *fusca*	.....	0	.....	0	.....	0	3a11.....	33	10
Polytrichum juniperinum	.....	0	1.....+a	38	.....	0	.....	0	7
Stereocaulon incrustatum	.....	0	..+..a..	25	.....	0	....1.....	8	7
Polytrichum alpinum	.....	0	.....3+1	38	.....	0	.....	0	7
Cladonia rangiferina	.....	0	.....b	13	.....a+....	17	.....	0	7
Stereocaulon sasakii	.....	0	..+.....	13	.....	0	...+.....	8	5
Cladonia arbuscula	.....	0	.....ab.	25	.....	0	.....	0	5

In one relevé only:

E_1: *Clematis nobilis* + (32), *Coeloglossum viride* 1 (40), *Dianthus morii* r (1), *Empetrum asiaticum* 1 (9), *Hypericum ascyron* + (30), *Pedicularis verticillata* + (1), *Pleuropteropyrum ajanense* r (8), *Poa nemoralis* + (21), *Polygonatum* sp. + (26), *Potentilla cryptotaenia* + (15), *P. sprengeliana* + (16), *Pseudostellaria heterophylla* 1 (40), *Ranunculus* sp. + (10), *R. borealis* + (26), *Saussurea eriophylla* + (26), *Valeriana fauriei* + (25);

E_0: *Cladonia gracilis* 1 (16), *C. lepidota* 1 (16), *C. pseudoevansii* + (33), *C. squamosissima* (Müll. Arg.) Ahti + (16), *C. submitis* 1 (16), *Dicranum polysetum* + (33), *Plagiothecium denticulatum* + (16), *Pohlia longicollis* + (16).

Relevé data (Table 8.1):

rel. no.	altit. (m)	exp.	slope (°)	cover in % E_3	E_2	E_1	E_0	date	location	author
salicetosum arcticae										
1	1740	E	5	55	40	75	95	07.10.86	Paektu-san, zone C	K
2	1740	E	5	45	40	60	90	07.10.86	Paektu-san, zone C	K
3	1740	E	0	50	30	80	80	07.10.86	Paektu-san, zone C	K
4	1780	E	8	50	35	60	90	08.10.86	Paektu-san, zone C	K
5	1800	NE	10	50	25	70	50	07.10.86	Paektu-san	J
6	1775	E	10	45	5	60	90	19.06.88	Paektu-san, zone C	K
7	1775	E	5	35	5	60	95	19.06.88	Paektu-san, zone C	K
8	1775	E	10	30	5	70	95	19.06.88	Paektu-san, zone C	K
9	1775	E	5	45	5	70	95	19.06.88	Paektu-san, zone C	K
gentianetosum algidae										
10	1775	NE	10	50	8	75	90	19.06.88	Paektu-san, zone C	K
11	1745	NE	10	50	20	50	95	19.06.88	Paektu-san, zone C	K
12	1730	E	10	60	40	50	95	19.06.88	Paektu-san, zone C	K
13	1870	E	10	40	1	75	50	09.10.86	Paektu-san, zone B	K
14	1860	E	15	45	0	80	45	09.10.86	Paektu-san, zone B	K
15	1850	NE	30	40	10	85	70	09.10.86	Paektu-san, zone B	K
16	1800	N	5	40	15	75	70	09.10.86	Paektu-san, zone B	K
17	1800	NE	10	50	10	75	95	09.10.86	Paektu-san, zone B	K
typicum										
18	1850	NE	16	50	15	75	90	15.06.88	Paektu-san, zone B	K
19	1830	NE	10	30	10	75	80	07.10.86	Paektu-san	J
20	1830	NNE	15	20	5	80	50	07.10.86	Paektu-san	J
21	1870	NNE	10	20	<5	80	80	15.06.88	Paektu-san, zone B	K
22	1870	NNE	5	40	10	70	80	15.06.88	Paektu-san, zone B	K
23	1870	NNE	10	25	5	85	60	15.06.88	Paektu-san, zone B	K
24	1870	NNE	5	50	10	70	70	15.06.88	Paektu-san, zone B	K
25	1850	0	0	30	0	60	45	07.10.86	Paektu-san, under timberline	J
26	1850	0	0	10	0	80	40	07.10.86	Paektu-san, under timberline	J
27	1950	E	10	20	1	60	70	06.10.86	Paektu-san, zone A	K
28	1900	SE	5	35	5	70	60	07.10.86	Paektu-san, zone A	K
29	1900	E	<5	20	3	50	60	07.10.86	Paektu-san, zone A	K
pyroletosum dahuricae										
30	1900	SW	10	20	5	50	70	06.10.86	Paektu-san, under timberline	J
31	1900	E	10	15	5	50	40	07.10.86	Paektu-san, under timberline	J
32	1880	E	5	10	10	75	60	07.10.86	Paektu-san, under timberline	J
33	1940	SE	5	15	10	50	50	20.06.88	Paektu-san, timberline	K,S
34	1935	SE	5	25	25	55	30	20.06.88	Paektu-san, timberline	K,S
35	1925	SE	5	40	5	45	60	20.06.88	Paektu-san, timberline	K,S
36	1920	E	5	50	0	70	70	21.06.88	Paektu-san, zone A	K
37	1920	E	5	50	10	60	15	21.06.88	Paektu-san, zone A	K
38	1920	E	5	50	<5	70	60	21.06.88	Paektu-san, zone A	K
39	1920	E	5	40	20	60	70	21.06.88	Paektu-san, zone A	K
40	1925	SE	5	55	5	60	60	20.06.88	Paektu-san, timberline	K,S
41	1920	E	5	60	0	50	80	21.06.88	Paektu-san, zone A	K

Table 8.2. Goodyero repentis-Piceetum jezoensis.

Relevé number	12345678	c	111 9012	c	ct
Char. and dif. - *Goodyero repentis-Piceetum jezoensis*					
E_1					
Goodyera repens (VP)	++++1++1	100	11+.	75	92
Lycopodium cryptomerianum (VP)	......+m	25	a+..	50	33
Dif. - subass. *usneetosum longissimae*					
E_3					
Usnea longissima Ach.	11111111	100	....	0	67
E_2					
Usnea longissima Ach.	1+111+11	100	....	0	67
E_1					
Potentilla coreana Soják	+1..+1+r	75	..+.	25	58
Saussurea alpicola	++.++.++	75	....	0	50
Gentiana jamesii	++.+.++.	63	....	0	42

Table 8.2. Continued.

Relevé number	12345678	c	9012	c	ct
			111		
E_0					
Thuidium philibertii	**+.+.+.++**	**63**	....	0	42
Drepanocladus uncinatus	**+.+.+.++**	**63**	....	0	42
Cladonia maxima	**++.+...+**	**50**	....	0	33
Peltigera lepidota	**.+.+.1..**	**38**	....	0	25
Dif. - subass. *listeretosum nipponicae*					
E_1					
Listera nipponica	.....	0	**1111**	**100**	33
Calypso bulbosa (VP)	.....	0	**1+++**	**100**	33
Pseudostellaria heterophylla (Lo)	.....	0	**1+++**	**100**	33
Clematis ochotensis (AP)	.....	0	**+++1**	**100**	33
Orthilia secunda (VP)	.....	0	**111.**	**75**	25
Ligularia fischeri (AP)	.....	0	**++1.**	**75**	25
***Laricion olgensis* (Lo), *Abieti nephrolepidis-Piceetalia jezoensis* (AP)**					
E_3					
Picea jezoensis	44344434	100	3334	100	100
Abies nephrolepis	aaaa11a1	100	3aaa	100	100
Larix olgensis	111111.1	88	1+1.	75	83
Picea koraiensis	11+1....	50	....	0	33
E_2					
Picea jezoensis	3333333a	100	3aaa	100	100
Abies nephrolepis	aaa31aa3	100	+aaa	100	100
Picea koraiensis	++1a....	50	....	0	33
Larix olgensis	++....r.	38	....	0	25
Lonicera edulis	.....	0	.r+.	50	17
E_1					
Picea jezoensis	ma11+11+	100	111+	100	100
Abies nephrolepis	111a++1+	100	1111	100	100
Viola sachalinensis	11+++++.	88	1+11	100	92
Clintonia udensis	++++++1.	88	11++	100	92
Ribes horridum	..+.+.+.	38	+.1.	50	42
Picea koraiensis	++++....	50	....	0	33
Carex peiktusani	++....+.	38	....	0	25
Ledum palustre var. *maximum* Nakai	.....	0	..+r	50	17
Larix olgensis	.....	0	..r.	25	8
***Vaccinio-Piceetea* (VP)**					
E_1					
Linnaea borealis	33bba1aa	100	aaaa	100	100
Lycopodium complanatum	11+1++1+	100	a111	100	100
Vaccinium vitis-idaea	11+++1+.	88	+++1	100	92
Phyllodoce coerulea	++a+311+	100	.+aa	75	92
Pyrola incarnata	++++++++	100	+.r.	50	83
Juniperus sibirica	ma11+1+.	88	+11.	75	83
Majanthemum dilatatum	+++....+	50	+.11	75	58
Lycopodium clavatum var. *nipponicum* Nakai	...1...1	25	1..m	50	33
Vaccinium uliginosum	.....	0	.+..	25	8
Others					
E_1					
Solidago japonica	111+++1+	100	+11m	100	100
Calamagrostis langsdorfii	11++.+1.	75	+a11	100	83
Festuca ovina	++..+++.	63	..+r	50	58
Prunella vulgaris	++.+....	38	..+.	25	33
Geranium eriostemon	++.....	25	....	0	17
Aquilegia japonica	.....	0	..r+	50	17
E_0					
Ptilium crista-castrensis	334a3334	100	5434	100	100
Pleurozium schreberi	4433344a	100	.a3a	75	92
Dicranum polysetum	1.13a11a	88	..1.	25	67
Hylocomium splendens	.1.a.b..	38	....	0	25
Cetraria laevigata Rass.	.+.+.1..	38	....	0	25
Cladonia gracilis	.+.+....	25	....	0	17
Cladonia rangiferina subsp. *grisea*	...+.+..	25	....	0	17
Cladonia pseudoevansii	...+.+..	25	....	0	17
Cladonia furcata	...+.+..	25	....	0	17

In one relevé only:
E_1: *Allium thunbergii* r (11), *Petasites saxatilis* + (3), *Pteridophyta* indet. + (12), *Ribes komarovii* + (4), *Rosa davurica* + (6), *Senecio* sp. r (11), *Viola albida* + (11);
E_0: *Cladonia rangiformis* 1 (1), *Peltigera aphthosa* 1 (8), *Sphagnum girgensohnii* + (11).

Relevé data (Table 8.2):

rel no.	altit. (m)	exp.	slope (°)	cover in % E_3	E_2	E_1	E_0	date	location	author
usneetosum longissimae										
1	1710	E	8	70	45	35	95	08.10.86	Paektu-san, zone D	K
2	1770	E	5	70	45	35	90	08.10.86	Paektu-san, zone D	J
3	1700	NE	15	75	60	25	95	08.10.86	Paektu-san, zone D	K
4	1770	E	5	75	60	25	95	08.10.86	Paektu-san, zone D	J
5	1700	E	5	75	55	20	95	08.10.86	Paektu-san, zone D	K
6	1630	E	5	60	60	30	95	08.10.86	Paektu-san, zone D	J
7	1720	NE	7	70	60	15	95	08.10.86	Paektu-san, zone D	K
8	1700	E	10	75	50	10	95	08.10.86	Paektu-san, zone D	K
listeretosum nipponicae										
9	1715	E	13	90	30	25	95	22.06.88	Paektu-san, zone D	K
10	1715	E	15	75	35	35	95	22.06.88	Paektu-san, zone D	K
11	1715	E	15	70	20	50	95	22.06.88	Paektu-san, zone D	K
12	1715	NE	15	80	30	50	95	22.06.88	Paektu-san, zone D	K

Table 8.3. Carici peiktusani-Abietetum nephrolepidis.

Relevé number	12345678	c	111111 901234	c	1111 5678	c	ct
Char. and dif. - *Carici peiktusani-Abietetum nephrolepidis*							
E_2							
Prunus padus (d)	++1a11aa	100	1...1+	50	....	0	61
E_1							
Carex nanella	+.a111+1	88	+11m11	100	+...	25	78
Carex peiktusani (Lo)	..aa1++.	63	11+1a.	83	.ma.	50	67
Cerastium frucatum	..1+111+	75	11+++.	83	....	0	61
Sanguisorba tenuifolia	..+111+1	75	1+....	33	....	0	44
Prunus padus	..++....	25	++..+.	50	....	0	28
Dif. - subass. *iridetosum dichotomae*							
E_2							
Betula platyphylla (AP)	1++1111.	88	.....	0	....	0	39
Dasiphora fruticosa	..+.11+.	50	.....	0	....	0	22
E_1							
Juniperus sibirica (VP)	aa.1a++1	88	.....	0	....	0	39
Iris dichotoma (Lo)	+.+11+++	88	.....	0	....	0	39
Pseudostellaria heterophylla (Lo)	..+11+11	75	+.....	17	....	0	39
Betula platyphylla (AP)	.+....++	38	+.....	17	....	0	22
Trollius ledebourii	...1.1+.	38	.....	0	....	0	17
Dasiphora fruticosa	.....++	25	.....	0	....	0	11
Dif. - subass. *phegopteridetosum polypodioidis*							
E_3							
Sorbus amurensis (AP)	.....	0	1+..1+	67	....	0	22
E_2							
Sorbus amurensis (AP)	..1.....	13	+11+++	100	....	0	39
Ribes komarovii	.....	0	+1.++.	67	....	0	22
Acer tegmentosum	.....	0	+..+++	67	....	0	22
E_1							
Phegopteris polypodioides	...+....	13	a+aaa.	83	....	0	33
Oxalis acetosella (VP)	.....	0	+1.++1	83	...+	25	33
Pseudostellaria sylvatica	.....	0	+1+++.	83	....	0	28
Sorbus amurensis (AP)	.....	0	+.++.+	67	....	0	22
Lonicera chrysantha	.....	0	1..++.	50	....	0	17
Ribes latifolium	.....	0	++..+.	50	....	0	17
Ribes komarovii	.....	0	+..+..	33	....	0	11
Dif. - subass. *lycopodietosum complanati*							
E_1							
Lycopodium complanatum (VP)	1+...+..	38	.....	0	+++.	75	33

Table 8.3. Continued.

Relevé number	12345678	c	111**1**1 90123**4**	c	1**1**11 5**6**78	c	ct
Ribes horridum (Lo)	.....	0	.....	0	.**11**.	**50**	11
***Laricion olgensis* (Lo), *Abieti nephrolepidis-Piceetalia jezoensis* (AP)**							
E_3							
Larix olgensis	33443333	100	43333a	100	aaa1	100	100
Abies nephrolepis	a1a1aa1+	100	133333	100	**4444**	**100**	100
Betula platyphylla	...1.a1.	38	.....	0	11..	50	28
Picea koraiensis	....1.aa	38	.+.+..	33	....	0	28
Picea jezoensis	1	13	+11.+.	67	....	0	28
Prunus padus	.....	0	.....+	17	....	0	6
E_2							
Lonicera edulis	11a1a1+a	100	31+++1	100	.+..	25	83
Picea jezoensis	++.....+	38	**11a+1+**	**100**	....	0	50
Larix olgensis	**1aa+aa+.**	**88**	.....	0	....	0	39
Abies nephrolepis	3a.....	25	.....	0	**aaaa**	**100**	33
Picea koraiensis	**..+1.a1+**	**63**	.....	0	....	0	28
Malus baccata	..1..1..	25	.....+	17	....	0	17
Sorbus sambucifolia	..+.....	13	a+....	33	....	0	17
Spiraea ulmifolia	..+.....	13	.+r...	33	....	0	17
Rhododendron aureum	.....1.+	25	.....	0	....	0	11
Rhododendron parvifolium	....1...	13	.....	0	....	0	6
Clematis ochotensis	.....+	13	.....	0	....	0	6
Acer barbinerve (RdA)	.....	0	.....+	17	....	0	6
Physocarpus amurensis	.....	0	.....+	17	....	0	6
E_1							
Lonicera edulis	a1aaa3aa	100	a1++++	100	.++1	75	94
Abies nephrolepis	+1+11+++	100	++1.r+	83	+1++	100	94
Ledum palustre var. *maximum* Nakai	**3a3aa1aa**	**100**	a+....	33	+.+a	75	72
Clintonia udensis	++++1+1.	88	+++1+1	100	....	0	72
Clematis ochotensis	..++1+11	75	+1+1+.	83	..+.	25	67
Picea jezoensis	.....	0	**+1++++**	**100**	+...	25	39
Ligularia fischeri	...+1a++	63	1.....	17	....	0	33
Bupleurum longeradiatum	....+1++	50	+...+.	33	....	0	33
Viola sachalinensis	..+.++..	38	.....+	17	....	0	22
Sorbus sambucifolia	..+.....	13	1...r.	33	....	0	17
Thalictrum contortum	....++..	25	+.....	17	....	0	17
Pyrola dahurica	...+.+..	25	.....	0	....	0	11
Larix olgensis	.....1+.	25	.....	0	....	0	11
Picea koraiensis	.....1+	25	.....	0	....	0	11
Malus baccata	.....r..	13	.....	0	....	0	6
Spiraea ulmifolia	.....	0	...+..	17	....	0	6
Listera nipponica	.....	0	.....+	17	....	0	6
***Vaccinio-Piceetea* (VP)**							
E_2							
Lonicera chrysantha	..+.....	13	1++...	50	....	0	22
Vaccinium uliginosum	..+1a...	38	.....	0	....	0	17
E_1							
Vaccinium vitis-idaea	aa1111aa	100	+a++1a	100	1a1a	100	100
Linnaea borealis	maaaaa3a	100	aaa3aa	100	.mam	75	94
Pyrola incarnata	++++a1..	75	+11A++	100	a11+	100	89
Majanthemum dilatatum	..1a11r1	75	a3aa3a	100	.+++	75	83
Lycopodium clavatum var. *nipponicum* Nakai	1+1aa.a1	88	1.....	17	1+++	100	67
Orthilia secunda	...+11+.	50	++a1+.	83	....	0	50
Vaccinium uliginosum	11....1A	50	.....	0	....	0	22
Lycopodium obscurum	....+1..	25	.....	0	....	0	11
Ligularia jamesii	.....+1	25	.....	0	....	0	11
Goodyera repens	.....	0	..+...	17	....	0	6
Chimaphila japonica	.....	0	1	17	....	0	6
Lycopodium cryptomerianum	.....	0	1	17	....	0	6
Calypso bulbosa	.....	0	.....r	17	....	0	6
Others							
E_2							
Rosa davurica	11a1.1++	88	aa1aa1	100	.1.+	50	83

Table 8.3. Continued.

Relevé number	12345678	c	111111 901234	c	1111 5678	c	ct
E_1							
Solidago japonica	1+11111+	100	111111	100	.+++	75	94
Rosa davurica	+1.11+1+	88	11++1r	100	....	0	72
Calamagrostis langsdorfii	aalaaa+1	100	.+++..	50	..+.	25	67
Ostericum maximowiczii	..11aa++	75	1r...+	50	....	0	50
Pteridium aquilinum	+.....	13	1.....	17	.a1.	50	22
Hypericum ascyron	....++.+	38	+.....	17	....	0	22
Salix sp.	11.....+	38	.....	0	....	0	17
Saussurea alpicola	++...+..	38	.....	0	....	0	17
Clematis nobilis	++.....	25	.....m	17	....	0	17
Milium effusum	..+..+..	25	1.....	17	....	0	17
Cacalia hastata	...++...	25	+.....	17	....	0	17
Sanguisorba parviflora	++.....	25	.....	0	....	0	11
Salix arctica Pall.	++.....	25	.....	0	....	0	11
Angelica dahurica	...+.+..	25	.....	0	....	0	11
Pedicularis resupinata	....++..	25	.....	0	....	0	11
Geranium eriostemon	....++..	25	.....	0	....	0	11
Aquilegia japonica	1	13	+.....	17	....	0	11
E_0							
Ptilium crista-castrensis	.4343a33	88	445553	100	51aa	100	94
Pleurozium schreberi	41....33	50	aaaaa3	100	1aa3	100	78
Rhytidium rugosum	1+..aa..	50	.....a	17	....	0	28

In one relevé only:

E_1: *Aegopodium podagraria* + (6), *Carex rupestris* 1 (14), *Convallaria keiskei* + (3), *Dryopteris* sp. + (3), *Equisetum hiemale* + (1), *Festuca ovina* + (5), *Gymnocarpium* sp. 1 (9), *Hemerocallis* sp. 1 (5), *Iris setosa* + (5), *Lilium distichum* r (14), *Polygonatum* sp. + (6), *Potentilla cryptotaenia* + (6), *Symrus excelsus* + (7), *Valeriana coreana* + (6);

E_0: *Hylocomium splendens* 4 (9), *Peltigera* sp. 1 (9).

Relevé data (Table 8.3):

rel no.	altit. (m)	exp.	slope (°)	cover in % E_3	E_2	E_1	E_0	date	location	author
iridetosum dichotomae										
1	1420	0	0	60	45	70	85	11.10.86	Paektu-san, near Samji Lake	K
2	1420	0	0	50	30	80	95	11.10.86	Paektu-san, near Samji Lake	K
3	1360	0	0	70	30	80	50	17.06.88	Paektu-san, zone E	K
4	1360	0	0	70	25	90	60	17.06.88	Paektu-san, zone E	K
5	1360	0	0	70	30	80	40	17.06.88	Paektu-san, zone E	K
6	1360	0	0	75	20	85	50	17.06.88	Paektu-san, zone E	K
7	1450	SW	5	60	30	85	80	23.06.88	Paektu-san, zone E	K
8	1450	SW	5	60	20	80	80	23.06.88	Paektu-san, zone E	K
phegopteridetosum polypodioidis										
9	1380	0	0	75	40	80	80	17.06.88	Paektu-san, zone E	K
10	1380	0	0	90	15	60	80	17.06.88	Paektu-san, zone E	K
11	1380	0	0	90	10	45	90	17.06.88	Paektu-san, zone E	K
12	1380	0	0	80	5	70	90	17.06.88	Paektu-san, zone E	K
13	1380	0	0	85	10	70	90	17.06.88	Paektu-san, zone E	K
14	1420	0	0	70	25	40	90	06.06.84	Paektu-san, below Samji Lake	D
lycopodietosum complanati										
15	1420	0	0	85	20	20	95	11.10.86	Paektu-san, below Samji Lake	K
16	1400	0	0	80	10	35	95	12.10.86	Paektu-san, below Samji Lake	J
17	1410	0	0	80	10	30	95	12.10.86	Paektu-san, below Samji Lake	J
18	1400	0	0	80	20	40	95	12.10.86	Paektu-san, below Samji Lake	J

Table 8.4. Ledo decumbentis-Laricetum olgensis.

Relevé number	12345	c	111111 6789012345	c	11112 67890	c	2222222 1234567	c	ct
Char. and dif. - *Ledo decumbentis-Laricetum olgensis*									
E_3									
Betula platyphylla (AP)	...1.	20	a1a111....	60	m1..1	60	1a1aa31	100	63
E_1									
Ledum decumbens	11433	100	+.+++14341	90	++.+.	60	+1+++.+	86	85
Artemisia stolonifera	.....	0	+1+++11+++	100	.1aa+	80	++++11+	100	78
Fragaria orientalis	.....	0	.++++.....	40	.1+..	40	1++....	43	33
E_0									
Cladonia ternuiformis	.....	0	......++++	40	.....	0	+++....	43	26
Dif. - subass. *linnaeetosum borealis*									
E_1									
Linnaea borealis (VP)	mmmm1	100	.....	0	....m	20	.....	0	22
Allium thunbergii	++..1	60	.....	0	.....	0	...+...	14	15
Dif. - subass. *potentilletosum cryptotaeniae*									
E_1									
Potentilla cryptotaenia	.....	0	1+1++1++++	100	...+.	20	.....	0	41
Valeriana fauriei	.....	0	+++.++++++	90	.....	0	.....	0	33
Bupleurum longeradiatum (Lo)	.....	0	1++1++++..	80	.....	0	.....	0	30
Gymnadenia conopsea	.....	0	1++...+++.	60	.....	0	...r...	14	26
Dianthus superbus	.....	0	++++.+..++	70	.....	0	.....	0	26
Gentiana scabra	.....	0	+++..+..+r	60	..+..	20	.....	0	26
Salix arctica Pall.	.....	0	+1++++....	60	.....	0	.....	0	22
Hypericum ascyron	.....	0	++.+....++	50	.....	0	.....	0	19
E_0									
Polytrichum juniperinum	.....	0	111a+.....	50	.....	0	.....	0	19
Dif. - subass. *brometosum jezoensis*									
E_2									
Rhododendron dahuricum (RdA)	.....	0	.....	0	44...	40	.....	0	7
E_1									
Bromus jezoensis	.....	0	.....	0	..111	60	.....	0	11
Rhododendron dahuricum (RdA)	.....	0	.....	0	a+...	40	.....	0	7
E_0									
Cladonia stellaris	.....	0	.....	0	..11+	60	.....	0	11
Dif. - subass. *betuletosum paishanensis*									
E_2									
Betula paishanensis	.....	0	.....	0	.....	0	33333aa	100	26
Rhododendron parvifolium (Lo)	.....	0	.....	0	.....	0	3a3.+b.	71	19
E_1									
Potentilla coreana Soják	.....	0	.....	0	+1...	40	+++++.+	86	30
Majanthemum dilatatum	.....	0	.....	0	.....	0	+.++++m	86	22
Rhododendron parvifolium (Lo)	.....	0	.....	0	.....	0	1m1+...	57	15
Iris dichotoma (Lo)	.....	0	.....	0	.....	0	++..+1.	57	15
Thalictrum contortum (AP)	.....	0	.....	0	.....	0	...++1+	57	15
***Laricion olgensis* (Lo), *Abieti nephrolepidis-Piceetalia jezoensis* (AP)**									
E_3									
Larix olgensis	34434	100	33a3a1a33a	100	33444	100	334a3a4	100	100
Usnea longissima Ach.	.....	0	.....	0	..1.1	40	.....	0	7
Populus davidiana	.....	0	..1.....	10	.....	0	.....	0	4
Picea koraiensis	.....	0	.....	0	...+.	20	.....	0	4
E_2									
Larix olgensis	3abba	100	aa3aa.33a3	90	.1aab	80	11ma11+	100	93
Betula platyphylla	+++11	100	113ma++...	70	...+.	20	....+..	14	52
Lonicera edulis	.....	0	.....	0	+....	20	11+aa1+	100	30
Picea koraiensis	..1..	20	++.....+..	30	..1++	60	.....	0	26
Picea jezoensis	1....	20	.+.11.....	30	..r..	20	.....	0	19
Malus baccata	.....	0	+.+.+.....	30	+....	20	.....	0	15
Abies nephrolepis	+...1	40	.....	0	...1.	20	.....	0	11
Populus davidiana	.....	0	+++.....	30	.....	0	.....	0	11
Sorbus sambucifolia	r....	20	.....	0	.....	0	.....	0	4
Sorbus amurensis	.....	0	.....	0	..+..	20	.....	0	4
Clematis ochotensis	.....	0	.....	0	.....	0	......+	14	4
E_1									
Lonicera edulis	1+11+	100	++.+++++++	90	1111+	100	+1111a+	100	96
Larix olgensis	+++.+	80	++1++1111m	100	.....	0	+++1.+.	71	70
Picea jezoensis	+....	20	..r+r+..r.	50	..+++	60	...r...	14	37

Table 8.4. Continued.

Relevé number	12345	c	111111 6789012345	c	11112 67890	c	2222222 1234567	c	ct
Ledum palustre var. *maximum* Nakai	**44+13**	**100**	+.+++.++a.	70	+....	20	.....	0	48
Betula platyphylla	.+...	20	++++++....	60	.....	0	.....	0	26
Carex peiktusani	.....	0	.....	0	..1..	20	**+1m+**...	**57**	19
Ribes horridum	+.+..	40	.....	0	..+..	20	....+1.	29	19
Carex nanella	.....	0	1.1++.....	40	.....	0	.....	0	15
Sanguisorba tenuifolia	.....	0	.....	0	.....	0	....+++	43	11
Viola sachalinensis	.....	0	.....	0	.++..	40	.....	0	7
Abies nephrolepis	....r	20	.....	0	.....	0	.....	0	4
Picea koraiensis	.....	0	..+.....	10	.....	0	.....	0	4
Vaccinio-Piceetea (VP)									
E_1									
Vaccinium vitis-idaea	34334	100	abb11+aabb	100	amabm	100	aa1a1a1	100	100
Vaccinium uliginosum	.1aaa	80	a31aa+3333	100	.+11+	80	...41a+	57	81
Juniperus sibirica	**babaa**	**100**	.++.....	20	..11b	60	.....	0	37
Pyrola incarnata	++...	40	.....	0	..+..	20	+1.....	29	19
Lycopodium clavatum var. *nipponicum* Nakai	+.1.+	60	+...+.....	20	.....	0	.....	0	19
Lycopodium complanatum	....+	20	.....	0	.....	0	.....	0	4
Others									
E_2									
Salix sp.	.....	0	1++.+1....	50	++...	40	.....	0	26
Dasiphora fruticosa	.....	0	1+m.1.....	40	+....	20	...+...	14	22
Rosa davurica	.....	0	.....	0	++...	40	.....	0	7
E_1									
Calamagrostis langsdorfii	++11a	100	a1am4+a1a1	100	aaaa3	100	a1aaabb	100	100
Dasiphora fruticosa	.....	0	3434a41+11	100	.a443	80	+1+.a3a	86	74
Rosa davurica	.....	0	++++++++++	100	1++++	100	1+++r..	71	74
Festuca ovina	.....	0	baa3a3m11b	100	111b+	100	...m1+.	43	67
Sanguisorba parviflora	.....	0	+++++1++r+	100	..++.	40	++++...	57	59
Solidago japonica	.....	0	1++++++1+	100	1	20	++....+	43	52
Hieracium umbellatum	.....	0	+.++++..++	70	...+.	20	...+++.	43	41
Ostericum maximowiczii	.....	0	+..++.+.++	60	+....	20	++.+...	43	37
Gentiana jamesii	...++	40	+.....	10	..+.+	40	.....	0	19
Achillea ptarmica	.....	0	...+++....	30	...+.	20	.....	0	15
Sedum verticullatum	.....	0	+++.....	30	.....	0	.....	0	11
Scorzonera albicaulis	.....	0	+++.....	30	.....	0	.....	0	11
Parnassia palustris	.....	0	++..+.....	30	.....	0	.....	0	11
Bupleurum euphorbioides	.....	0	.....	0	...++	40	.....+.	14	11
Adenophora tetraphylla	.....	0	.....	0	.....	0	1++....	43	11
Pedicularis resupinata	.....	0	.....	0	.....	0	....+++	43	11
Pteridium aquilinum	.....	0	.+1.....	20	.....	0	.....	0	7
Poa nemoralis	.....	0	.....1+..	20	.....	0	.....	0	7
E_0									
Pleurozium schreberi	434a3	100	44333a4554	100	4a443	100	.a3....	29	81
Ptilium crista-castrensis	baa43	100	.....	0	a3b.4	80	443a...	57	48
Cladonia furcata	.....	0	111+.aa1++	90	.....	0	a11a...	57	48
Cladonia rangiferina	11...	40	.....	0	.1.a.	40	....+..	14	19
Cetraria laevigata Rass.	a....	20	.....	0	...a.	20	....+aa	43	19
Peltigera sp.	.+.++	60	.....	0	....+	20	.....	0	15
Cladonia sp.	.....	0	.....++++	40	.....	0	.....	0	15
Rhytidium rugosum	.....	0	.....	0	.....	0	a1a....	43	11
Aulacomnium palustre	b....	20	.....a....	10	.....	0	.....	0	7

In one relevé only:
E_2: *Crataegus* sp. + (8), *Prunus padus* + (16); *Salix* sp. (no. 2) + (2);
E_1: *Adenophora gmelini* + (24), *A. polyantha* + (24), *Agropyron amurense* + (19); *Equisetum hiemale* 1 (10), *Galium verum* var. *asiaticum* Nakai + (24), *Thalictrum spirostigmum* + (25);
E_0: *Ceratodon purpureus* + (15), *Cladonia gracilis* + (25), *C. maxima* + (5), *Sphagnum girgensohnii* a (1), *Stereocaulon incrustatum* + (19).

Relevé data (Table 8.4):

rel no.	altit. (m)	exp.	slope (°)	E_3	cover in % E_2	E_1	E_0	date	location	author
linnaeetosum borealis										
1	1190	0	0	40	75	40	90	09.10.86	Paektu-san, Taehongdong, zone E	K
2	1190	0	0	60	75	30	20	09.10.86	Paektu-san, Taehongdong, zone E	K
3	1190	0	0	70	70	35	90	09.10.86	Paektu-san, Taehongdong, zone E	K
4	1190	0	0	30	45	85	20	09.10.86	Paektu-san, Taehongdong, zone E	K
5	1190	0	0	40	50	40	60	09.10.86	Paektu-san, Pektu Plateau	J
potentilletosum cryptotaeniane										
6	1190	0	0	60	35	60	60	09.10.86	Paektu-san, Pektu Plateau	J
7	1190	0	0	60	30	30	80	09.10.86	Paektu-san, Pektu Plateau	J
8	1290	0	0	50	75	60	80	09.10.86	Paektu-san, Taehongdong, zone E	K
9	1190	SE	5	40	75	40	70	09.10.86	Paektu-san, Pektu Plateau	J
10	1450	0	0	60	20	85	75	12.10.86	Paektu-san, over Samji Lake	J
11	1450	SE	5	60	25	80	75	12.10.86	Paektu-san, over Samji Lake	J
12	1450	NW	10	75	30	70	95	12.10.86	Paektu-san, over Samji Lake	J
13	1400	0	0	50	40	80	70	11.10.86	Paektu-san, near Samji Lake	K
14	1400	0	0	30	20	85	75	11.10.86	Paektu-san, near Samji Lake	K
15	1400	0	0	40	60	85	50	11.10.86	Paektu-san, near Samji Lake	K
brometosum jezoensis										
16	1400	0	0	35	20	85	60	11.10.86	Paektu-san, over Samji Lake	K
17	1400	0	0	70	40	90	40	11.10.86	Paektu-san, near Samji Lake	K
18	1400	0	0	5	5	90	40	11.10.86	Paektu-san, clearing over Samji Lake	K
19	1400	0	0	20	40	75	80	11.10.86	Paektu-san, near Samji Lake	K
20	1400	0	0	35	40	65	90	11.10.86	Paektu-san, near Samji Lake	K
betuletosum paishanensis										
21	1400	0	0	30	20	70	85	11.10.86	Paektu-san, near Samji Lake	K
22	1400	0	0	20	45	80	60	11.10.86	Paektu-san, near Samji Lake	K
23	1600	N	15	45	40	85	90	12.10.86	Paektu-san, over Samji Lake	J
24	1500	0	0	65	20	80	95	12.10.86	Paektu-san, over Samji Lake	J
25	1500	N	5	60	30	80	95	12.10.86	Paektu-san, over Samji Lake	J
26	1500	NE	25	55	30	40	95	12.10.86	Paektu-san, over Samji Lake	J
27	1500	0	0	60	40	75	90	12.10.86	Paektu-san, over Samji Lake	J

Table 8.5. Polysticho retroso-paleacei-Rhododendretum dahurici.

Relevé number	1234567	c	111111111 89012345678	c	ct
Char. - *Polysticho retroso-paleacei-Rhododendretum dahurici*, *Rhododendro dahurici-Acerion barbinervi* (RdA)					
E_2					
Rhododendron dahuricum	a31+a3a	100	1a334445344	100	100
Acer barbinerve	.+...1+	43	...+.a11+11	64	56
E_1					
Polystichum retroso-paleaceum	.+r..1.	43	++1+aaa.aa1	91	72
Rhododendron dahuricum	.....	0	+mmmma11a1+	100	61
Sedum middendorffianum	.+1..1.	43	1..+..1.+11	55	50
Polypodium virginianum L.	.....+.	14	++.++1.++..	64	44
E_0					
Sphagnum girgensohnii	54444a5	100	b31aa1++1++	100	100
Cladonia amaurocraea	++a1a++	100	1....+++.++	55	72
Oncophorus wahlenbergii	++...++	57	.+...+++.++	55	56
Abietinella abietina	.....+.	14	.....+1+.1+	45	33
Dif. - subass. *ledetosum maximi*					
E_0					
Dicranum polysetum	++aaa++	100	.+.....a...	18	50
Rhytidium rugosum	1a.11aa	86	.+..+.....	18	44
Peltigera scabrosa	++++.++	86	.....	0	33
Entodon compressus	++...++	57	.....	0	22
Cladonia arbuscula	..a1a.+	57	.....	0	22
Cladonia maxima	..a+a.+	57	.....	0	22
Dif. - subass. *sorbetosum amurensis*					
E_3					
Sorbus amurensis (AP)	.a.....	14	.....1..11	27	22
E_2					
Sorbus amurensis (AP)	.....	0	.+a1aaa.11a	82	50

Table 8.5. Continued.

Relevé number	1234567	c	1111111111 8901234567 8	c	ct
E_1					
Daphne kamtschatica	.....	0	..+..+.++..	**36**	22
E_0					
Anastrophyllum minutum	.....	0	.+...++++++	**64**	39
Cladonia stellaris	.....	0	...b.+++.++	**55**	33
Polytrichum commune	.....	0	+a11+...1..	**55**	33
Cladonia pyxidata	.....	0	1+++a.....	**45**	28
Peltigera leucophlebia	.....	0	.....+++.++	**45**	28
Lophozia excisa	.....	0	.....+++.++	**45**	28
Peltigera aphthosa	.....	0	1.++....a..	**36**	22
***Abieti nephrolepidis-Piceetalia jezoensis* (AP)**					
E_3					
Larix olgensis (Lo)	3+11aa3	100	..a1.a.a.aa	55	72
Betula platyphylla	++...a.	43	..1..a1..11	45	44
Betula ermanii	.a.....	14	......1..+.	18	17
Abies nephrolepis	.....	0	..11.....	18	11
E_2					
Betula platyphylla	.11..11	57	**+111+1a1aa1**	**100**	83
Abies nephrolepis	.11.+r.	57	++.+1r.111+	82	72
Larix olgensis (Lo)	+.+11+1	86	++1+...+.+.	55	67
Betula ermanii	.1.....	14	......1..a1	27	22
Lonicera edulis	.....	0	.....+..	9	6
E_1					
Ledum palustre var. *maximum* Nakai	**5555533**	**100**	443b1+++...	73	83
Larix olgensis (Lo)	+....+1	43	.....r.+..+	27	33
Abies nephrolepis	.....	0	.+.++.+++..	**55**	33
***Vaccinio-Piceetea* (VP)**					
E_1					
Vaccinium vitis-idaea	1..++..	43	..+.+.....	18	28
Lycopodium clavatum var. *nipponicum* Nakai	+.....	14	...+++1....	36	28
Lycopodium chinensis	.....	0	...+...1...	18	11
Others					
E_2					
Rosa davurica	+++..1+	71	..11+++11a+	82	78
Euonymus alata	.....	0	..+.....+..	18	11
E_1					
Rosa davurica	1+...a+	57	+a11+...11.	64	61
Camptosorus sibiricus	.....	0	+.1.....+..	27	17
Lepisorus ussuriensis	.....	0	...+.1..+..	27	17
Carex sp.	.....	0	......++...	18	11
E_0					
Cladonia rangiferina subsp. *grisea*	1aa1aaa	100	aa+a+.1++1.	82	89
Hylocomium splendens	+aaaa3+	100	.+.+.43..31	55	72
Ptilium crista-castrensis	.a...3.	29	aa.aaaa3a35	91	67
Pleurozium schreberi	.a...3.	29	a3333.aa3.a	82	61
Drepanocladus uncinatus	++...++	57	.+...+++.++	55	56
Thuidium philibertii	++...++	57	+++.....	27	39
Dicranum fragilifolium	+..11..	43	.+.....	9	22
Aulacomnium palustre	.+....+	29	.+.+.....	18	22
Cladonia pleurota	.....	0	1+.+.....	27	17
Peltigera cf. *elisabethae*	..1.1..	29	.....	0	11
Cladonia gracilis subsp. *turbinata*	.....	0	1..a.....	18	11
Pohlia nutans	.....	0	.++.....	18	11
Pohlia longicollis	.....	0	.+.+.....	18	11
Dicranum fuscescens	.....	0	.+..+.....	18	11
Bartramia pomiformis	.....	0	.+....a....	18	11
Hedwigia ciliata	.....	0	...++.....	18	11
Physematium manchuriense	.....	0	...+....+..	18	11

In one relevé only:

E_1: *Euonymus alata* + (15), *Microlepia pilosella* + (3);

E_0: *Brachythecium buchananii* + (9), *B. salebrosum* + (9), *Campylium chrysophyllum* + (9), *Cladonia cornuta* 1 (8), *C. rangiferina* a (8), *C. squamosissima* (Müll. Arg.) Ahti + (7), *Climacium japonicum* + (9), *Dicranum scoparium* + (7), *Eurhynchium eustegium* + (9), *Fissidens cristatus* + (9), *Lophocolea itoana* +(9), *Plagiomnium acutum* + (9), *Plagiothecium piliferum* + (9), *Polytrichum juniperinum* + (2), *Ramalina* sp. + (10), *Sphagnum nemoreum* + (9).

Relevé data (Table 8.5):

rel. no.	altit. (m)	exp. (°)	slope	E_3	cover in % E_2	E_1	E_0	date	location	author
ledetosum maximi										
1	950	N	30	40	25	80	95	12.10.86	Paektu-san, Naegok	K
2	950	NNE	35	20	50	80	95	10.10.86	Paektu-san, Naegok	K
3	950	N	30	5	10	85	95	12.10.86	Paektu-san, Naegok	K
4	950	N	30	5	5	90	95	12.10.86	Paektu-san, Naegok	K
5	950	N	30	10	10	80	80	12.10.86	Paektu-san, Naegok	K
6	950	NE	35	30	50	75	95	12.10.86	Paektu-san, Naegok	K
7	950	N	30	45	30	65	95	12.10.86	Paektu-san, Naegok	K
sorbetosum amurensis										
8	1000	NW	15	0	10	70	95	11.10.86	Paektu-san, Naegok	J
9	1000	NE	30	0	20	80	95	11.10.86	Paektu-san, Naegok	J
10	1000	NE	40	20	70	50	95	11.10.86	Paektu-san, Naegok	J
11	1000	NE	30	10	75	30	95	11.10.86	Paektu-san, Naegok	J
12	1000	NE	40	0	80	35	90	11.10.86	Paektu-san, Naegok	J
13	1000	NE	40	25	85	10	95	12.10.86	Paektu-san, Naegok	K
14	1000	NNE	40	20	80	15	90	12.10.86	Paektu-san, Naegok	K
15	1000	N	33	20	90	10	95	12.10.86	Paektu-san, Naegok	K
16	1000	NE	50	0	60	305	95	11.10.86	Paektu-san, Naegok	J
17	1000	NE	35	35	80	10	95	12.10.86	Paektu-san, Naegok	K
18	1000	NNE	40	30	75	5	95	12.10.89	Paektu-san, Naegok	K

Table 8.6. Taxo-Pinetum pumilae and *Thujo koraiensis-Piceetum jezoensis.*

Relevé number	1	2	3	4	5	6	7
Char. - *Taxo-Pinetum pumilae*							
E_2							
Pinus pumila	**5**	**3**	**b**	.	.	.	.
Syringa wolfi (AnP)	.	**1**	**a**	.	+	.	.
Abies nephrolepis (AP)	**1**	**r**	.	.	.	.	.
Tripterygium regelii	.	**b**	.	.	.	.	.
Lonicera sachalinensis (AP)	.	**a**	.	.	.	.	.
E_1							
Syringa wolfi (AnP)	.	.	**a**	.	.	+	.
Thujo koraiensis-Piceetum jezoensis							
E_3							
Picea jezoensis (AP)	.	.	.	.	.	**3**	**a**
Abies nephrolepis (AP)	.	.	.	.	.	**+**	.
E_2							
Picea jezoensis (AP)	.	.	1	**1**	**a**	.	.
E_1							
Ligularia fischeri (AP)	.	.	+	**3**	**1**	**1**	.
Clintonia udensis (AP)	.	r	.	.	.	**1**	**1**
Scabiosa japonica var. *alpina* Takeda	.	.	.	**+**	**+**	.	**+**
***Abieti nephrolepidis-Piceion jezoensis* (AnP), *Abieti nephrolepidis--Piceetalia jezoensis* (AP)**							
E_3							
Betula ermanii	.	.	.	.	.	1	+
Acer ukurundense	.	.	.	.	.	.	a
E_2							
Thuja koraiensis	1	a	+	.	3	1	1
Betula ermanii	.	a	a	b	a	.	.
Rhododendron aureum	b	.	.	.	.	.	.
Acer tschonoskii	.	1	.	.	.	.	.
Sorbus amurensis	.	+	.	.	.	.	.
Acer ukurundense	.	.	.	.	.	.	a
E_1							
Calamagrostis arundinacea var. *hirsuta* Hack.	a	+	a	a	3	a	.
Dryopteris crassirhizoma	.	+	a	.	+	.	.
Betula ermanii	.	.	1	.	+	1	.
Thalictrum contortum	.	.	+	+	+	.	.
Acer ukurundense	.	.	+	.	.	.	.
Sorbus amurensis	.	.	.	.	.	+	.

Table 8.6. Continued.

Relevé number	1	2	3	4	**5**	6	7
Vaccinio-Piceetea (VP)							
E_3							
Pinus koraiensis	.	.	.	.	.	1	.
E_2							
Pinus koraiensis	.	.	.	.	1	.	.
E_1							
Majanthemum bifolium	.	1	.	.	.	.	b
Oxalis acetosella	.	1	.	.	.	.	+
Lycopodium obscurum	.	.	.	.	.	.	+
Others							
E_2							
Rosa sp.	.	.	.	.	.	+	1
Rhododendron schlippenbachii	.	.	.	.	.	3	.
E_1							
Carex siderosticta	.	+	1	.	1	a	.
Cirsium schantarense	.	+	.	+	.	+	.
Actinidia polygama	.	.	3	.	a	a	.
Carex sp.	.	.	1	a	a	.	.
Senecio nemorensis agg.	.	.	1	.	.	+	a
Lonicera chrysantha	.	.	a	+	+	.	.
Angelica decursiva	.	.	1	1	1	.	.
Cnidium monnieri	.	.	+	+	+	.	.
Astilbe chinensis	.	.	+	+	+	.	.
Veratrum patulum	.	+	.	.	+	.	.
Atractylodes ovata	.	.	1	+	.	.	.
Weigela florida	.	.	1	.	+	.	.
Veronica kiusiana	.	.	+	.	1	.	.
Rosa koreana	.	.	+	.	+	.	.
Heracleum cf. *moellendorffii*	.	.	r	.	+	.	.
Aconitum triphyllum	.	.	.	a	1	.	.
Trisetum sibiricum	.	.	.	a	1	.	.
Sabina sargentii	.	.	.	1	1	.	.
Saussurea triangulata	.	.	.	1	+	.	.
Anemone narcissiflora	.	.	.	+	1	.	.
Sedum polytrichoides	.	.	.	+	1	.	.
Pedicularis resupinata var. *umbrosa* Komar.	.	.	.	+	+	.	.
Saxifraga octopetala	.	.	.	+	+	.	.
Swertia veratroides	.	.	.	+	+	.	.
Artemisia stolonifera	.	.	.	.	1	1	.
Acer barbinerve	.	.	.	.	.	1	1
Lycopodium serratum	.	.	.	.	.	1	+
Polystichum tripteron	.	.	.	.	.	1	+
Deutzia glabrata	.	.	.	.	.	+	+
Phtheirospermum japonicum	.	.	.	.	.	+	+

In one relevé only:

E_3: *Euonymus pauciflora* + (2);

E_2: *Acer barbinerve* + (6), *A. pseudosieboldianum* + (6), *Actinidia polygama* a (7), *Alnus borealis* + (2), *Deutzia glabrata* + (7), *Echinopanax elatum* + (2), *Quercus mongolica* + (5), *Tilia taquetii* + (6), *Weigela florida* + (7);

E_1: *Aconitum villosum* + (2), *Adenophora mandshurica* + (4), *A. koreana* + (4), *Asarum heterotropoides* + (2), *Aquilegia oxysepala* + (2), *Adenophora tetraphylla* r (2), *Astilboides tabularis* (Hems.) Engl. + (6), *Athyrium squamigerum* + (7), *Cacalia kamtschatica* + (2), *C. koraiensis* 1 (6), *Caltha minor* + (2), *Carex nanella* 1 (5), *Cimicifuga davurica* a (2), *Circaea alpina* + (2), *Clematis brachyura* + (5), *C. ochotensis* r (2), *Clinopodium chinense* var. *shibetchense* (Lév.) Koidz. + (4), *Codonopsis pilosula* + (3), *Diarrhena japonica* a (3), *Dryopteris* sp. a (2), *Euonymus alata* 1 (3), *Festuca ovina* + (5), *F. parvigluma* 1 (4), *Galium kamtschaticum* 1 (2), *Gentiana scabra* + (5), *Geranium dahuricum* 1 (3), *Hemerocallis minor* + (3), *Hypericum ascyron* + (3), *Lonicera caerulea* agg. a (3), *Libanotis seseloides* + (5), *Melica nutans* + (2), *Moehringia lateriflora* + (2), *Orostachys minuta* + (5), *Paeonia japonica* r (2), *Paris verticillata* 1 (2), *Parnassia palustris* 1 (3), *Peucedanum terebintaceum* + (5), *Phegopteris decursive-pinnata* a (3), *Ph. polypodioides* 1 (2), *Potentilla fragarioides* 1 (4), *Primula jezoana* 1 (2), *Rhododendron mucronulatum* + (5), *Rh. schlippenbachii* + (5), *Rubus komarovii* + (3), *Saussurea saxatilis* + (7), *Scrophularia buergeriana* + (3), *Sedum verticullatum* + (5), *S. viviparum* 1 (5), *Smilacina japonica* + (2), *S. japonica* var. *mandshurica* Maxim. + (7), *Solidago japonica* + (6), *Thymus quinquecostatus* + (5), *Viola collina* + (7).

Relevé data (Table 8.6):

rel. no.	altit. (m)	exp.	slope (°)	E_3	cover in % E_2	E_1	E_0	date	MS	location	author
Taxo-Pinetum pumilae											
1	1890	W	10	0	100	10	40	07.10.89	M	Pirobong Mt., n summit	V
2	1750	SW	15	0	85	30	<5	18.06.90	M	Wonmanbong	K,J
3	1790	SE	37	0	30	90	0	16.09.86	M	Wonmanbong	K,J,D
Thujo koraiensis-Piceetum jezoensis											
4	1755	SW	35	0	30	95	0	16.09.86	M	Wonmanbong, slope	K,J,D
5	1660	S	55	0	40	75	5	16.09.86	M	Wonmanbong, slope	K
6	1640	S	15	50	60	70	50	16.09.86	M	Wonmanbong, slope	K
7	1630	NNW	25	40	40	60	85	16.09.86	M	Wonmanbong, slope	K

Table 8.7. Lychno-Quercetum mongolicae disporetosum ovalae (a) and *astilbetosum thunbergii* (b).

Subassociation	a		b			
	11		111111			1122
Relevé number	12345678901	c	234567	c	ct	8901
Char. - *Lychno-Quercetum mongolicae*						
E_3						
Betula schmidtii	a.1..a11133	73	.1.+a1	67	71	a...
E_2						
Actinidia polygama	....+1a1...	36	.....	0	23	....
Betula schmidtii	.....	0	.+..1.	33	12	a.3.
E_1						
Viola diamantica	...+++...+.	36	.+....	17	29	....
Actinidia polygama	...1+1a....	36	.....	0	23	....
Angelica gigas	...a+..+...	27	.....	0	17	....
Ligularia fischeri	...11.....	18	..a...	17	17	....
Lychnis cognata	...11.....	18	.....	0	12	....
Primula jezoana	...11.....	18	.....	0	12	....
Pseudostellaria palibiniana	.....1.....	9	.....	0	6	....
Dif. - subass. *disporetosum ovalae*						
E_3						
Acer mono (QF)	.31111aa1..	73	....+.	17	53	....
Carpinus cordata (QF)	...a.1aa3a1	64	.....	0	41	....
Prunus leveilleana (RQ)	1+.a.1..+.a	55	+.....	17	41	....
Styrax obassia (RQ)	1.m...1a+.m	55	.....	0	35	....
Magnolia sieboldii	.....111+1a	55	.....	0	35	....
E_2						
Acer mono (QF)	+11a11.++a1	91	.....+	17	64	...1
Magnolia sieboldii	...1.a11+1+	64	.1....	17	47	....
Carpinus cordata (QF)	++...+.a+.+	55	.....	0	35	....
Corylus heterophylla (RQ)	..+1++11...	55	.....	0	35	....
E_1						
Rubus crataegifolius	...1a1r.+a+	64	.+....	17	47	....
Viola collina	+.+++...+++	64	.....	0	41	....
Cardamine leucantha	+++a+.....+	55	.....	0	35	....
Dryopteris crassirhizoma	...11+a1..+	55	.m....	17	41	....
Hepatica asiatica (RQ)	...aa1.11a.	55	..a...	17	41	....
Schizandra chinensis	...1a...aa+	45	.....	0	29	....
Rubia chinensis	...+++++...	45	.....	0	29	....
Magnolia sieboldii	...+.1++...	36	.....	0	23	....
Disporum ovale	....1...++.	27	.....	0	17	....
Dif. - subass. *astilbetosum thunbergii*						
E_2						
Lespedeza hedysaroides	.....+.	9	++.3a1	83	35	1...
Rhododendron mucronulatum (RQ)	.....	0	a+r..r	67	23	331a
E_1						
Astilbe thunbergii	.....a1	18	+a+..+	67	35	.+1.
Pino *koraiensis-Quercion mongolicae* (PkQ)						
E_3						
Pinus koraiensis	...a+.....	18	1+a+..	67	35	34..
Cornus controversa	+.....a1...	27	.+....	17	23	....
Acer tegmentosum	...a1.....	18	.....	0	12	....
Acer triflorum	.....1..	9	.....	0	6	....

Table 8.7. Continued.

Subassociation	a		b			
	11		111111			1122
Relevé number	12345678901	c	234567	c	ct	8901
E_2						
Pinus koraiensis	.....	0	.+1r.+	67	23	..+.
Cornus controversa	+.1.....1.	27	.....+	17	23	....
Acer tschonoskii	...a++.....	27	.....	0	17	....
Acer tegmentosum	...11.....+	27	.....	0	17	....
Acer triflorum	1.....+..	18	.....	0	12	....
Deutzia glabrata	.....	0	.....+	17	6	....
E_1						
Athyrium coreanum (transgr.)	+.+...r.+++	55	+m...+	50	53	...+
Pinus koraiensis (d)	...+.+.....	18	.++...	33	23	+...
Diarrhena japonica	...1...+.+.	27	.....r	17	23	....
Bupleurum longeradiatum	...+a....+.	27	..r...	17	23	....
Campanula punctata	...+++.....	27	.....	0	17	....
Acer tegmentosum	...1.....	9	....r.	17	12	....
Aconitum triphyllum	....1.....	9	..m...	17	12	....
Abies holophylla	+.....	9	.....	0	6	....
Acer triflorum	+.....	9	.....	0	6	....
Cornus controversa	+.....	9	.....	0	6	....
Acer tschonoskii	...+.....	9	.....	0	6	....
Pedicularis resupinata	.....+.....	9	.....	0	6	....
***Rhododendro-Quercetalia mongolicae* (RQ)**						
E_3						
Quercus mongolica	ma435411+1.	91	134a4a	100	94	1a..
Acer pseudosieboldianum	a11+a.a133a	91	a3a3a3	100	94	1...
Tilia amurensis	..1...+1...	27	+1...1	50	35	....
Fraxinus rhynchophylla	.....aa1.a.	36	...+..	17	29	.+..
Pinus densiflora	3.a.....	18	....1.	17	17	....
Carpinus laxiflora (LiQ)	.....3...	9	aa....	33	17	....
Tilia mandshurica	.....a..a.	18	.....	0	12	....
Micromeles alnifolia	+.....	9	.....	0	6	....
Quercus serrata (LiQ)	..1.....	9	.....	0	6	....
Maackia amurensis	.....	0	.1....	17	6	....
E_2						
Acer pseudosieboldianum	31a.aaa1+aa	91	3aa333	100	94	1331
Fraxinus rhynchophylla	+.++11...+1	64	.+.a11	67	64	...1
Quercus mongolica	++...1.+.+r	55	1..1+1	67	58	.1+.
Styrax obassia	.....a1a..+	36	r+.r1.	67	47	....
Tilia amurensis	..++1a.1...	45	....++	33	41	....
Rhododendron schlippenbachii	...+.1.+...	27	1a+.a.	67	41	+1a.
Lespedeza maximowiczii (LiQ)	.aa..+.++..	45	.....	0	29	....
Aralia elata	.++...r..++	45	.....	0	29	....
Stephanandra incisa	..3...+...b	27	++....	33	29	....
Palura paniculata	....++..++.	36	.....+	17	29	....
Benzoin obtusilobum	.....aa3...	27	13....	33	29	.a..
Maackia amurensis	.....1...++	27	1	17	23	..+.
Vitis amurensis	....r.+1...	27	.....	0	17	....
Carpinus laxiflora (LiQ)	.....1+....	18	r.....	17	17	....
Rhus trichocarpa	.....+r....	18	r.....	17	17	....
Weigela florida	.....+.+.	18	.....+	17	17	++.1
Corylus heterophylla var. *thunbergii*	.....++	18	.+....	17	17	....
Micromeles alnifolia	.....+	9	.++...	33	17	...1
Juniperus rigida (RmP)	r.....	9	...+..	17	12	....
Tripterygium regelii	.....a.+...	18	.....	0	12	....
Callicarpa dichotoma (LiQ)	.....r.....	9	+.....	17	12	....
Tilia mandshurica	.....a..+.	18	.....	0	12	....
Prunus leveilleana	.....1..+..	18	.....	0	12	.+..
Lespedeza bicolor	.....	0	+..1..	33	12	....
Solenolantana carlesii (LiQ)	1.....	9	.....	0	6	....
Fagara schinifolia	..+.....	9	.....	0	6	....
Quercus serrata (LiQ)	.....+.....	9	.....	0	6	....
Pinus densiflora	.....	0	...+..	17	6	....
Vaccinium koreanum	.....	0	....+.	17	6	1...

Table 8.7. Continued.

Subassociation	a		b			
	11		111111			1122
Relevé number	12345678901	c	234567	c	ct	8901
E_1						
Acer pseudosieboldianum	m...+1.+.+1	55	a1+111	100	71	.+..
Vitis amurensis	+1.....++++	55	+.+r+1	83	64	....
Isodon excisus	+.1..+1+++1	73	11...+	50	64	..a+
Fraxinus rhynchophylla	+.+111..1.+	64	.+.a11	67	64	....
Ainsliaea acerifolia	...1.a1+.1.	45	.a3.a.	50	47	....
Carex lanceolata	++.....	18	.+.a.a	50	29	11..
Quercus mongolica	+1.....+..	27	...1+.	31	29	.+..
Maackia amurensis	..1.++..++.	45	.....	0	29	....
Melampyrum roseum	...++.....	18	..+aa.	50	29	+1..
Benzoin obtusilobum	.....1+1...	27	1a....	23	29	....
Astilbe koreana	...1a+.+...	36	.....	0	23	....
Styrax obassia	+.....++...	27	.....	0	17	....
Meehania urticifolia (RmP)	...aa.....a	27	.....	0	17	....
Tripterygium regelii	...1.1.+...	27	.....	0	17	....
Oplismenus undulatifolius (LiQ)	aa.....	18	.....	0	12	....
Parthenocissus tricuspidata	+.....1....	18	.....	0	12	....
Syneilesis palmata (LiQ)	.....1.a...	18	.....	0	12	....
Carpinus laxiflora (LiQ)	.....+.....	9	1.....	17	12	....
Lespedeza maximowiczii (LiQ)	.1.....	9	.....	0	6	....
Asparagus oligoclonus	.+.....	9	.....	0	6	....
Hosta longipes	....+.....	9	.....	0	6	....
Prunus leveilleana	.....1.....	9	.....	0	6	....
Stephanandra incisa	.....r.....	9	.....	0	6	....
Tilia mandshurica	.....+....	9	.....	0	6	....°
Hosta sieboldiana	.....+...	9	.....	0	6	....
Corylus heterophylla	.....+...	9	.....	0	6	....
Codonopsis lanceolata (LiQ)	.....+	9	.....	0	6	....
Callicarpa dichotoma (LiQ)	.....	0	+.....	17	6	....
Atractylodes ovata	.....	0	..+...	17	6	....
Pinus densiflora	.....	0	...+..	17	6	....
Rhododendron schlippenbachii	.....	0	....1.	17	6	....
Vaccinium koreanum	.....	0	....+.	17	6	a...
***Querco-Fagetea crenatae* (QF)**						
E_3						
Actinidia arguta	11.....+++	45	.....+	17	35	....
Kalopanax pictus	1+...1.....	27	1	17	23	....
E_2						
Euonymus oxyphylla	.....a++.+.	36	r+..+.	50	41	...1
Kalopanax pictus	+++...r....	36	.....	0	23	....
Actinidia kolomicta	.....++...	18	.....	0	12	....
Actinidia arguta	.+.....	9	.....	0	6	....
E_1						
Carex siderosticta	1+.a1a.1++1	82	.a1a11	83	82	.+1+
Aster scaber	.+.11+.+111	73	..+.1+	50	64	..++
Acer mono	1111....+++	64	...+.+	33	53	....
Asarum heterotropoides	.....+++.++	45	.+....	17	35	....
Kalopanax pictus	.+...+.+..+	36	.....	0	23	....
Viola keiskei	.....+++	27	.+....	17	23	....
Carpinus cordata	++.+.....	27	.....	0	17	....
Euonymus oxyphylla	r.....	9	...r..	17	12	....
Actaea asiatica	...a1.....	18	.....	0	12	....
Paris verticillata	...+.....	9	.r....	17	12	....
Actinidia kolomicta	....+.....	9	.....	0	6	....
Smilax nipponica	.....	0	.+....	17	6	....
Others						
E_2						
Rhamnus davurica	.++.....+..	27	+...+.	33	29	....
Rubus crataegifolius	..+...+....	18	1.+.r.	50	29	....
Euonymus pauciflora	...+1.....+	27	...r.+	33	29	....
Marlea macrophylla	..+....+..a	27	...+..	17	23	....
Pueraria lobata	+1+.....	27	.....	0	17	....
Schizandra chinensis	...1....+b.	27	.....	0	17	....

Table 8.7. Continued.

Subassociation	a		b			
	11		111111			1122
Relevé number	12345678901	c	234567	c	ct	8901
E_1						
Artemisia keiskeana	1+1.a+.+...	55	1+11.1	83	64	....
Dryopteris sp.	...alaaa+.a	64	.+....	17	47	....
Solidago virga-aurea	...1.+...+.	27	++a11.	83	47	+.++
Aster indicus	11a.....	27	1	17	23	....
Polygonatum odoratum var. *pluriflorum*	rrr.....	27	.1....	17	23	....
Dioscorea quinqueloba	.r....++.+.	36	.....	0	23	....
Cimicifuga davurica	..1.....11+	36	.....	0	23	....
Spodiopogon sibiricus	..+.....	9	3..m..	33	23	.11.
Athyrium sp.	...1.a+a...	36	.....	0	23	....
Polystichum tripteron	...1.111...	36	.....	0	23	....
Vicia amurensis	...++1r....	36	.....	0	23	....
Viola acuminata	....+....++	27	3	17	23	....
Calamagrostis arundinacea	.....+..+..	18	a.+...	33	23	3a+.
Viola chaerophylloides	++.....+	27	.....	0	17	....
Carex nervata	++.....	18	..+...	17	17	....
Rubia akane	++.....	18	..r...	17	17	....
Smilax sieboldii	+r+.....	27	.....	0	17	....
Sanicula chinensis	+r..+.....	27	.....	0	17	....
Paeonia obovata	...1+.r....	27	.....	0	17	....
Lilium tsingtanense	...+++.....	27	.....	0	17	....
Synurus pungens	....a++....	27	.....	0	17	....
Polygonatum inflatum	.....a++...	27	.....	0	17	....
Arisaema peninsulae	.....+1+...	27	.....	0	17	....
Viola selkirkii	.....+++...	27	.....	0	17	....
Viola albida	.....+++...	27	.....	0	17	....
Vicia venosa	.....+1+	27	.....	0	17	...+
Lepisorus ussuriensis	.....+r....	18	.....	0	12	...+
Saussurea sp.	.....	0	.+r...	33	12	+...
Lespedeza cyrtobotrya	.....	0	....++	33	12	..+.

In two relevés:

E_3: *Betula costata* a (4, 5), *Castanea crenata* a (1), + (2);

E_2: *Deutzia prunifolia* r (2), + (3), *Euonymus planipes* 1 (4), + (5), *Lonicera praeflorens* + (8), 1 (11), *Philadelphus schrenckii* 1 (4), a (5), *Prunus padus* a (4), + (6), *Ribes fasciculatum* 1 (4, 5), *Sambucus* sp. r (2), + (10), *S. sieboldiana* + (4, 5), *Sorbus commixta* + (18, 21), *Spiraea* sp. + (7, 13), *S. betulifolia* + (18, 19), *Viburnum sargentii* 1 (4, 5);

E_1: *Adenophora tetraphylla* + (4), 1 (5), *Aconitum himalaicum* 1 (4), + (5), *A. pseudolaeve* agg. + (9, 10), *Androsace cortusaefolia* + (8, 21), *Arisaema robustum* + (4, 5), *Cacalia adenostyloides* + (6), 1 (8), *Caulophyllum robustum* 1 (4), + (5), *Disporum sessile* + (2, 3), *Dryopteris subtripinnata* + (15, 16), *Euphorbia lucorum* + (9, 11), *Geranium koreanum* 1 (4), a (5), *Impatiens noli-tangere* + (4, 10), *Keumkangsania latisepala* + (6, 8), *Ligustrina reticulata* + (1, 12), *Marlea macrophylla* 1 (7), + (8), *M. platanifolia* + (7, 8), *Paraixeris denticulata* r (15), + (21), *Peucedanum coreanum* + (2), r (14), *Pilea* sp. r (9), + (21), *Polygonatum involucratum* + (6, 7), *Rubia cordifolia* agg. 1 (4, 5), *Saxifraga fortunaei* Hook. + (8), 1 (13), *S. uchyiamana* 1 (4, 5), *Scopolia parviflora* + (4), 1 (7), *Spuriopimpinella calycina* + (5), 1 (6), *Smilax* sp. + (1, 2), *Thalictrum filamentosum* 1 (6), + (8), *Vicia unijuga* + (1, 14), *Weigela praecox* + (4, 5).

In one relevé only:

E_3: *Acer ginnala* + (2), *Actinidia polygama* + (7), *Alnus mandshurica* + (12), *Betula* sp. 1 (1), *Celtis jessoensis* a (2), *Juglans mandshurica* a (7), *Marlea macrophylla* + (15), *Populus koreana* + (15), *Salix* sp. 1 (2), *Ulmus davidiana* a (10);

E_2: *Acanthopanax sessiliflorus* + (4), *Acer mandshuricum* + (5), *Berberis amurensis* + (4), *Betula* cf. *chinensis* + (8), *Cimicifuga heracleifolia* b (20), *C. simplex* + (11), *Clematis koreana* + (21), *Clerodendron trichotomum* + (12), *Corylus mandshurica* + (6), *Desmodium oldhamii* r (2), *Deutzia* sp. r (7), *Euonymus sieboldiana* 1 (5), *Forsythia ovata* + (8), *Ligustrina reticulata* + (12), *Lonicera maackii* + (2), *Morus bombycis* + (10), *M. mongolica* + (11), *Philadelphus* sp. 1 (9), *Staphylea bumalda* a (2), *Syringa dilatata* 1 (21), *S. micrantha* + (4), *Sorbaria sorbifolia* (L.) A. Braun + (1), *Spiraea ussuriensis* + (4), *Viburnum dilatatum* 1 (13), *Weigela praecox* 1 (4), *Ulmus* sp. r (1);

E_1: *Adenophora verticillata* var. *hirsuta* Fr. Schm. 1 (5), *Angelica decursiva* + (20), *Anthriscus aemula* var. *hirtifructus* (Ohwi) Kitag. + (4), *Artemisia sylvatica* 1 (5), *Athyrium crenatum* + (2), *Atractylodes koreana* r (15), *Berberis amurensis* + (4), *Campanula takesimana* + (10), *Cardamine impatiens* + (4), *Celastrus orbiculatus* 1 (21), *Celtis jessoensis* + (2), *Chrysanthemum coreanum* 1 (21), *Chrysosplenium barbatum* + (10),*Cimicifuga* sp. + (5), *Circaea cordata* + (10), *Clematis flabellata* + (8), *C. tubulosa* 1 (6), *Clerodendron trichotomum* r (12), *Deutzia* sp. + (4), *D. prunifolia* + (1), *Euonymus pauciflora* 1 (4), *E. planipes* + (8), *Gentiana zollingerii* r (2), *Geranium* sp. r (14), *Heracleum* sp. + (4), *Hypericum ascyron* r (6), *Isodon japonicus* 1 (4), *Jeffersonia dubia* + (5), *Lactuca triangulata* + (7), *Ligustrum obtusifolium* r (2), *Lilium cernuum* r (17), *Liparis krameri* r (17), *Lonicera praeflorens* + (8), *Lysimachia clethroides* + (2), *Majanthemum bifolium* 1 (4), *Microlepia pilosella* + (6), *Oxalis acetosella* r (5), *Paraixeris chelidoniifolia* + (6), *Patrinia saniculaefolia* + (8), *Peucedanum terebintaceum* + (18), *Phegopteris polypodioides* + (4), *Philadelphus schrenckii* + (4), *Phryma leptostachya* 1 (10), *Phtheirospermum japonicum* 1 (13), *Polypodium vulgare* r (3), *Polystichum* sp. + (21), *Potentilla* sp. + (5), *P. dickinsii* 1 (18), *P. freyniana* 1 (4), *Pternopetalum tanakae* + (21), *Rhododendron fauriae* + (13), *Rodgersia podophylla* 1 (7), *Rosa* sp. + (14), *Sanguisorba officinalis* + (18), *Saussurea conandrifolia* + (4), *S. grandiflora* + (21), *Scutellaria pekinensis* var. *alpina* (Nakai) Hara + (6), *Thalictrum actaefolium* 1 (13), *Veratrum patulum* 1 (5), *Viburnum sargentii* + (5), *Viola rossii* + (8), *V. variegata* + (4), *Weigela florida* 1 (19), *Woodsia polystichoides* r (3).

Relevé data (Table 8.7):

rel. no.	altit. (m)	exp. (°)	slope	cover in % E_3	E_2	E_1	E_0	date	MS	location	author
disporetosum ovalae											
1	320	S	15	80	30	30	0	08.10.89	M	Manpchok V, Pison Waterfall	N
2	470	S	15	60	30	30	0	11.10.89	M	under Kansenam Temple	N
3	460	E	35	90	60	30	0	09.10.89	M	near Sanwonam Temple	N
4	1130	W	34	90	40	60	0	16.06.90	M	under Pobwangbong Mt.	K,S
5	1050	SW	26	85	20	70	0	16.06.90	M	under Pobwangbong Mt.	K,S
6	560	NE	30	75	55	60	15	29.06.90	K	under Sansonam Temple	K,S
7	350	NNE	40	70	70	40	10	29.06.90	K	forest under Sansonam Temple	K,S
8	440	NE	35	75	60	40	10	29.06.90	K	Samsonam valley L part	K,S
9	520	WNW	30	80	60	40	0	09.10.89	M	near Sanwonam Temple	B,V
10	480	SW	30	80	40	30	0	10.10.89	M	near Hwayangam Temple	B,V
11	500	NNW	30	90	40	40	0	09.10.89	M	near Sanwonam Temple	B
astilbetosum thunbergii											
12	500	S	35	70	75	65	0	14.10.89	K	under Kuryong Waterfall	N
13	850	NNW	45	70	60	30	0	14.10.89	K	opp Kuryong Waterfall	B
14	1230	S	20	70	15	60	0	07.10.89	M	Chilson Valley, near small arbour	N
15	600	W	15	80	60	25	1	07.10.89	M	Chilson Valley, Wonmanbong	N
16	820	NNW	45	80	70	30	0	10.10.89	M	over Hwayangam Temple	N
17	750	S	35	75	30	20	0	08.10.89	M	Manpchok V, under Kuchung	N,V,B
18	350	SE	45	40	70	60	15	15.10.89	K	Manmoulsang V, Chonsonde Mt.	B
19	320	SE	35	60	60	40	0	15.10.89	K	Manmoulsang V, Chonsonde Mt.	B
20	350	SE	45	0	80	40	0	15.10.89	K	Manmoulsang V, Chonsonde Mt.	B
21	640	NW	30	0	40	20	60	02.10.89	S	Haedju, behind quarry	B,V

Table 8.8. Vaccinio-Quercetum mongolicae.

Relevé number	1	2	3	4	5	ct
Char. and dif. - *Vaccinio-Quercetum mongolicae*						
E_2						
Tilia taquetii	.	.	+	+	+	**60**
E_1						
Saussurea conandrifolia	+	a	+	+	.	**80**
Geranium koreanum var. hirsutum Nakai	.	+	+	.	+	**60**
Vaccinium koreanum (RQ)	a	.	.	+	.	**40**
Duchesnea indica	.	+	.	.	+	**40**
Halenia corniculata	.	+	.	.	+	**40**
Lonicera chrysantha	.	+	.	.	+	**40**
Acer barbinerve	.	.	+	.	+	**40**
Caulophyllum robustum	.	.	.	r	+	**40**
Tilia taquetii	.	.	.	+	.	**20**
***Pino koraiensis-Quercion mongolicae* (PkQ)**						
E_3						
Pinus koraiensis	.	.	+	+	.	40
Betula ermanii (d)	.	.	.	.	1	20
Abies nephrolepis (d)	.	.	.	.	1	20
Cornus controversa	.	.	.	.	1	20
E_2						
Pinus koraiensis	.	1	1	1	+	80
Magnolia sieboldii	.	.	r	+	+	60
Abies nephrolepis (d)	.	.	.	.	+	20
Acer triflorum	.	.	.	.	+	20
Acer ukurundense	.	.	.	.	+	20
E_1						
Viola collina	+	.	.	+	+	60
Diarrhena japonica	.	+	+	.	+	60
Pinus koraiensis	.	+	+	.	r	60
Deutzia glabrata	1	.	.	.	.	20
Campanula punctata	.	1	.	.	.	20
Aconitum triphyllum	.	+	.	.	.	20
Athyrium coreanum (transgr.)	.	+	.	.	.	20
Magnolia sieboldii	.	.	.	+	.	20
Dryopteris crassirhizoma	.	.	.	.	+	20

Table 8.8. Continued.

Relevé number	1	2	3	4	5	ct
Rhododendro-Quercetalia mongolicae (RQ)						
E_3						
Quercus mongolica	4	5	5	4	4	100
Micromeles alnifolia	1	.	+	.	.	40
Pinus densiflora	+	.	.	.	.	20
Prunus leveilleana	.	.	.	+	.	20
E_2						
Rhododendron schlippenbachii	3	3	4	4	+	100
Acer pseudosieboldianum	3	a	m	3	3	100
Quercus mongolica	+	+	.	+	.	60
Micromeles alnifolia	.	+	+	.	.	40
Lespedeza bicolor	1	.	.	.	.	20
Rhododendron mucronulatum	+	.	.	.	.	20
Pinus densiflora	r	.	.	.	.	20
Euonymus alata	.	.	+	.	.	20
Palura paniculata	.	.	+	.	.	20
Fagara schinifolia	.	.	.	.	1	20
E_1						
Rhododendron schlippenbachii	a	1	1	1	+	100
Melampyrum roseum	1	a	+	1	1	100
Acer pseudosieboldianum	1	1	+	1	.	80
Fraxinus rhynchophylla	1	r	+	.	+	80
Carex nanella	1	1	.	+	.	60
Quercus mongolica	.	+	+	+	.	60
Euonymus alata	.	+	+	.	+	60
Ainsliaea acerifolia	.	.	3	b	b	60
Astilbe koreana	+	+	.	.	.	40
Lespedeza bicolor	+	+	.	.	.	40
Hepatica asiatica	.	+	.	.	+	40
Parthenocissus tricuspidata	+	.	.	.	.	20
Rhododendron mucronulatum	+	.	.	.	.	20
Hosta longipes	.	+	.	.	.	20
Stephanandra incisa	.	+	.	.	.	20
Weigela florida	.	+	.	.	.	20
Querco-Fagetea crenatae						
E_2						
Acer mono	.	.	+	.	.	20
Carpinus cordata	.	.	.	.	1	20
E_1						
Carex siderosticta	1	b	1	1	1	100
Aster scaber	+	+	.	.	+	60
Viola keiskei	.	1	1	+	.	60
Others						
E_2						
Sorbus amurensis	.	+	+	.	.	40
E_1						
Artemisia keiskeana	+	1	+	+	.	80
Solidago japonica	+	+	+	.	+	80
Peucedanum terebintaceum	.	1	+	1	.	60
Syringa palibiniana	+	.	.	.	+	40
Bupleurum longeradiatum	.	+	+	.	.	40
Isodon japonicus	.	+	.	.	1	40
Actinidia polygama	.	+	.	.	+	40
Smilax china	.	.	+	.	+	40

In one relevé only:
E_3: *Juglans regia* 1 (5);
E_2: *Lonicera chrysantha* + (2);
E_1: *Aster spathulifolius* + (2), *Impatiens noli-tangere* r (1), *Lilium tsingtanense* + (4), *Phtheirospermum japonicum* + (5), *Rubus crataegifolius* 1 (5), *Saussurea grandiflora* + (5), *Sedum verticullatum* + (5), *Synurus palmatopinnatifidus* + (2), *Veratrum patulum* r (5).

Relevé data (Table 8.8):

rel. no.	altit. (m)	exp.	slope (°)	cover in % E_3	E_2	E_1	E_0	date	MS	location	author
1	820	S	32	75	60	60	15	14.09.86	M	near Kuchung Waterfall	K
2	1210	SW	27	80	50	60	10	18.09.86	M	Wonmanbong, vis point	K,J
3	1185	W	16	90	70	35	5	18.09.86	M	slope of the Wonmanbong	K,J
4	1165	WSW	40	70	85	60	0	18.09.86	M	slope of the Wonmanbong	K,J
5	1060	W	30	80	50	40	10	18.09.86	M	slope of the Wonmanbong	K,J

Table 8.9. Parthenocisso tricuspidati-Fraxinetum rhynchophyllae.

Relevé number	1	2	3	4	5	6	7	ct	8	9	10	11
Char. and dif. - *Parthenocisso-Fraxinetum rhynchophyllae*												
E_3												
Micromeles alnifolia (RQ)	**a**	.	**4**	**4**	.	.	**3**	**57**	.	.	.	.
E_2												
Deutzia glabrata (PkQ)	.	**1**	.	**a**	**+**	**a**	.	**57**	.	.	.	.
Staphylea bumalda	.	.	.	.	**+**	**+**	**1**	**43**	.	.	+	+
Micromeles alnifolia (RQ)	**1**	**1**	.	.	.	.	.	**29**	1	1	.	.
Codonopsis pilosula	.	.	.	.	.	**+**	**+**	**29**	.	.	.	.
E_1												
Parthenocissus tricuspidata (RQ)	**+**	**a**	.	**+**	**a**	**1**	**1**	**86**	.	a	.	1
Diarrhena japonica (PkQ)	**+**	**+**	**+**	.	**1**	**+**	**+**	**86**	.	.	.	1
Lactuca bungeana	**+**	**+**	.	.	**+**	**+**	**+**	**71**	.	.	.	.
Deutzia glabrata (PkQ)	.	**a**	.	**m**	**+**	**1**	**+**	**71**	.	.	.	.
Aster tataricus	.	.	.	.	**1**	**1**	**1**	**43**	.	.	.	.
Hedera rhombea	**r**	.	.	.	.	.	**+**	**29**	.	.	.	.
Rubia hexaphylla (Mak.) Mak.	.	.	.	.	**+**	.	**+**	**29**	.	.	.	.
Staphylea bumalda	.	.	.	.	.	.	**1**	**14**	.	.	.	.
***Pino koraiensis-Quercion mongolicae* (PkQ)**												
E_3												
Cornus controversa	.	1	1	1	.	.	.	43	1	r	.	.
Magnolia sieboldii	.	.	.	.	.	1	.	14	.	.	.	.
Acer triflorum	.	.	.	.	.	.	1	14	.	.	.	.
Pinus koraiensis	.	.	.	.	.	.	.	0	4	.	.	.
Acer ukurundense	.	.	.	.	.	.	.	0	+	.	.	.
Abies nephrolepis	.	.	.	.	.	.	.	0	.	.	+	.
E_2												
Magnolia sieboldii	.	.	+	1	a	a	.	57	+	.	.	.
Acer tegmentosum	+	.	.	+	.	+	.	43	+	+	.	.
Cornus controversa	.	.	.	1	1	.	.	29	.	.	.	+
Acer triflorum	.	.	+	.	.	.	.	14	.	.	.	.
Pinus koraiensis	.	.	.	.	.	.	.	0	+	.	.	.
Acer ukurundense	.	.	.	.	.	.	.	0	.	.	r	.
E_1												
Viola collina	+	.	1	.	+	.	+	57	.	.	.	.
Athyrium coreanum (transgr.)	.	.	+	+	.	+	1	57	.	.	.	a
Dryopteris crassirhizoma	1	1	.	.	+	.	.	43	a	.	.	1
Aconitum triphyllum	r	.	.	.	.	+	1	43	.	.	.	+
Acer tegmentosum	+	.	.	.	.	.	.	14	+	.	.	.
Cornus controversa	.	.	.	.	+	.	.	14	.	.	.	.
Campanula punctata	.	.	.	.	.	.	r	14	.	.	+	+
Magnolia sieboldii	.	.	.	.	.	.	.	0	+	r	.	.
Abies nephrolepis	.	.	.	.	.	.	.	0	.	.	+	+
Pedicularis resupinata	.	.	.	.	.	.	.	0	+	.	.	.
***Rhododendro-Quercetalia mongolicae* (RQ)**												
E_3												
Pinus densiflora	3	a	1	1	3	.	a	86	.	4	.	a
Quercus mongolica	1	3	1	.	.	1	+	71	.	1	3	3
Fraxinus rhynchophylla	.	1	1	.	a	4	a	71	.	1	1	.
Prunus leveilleana	.	1	.	.	.	.	1	29	.	.	.	.
Acer pseudosieboldianum	.	.	1	.	.	.	.	14	.	a	.	.
E_2												
Acer pseudosieboldianum	3	3	3	a	3	a	a	100	b	3	3	.
Quercus mongolica	+	.	+	+	1	+	+	86	1	+	.	.

Table 8.9. Continued.

Relevé number	1	2	3	4	5	6	7	ct	8	9	10	11
Lespedeza bicolor	.	.	.	1	a	1	+	57	.	.	.	.
Styrax obassia	.	.	.	1	+	1	+	57	.	1	1	a
Rhododendron schlippenbachii	1	.	.	m	.	.	.	29	.	.	.	.
Fraxinus rhynchophylla	.	+	.	.	.	+	.	29	a	.	+	1
Prunus leveilleana	.	+	.	.	.	r	.	29	.	+	1	+
Stephanandra incisa	.	.	.	a	+	.	.	29	.	b	.	.
Rhododendron mucronulatum	.	.	.	+	.	.	.	14	.	1	.	.
Aralia elata	.	.	.	.	1	.	.	14	.	r	.	1
Pinus densiflora	.	.	.	.	+	.	.	14	.	.	.	.
Euonymus alata	.	.	.	.	.	1	.	14	.	.	.	.
Corylus heterophylla	.	.	.	.	.	r	.	14	1	a	.	.
Fagara schinifolia	.	.	.	.	.	.	.	0	.	+	+	.
Tilia mandshurica	.	.	.	.	.	.	.	0	+	.	.	.
E_1												
Acer pseudosieboldianum	b	1	1	1	1	1	a	100	1	1	.	.
Quercus mongolica	+	+	+	1	+	+	+	100	.	.	+	1
Lespedeza bicolor	.	+	.	a	1	1	+	71	.	.	.	.
Prunus leveilleana	.	.	r	+	r	+	+	71	.	.	.	.
Fraxinus rhynchophylla	1	+	.	+	+	.	.	57	1	1	+	+
Euonymus alata	1	.	1	.	.	1	1	57	.	+	+	1
Styrax obassia	.	1	.	a	+	+	.	57	.	.	.	1
Carex nanella	.	+	+	.	+	.	1	57	.	.	.	.
Astilbe koreana	+	.	.	+	.	.	+	43	+	+	.	+
Melampyrum roseum	+	+	.	.	.	.	.	29	.	.	.	.
Rhododendron mucronulatum	.	r	.	+	.	.	.	29	.	.	.	.
Stephanandra incisa	.	.	.	1	+	.	.	29	+	a	.	.
Hepatica asiatica	.	.	a	.	.	.	.	14	.	.	.	.
Ainsliaea acerifolia	.	.	.	a	.	.	.	14	+	.	.	.
Rhododendron schlippenbachii	.	.	.	1	.	.	.	14	.	.	.	.
Aralia elata	.	.	.	.	+	.	.	14	.	+	.	a
Fagara schinifolia	.	.	.	.	+	.	.	14	+	+	.	.
Corylus heterophylla	.	.	.	.	.	r	.	14	.	1	.	.
Micromeles alnifolia	.	.	.	.	.	r	.	14	.	1	.	.
Asparagus oligoclonus	.	.	.	.	.	.	r	14	.	.	.	.
Vitis amurensis	.	.	.	.	.	.	.	0	1	1	r	1
Carex lanceolata	.	.	.	.	.	.	.	0	+	1	1	1
Benzoin obtusilobum	.	.	.	.	.	.	.	0	+	.	.	.
Leibnitzia anandria (RmP)	.	.	.	.	.	.	.	0	+	.	.	.
Lespedeza maximowiczii	.	.	.	.	.	.	.	0	.	.	.	+
***Querco-Fagetea crenatae* (QF)**												
E_3												
Actinidia arguta	.	.	.	.	.	a	3	29	.	.	.	.
Carpinus cordata	.	.	.	.	1	.	.	14	.	.	.	.
Acer mono	.	.	.	.	.	.	1	14	.	.	1	.
Actinidia kolomicta	.	.	.	.	.	.	.	0	a	.	1	.
Quercus dentata	.	.	.	.	.	.	.	0	.	.	.	a
E_2												
Acer mono	a	+	+	1	+	+	1	100	1	+	a	a
Actinidia arguta	.	.	.	.	.	a	3	29	.	.	.	1
Carpinus cordata	.	.	.	.	+	.	.	14	.	.	.	.
Kalopanax pictus	.	.	.	.	.	+	.	14	.	.	.	.
Quercus acutissima	.	.	.	.	.	.	.	0	.	+	+	.
Actinidia kolomicta	.	.	.	.	.	.	.	0	1	.	.	.
Quercus dentata	.	.	.	.	.	.	.	0	.	+	.	.
E_1												
Acer mono	+	r	.	+	.	+	1	71	+	.	1	+
Carex siderosticta	1	.	1	.	1	.	1	57	1	1	+	1
Actinidia arguta	+	1	.	.	.	a	a	57	.	.	.	.
Viola keiskei	.	+	.	.	1	+	.	43	.	.	.	.
Pyrola japonica	1	r	.	.	.	.	.	29	.	.	.	r
Athyrium yokoscense	.	.	+	.	.	+	.	29	.	.	.	.
Smilacina japonica agg.	.	.	.	.	+	.	1	29	+	+	.	+
Actinidia kolomicta	.	.	+	.	.	.	.	14	1	.	.	.
Aster scaber	.	.	.	.	.	.	+	14	1	1	1	.

Table 8.9. Continued.

Relevé number	1	2	3	4	5	6	7	ct	8	9	10	11
Kalopanax pictus	.	.	.	.	.	.	.	0	1	.	+	.
Quercus dentata	.	.	.	.	.	.	.	0	.	+	.	.
Others												
E_3												
Populus davidiana	a	1	.	.	.	.	.	29	.	.	.	3
E_2												
Sorbaria sorbifolia (L.) A. Braun	+	.	.	1	+	.	.	43	+	.	.	.
Menispermum dahuricum	.	.	.	.	.	+	+	29	.	.	.	.
Morus mongolica	.	.	.	.	.	+	+	29	+	.	.	.
E_1												
Solidago japonica	1	.	+	+	.	.	+	57	.	.	.	.
Viola acuminata	.	.	+	.	1	.	+	43	.	.	+	+
Viola chaerophylloides	.	.	.	.	1	+	+	43	.	.	.	.
Syringa palibiniana	+	.	1	.	.	.	.	29	.	.	.	.
Rubus crataegifolius	+	.	.	.	+	.	.	29	1	+	.	.
Thalictrum contortum	+	.	.	.	.	.	1	29	.	.	.	.
Lysimachia barystachys	.	+	.	.	1	.	.	29	.	.	.	.
Asplenium sp.	.	+	.	.	+	.	.	29	.	.	.	.
Morus mongolica	.	+	.	.	.	+	.	29	.	.	.	.
Sorbaria sorbifolia (L.) A. Braun	.	.	.	1	+	.	.	29	+	+	+	.
Cardamine leucantha	.	.	.	.	.	a	1	29	+	.	b	a
Sanicula chinensis	.	.	.	.	.	.	+	14	+	.	+	+
Dioscorea quinqueloba	.	.	.	.	.	r	.	14	1	+	.	1
Agrimonia pilosa	.	.	.	.	+	.	.	14	+	.	.	+
Smilax sieboldii	.	.	.	.	.	.	.	0	1	+	1	.

In two relevés:

E_3: *Betula costata* + (9, 10), *Castanea crenata* 3 (5), 1 (11), *Larix olgensis* + (8), 3 (10);
E_2: *Acer ginnala* + (9, 11), *Pueraria lobata* + (8, 11);
E_1: *Actinidia polygama* 1 (9, 11), *Artemisia keiskeana* + (4), 1 (9), *A. sylvatica* + (8), 1 (11), *Arthraxon hispidus* + (5), 1 (11), *Geum aleppicum* + (9, 11), *Lepisorus ussuriensis* 1 (5), r (11), *Lysimachia clethroides* 1 (9), + (11), *Onoclea sensibilis* + (8), 1 (11), *Pseudostellaria davidii* + (10, 11), *Rubia cordifolia* agg. + (8), 1 (10), *Sedum sarmentosum* + (6), a (1), *Solidago virga-aurea* 1 (9, 11).

In one relevé only:

E_3: *Actinidia polygama* a (11), *Juglans mandshurica* 1 (8), *Morus bombycis* 1 (11), *Pueraria lobata* + (11), *Pyrus* sp. 1 (6); *Salix* sp. + (11);
E_2: *Acer barbinerve* + (7), *Aconitum pseudoleave* agg. + (8), *Actinidia polygama* 1 (11), *Celastrus orbiculatus* 1 (6), *Deutzia prunifolia* a (3), *Morus bombycis* + (11), *M. tiliaefolia* + (6), *Philadelphus tenuifolius* + (8), *Populus davidiana* + (2), *Quercus aliena* + (8), *Rhamnus davurica* + (11), *Sorbus commixta* r (8), *Viburnum koreanum* + (8), *Weigela florida* f. *leucantha* Nakai + (2), *W. florida* + (1);
E_1: *Acanthopanax sessiliflorus* 1 (8), *Acer ginnala* + (11), *Adenocaulon himalaicum* 1 (11), *Adianthum pedatum* 1 (8), *Agrimonia coreana* + (6), *Allium komarovianum* + (2), *Amphicarpaea trisperma* + (5), *Anemone reflexa* + (2), *Artemisia manshurica* 1 (6), *A. viridissima* 1 (11), *Asperula maximowiczii* + (10), *Asplenium incisum* + (11), *A. wilfordii* + (8), *Aster ageratoides* + (8), *A. tataricus* + (10), *A. yomena* 1 (3), *Boehmeria longispica* + (1), *B. spicata* 1 (10), *Camptosorus sibiricus* + (6), *Carex* sp. + (11), *Celastrus orbiculatus* + (6), *Cephalanthera longibracteata* + (7), *Chimaphila japonica* 1 (2), *Cimicifuga heracleifolia* 1 (10), *C. simplex* + (8), *Corydalis ochotensis* + (12), *Cystopteris* sp. 1 (5), *Desmodium oldhamii* + (11), *Disporum sessile* + (10), *Dryopteris maximowiczii* 1 (4), *D. tokyoensis* + (5), *Equisetum arvense* + (12), *Erigeron annuus* + (12), *Fraxinus excelsior* r (9), *Galium aparine* + (10), *Glechoma longituba* + (5), *Hemerocallis disticha* 1(12), *H. minor* + (7), *Hypericum ascyron* + (8), *Impatiens noli-tangere* + (1), *Isodon japonicus* + (9), *Lilium lancifolium* + (12), *Ligusticum tenuissimum* 1 (1), *Liparis japonica* r (8), *L. koreana* + (5), *L. yatabei* + (2), *Lonicera subhispida* + (9), *Marlea macrophylla* r (5), *Menispermum dahuricum* + (10), *Milium effusum* + (10), *Miscanthus sinensis* + (6), *Monotropa hypopithys* r (10), *Morus tiliaefolia* + (1), *Neottia papilligera* r (8), *Oxalis obtriangulata* + (10), *Peucedanum terebintaceum* + (7), *Phryma leptostachya* 1 (7), *Polystichum tripteron* + (4), *Pseudostellaria heterophylla* + (10), *Pyrola minor* + (10), *Rhamnus davurica* r (11), *Rhynchosia acuminatifolia* 1 (10), *Rubus corchorifolius* + (11), *R. parvifolius* + (11), *Saussurea saxatilis* r (8), *Scutellaria kiusiana* + (10), *Sedum kamtschaticum* 1 (6), *S. verticullatum* + (6), *S. viviparum* + (6), *Setaria viridis* r (5), *Smilax china* 1 (11), *Sorbus amurensis* + (1), *Spodiopogon sibiricus* 1 (9), *Synurus pungens* + (11), *Thalictrum aquilegifolium* + (11), *Tilia taquetii* + (1), *Valeriana fauriei* + (8), *Viola dactyloides* + (9), *V. diamantica* + (9), *V. variegata* + (5), *Weigela florida* 1 (1), *Woodsia polystichoides* + (11).

Relevé data (Table 8.9):

rel. no.	altit. (m)	exp.	slope (°)	cover in % E_3	E_2	E_1	E_0	date	MS	location	author
1	610	NW	20	65	75	50	40	14.09.86	M	below Kuchung Waterfall	K
2	430	W	25	80	60	15	30	14.09.86	M	E from the Ynson Waterfall	K
3	700	W	35	80	60	40	5	19.09.86	M	valley under Kuchung Waterfall	K
4	490	NW	34	80	70	75	10	17.09.86	M	near Sanwonam Monastery	K
5	330	S	31	65	70	35	20	14.09.86	M	S slope over Kuchung Waterfall	K
6	366	SE	34	80	30	50	50	15.09.86	M	valley of the Habiro Monastery	K
7	382	S	20	75	60	65	40	15.09.86	M	valley of the Habiro Monastery	K
8	400	N	15	70	40	60	0	17.06.90	M	below the Habiro Monastery	J
9	390	W	25	70	60	50	5	16.06.90	M	valley front of the Museum	J
10	420	NE	20	70	50	50	0	20.06.90	M	below the Habiro Monastery	J
11	510	SSW	25	85	40	50	0	15.06.90	M	near Kumgangul Waterfall	K,S

Table 8.10. Festuco ovinae-Pinetum densiflorae.

Relevé number	123456789	c	11111111 01234567	c	ct
Char. and dif. - *Festuco ovinae-Pinetum densiflorae*					
E_2					
Euonymus alata (RQ)	.1.rr..1.	44	+...11.+	50	47
Prunus nakaii	.......a1	22	....	0	12
Lespedeza daurica	....	0	....+...	13	6
E_1					
Atractylodes koreana	1+.11+111	89	11+1++11	100	94
Fagara schinifolia (RQ)	.1+++++11	89	..++++++	75	82
Sophora flavescens	++...1.+1	56	++r1..++	75	65
Iris rossi (RmP)	...++..a1	44	1++++.1+	88	65
Saussurea eriophylla	....+++11	56	..++.+++	63	59
Clematis mandshurica (RmP)	.r...1..+	33	+1..1111	75	53
Potentilla fragarioides	....+....	11	+.+1++r+	88	47
Asparagus oligoclonus (RQ)	.....+.++	33	..++..++	50	41
Prunus nakaii	..+..++1.	44	.......+	13	29
Artemisia japonica	.1+1.+...	44	....	0	24
Stipa extremiorientalis	...+a....	22	11	25	24
Stevenia axillaris	...+.++..	33	...r....	13	24
Rhaponticum uniflorum	....r....	11	..+...r+	38	24
Platycodon grandiflorus (RmP)	.....+1.+	33	+.......	13	24
Patrinia villosa	+......++	33	....	0	18
Festuca ovina	...+.a1..	33	....	0	18
Lespedeza daurica	.....+...	11	....++..	25	18
Dif. - subass. *peucedanetosum terebintacei*					
E_2					
Pinus densiflora (RQ)	1a.++aa..	67	....	0	35
Fagara schinifolia (RQ)	..1..a13.	44	....	0	24
E_1					
Rhododendron mucronulatum (RQ)	b.b33aa.1	78	.....+..	13	47
Peucedanum terebintaceum	.+++++1+.	78	.......+	13	47
Lespedeza bicolor (RQ)	+1++.++..	67	....	0	35
Prunella asiatica	++...1+.+	56	....	0	29
Euonymus alata (RQ)	.1...+++.	44	....	0	24
Smilax sieboldii	.+....+1a	44	....	0	24
Dif. - subass. *lilietosum parthenenioni*					
Polystichum polyblepharon	....	0	+++++1+1	100	47
Lilium concolor var. *parthenenion*	....	0	11+++.++	88	41
Rubia cordifolia agg.	..+......	11	+.+..+r+	63	35
Pueraria lobata	....	0	.+11....	38	18
Thalictrum aquilegifolium	....	0	....+.11	38	18
***Rhododendro mucronulati-Pinion densiflorae* (RmP)**					
E_2					
Juniperus rigida	+r.++1.11	78	111a+++1	100	88
E_1					
Meehania urticifolia	...+11a11	67	+...1+11	63	65
Juniperus rigida	+..r+.+11	67	+..+.+..	38	53
Hieracium umbellatum	.....1..+	22	....r.+.	25	24
Leibnitzia anandria	+1+.....	33	....	0	18

Table 8.10. Continued.

Relevé number	123456789	c	11111111 01234567	c	ct
***Rhododendro-Quercetalia mongolicae* (RQ)**					
E_3					
Pinus densiflora	443334343	100	33443ab3	100	100
Quercus mongolica	3a33a.a..	67	.....33a	38	53
Maackia amurensis	..1.1....	22	...11.1.	38	29
Fraxinus rhynchophylla	...+.....	11	.......+	13	12
E_2					
Quercus mongolica	abb11.11.	78	.a+.1a3a	75	76
Rhododendron mucronulatum	a.b33a31a	89	a...a1.1	50	71
Fraxinus rhynchophylla	..11..r.1	44	+1..++11	75	59
Benzoin obtusilobum	..a++....	33	+1+..+a1	75	53
Corylus heterophylla	.b+.+...1	44	....1+a.	38	41
Maackia amurensis	.+.++....	33	.++1.1..	50	41
Micromeles alnifolia	.1a..+..+	44	1.+.....	25	35
Palura paniculata	.1+....1.	33	.......+	13	24
Vitis amurensis	.......aa	22	......+.	13	18
Rhus trichocarpa	.......1.	11	.1.....	13	12
Indigofera kirilowii	.......++	22	....	0	12
Styrax obassia	....	0	......+1	25	12
Stephanandra incisa	.+.....	11	....	0	6
Aralia elata	..r.....	11	....	0	6
E_1					
Carex lanceolata	a11++a...	67	aaaa1a1a	100	82
Quercus mongolica	ab.1+++1.	78	1++.a.1a	75	76
Indigofera kirilowii	11+..11+.	67	1a11+1.1	88	76
Vitis amurensis	..+..+..1	33	1.+r++++	88	59
Fraxinus rhynchophylla	....1.+.+	33	++++11+.	88	59
Benzoin obtusilobum	r.ar+r...	56	.....+1+	38	47
Pinus densiflora	+.1+.+1..	56	.+...r..	25	41
Parthenocissus tricuspidata	..1..+.aa	44	.1.....	13	29
Astilbe koreana	..1.a....	22	......+.	13	18
Palura paniculata	..+r.....	22	.......r	13	18
Maackia amurensis	....+....	11	....+1..	25	18
Rhus trichocarpa	.......+.	11	+...+...	25	18
Micromeles alnifolia	+1.....	22	....	0	12
Lespedeza maximowiczii (LiQ)	+.....+..	22	....	0	12
Syneilesis palmata (LiQ)	r1.....	22	....	0	12
Corylus heterophylla	.a.+.....	22	....	0	12
Styrax obassia	....r....	11	.......r	13	12
Viola collina (PkQ)	......+.+	22	....	0	12
Stephanandra incisa	.r.....	11	....	0	6
Magnolia sieboldii (LiQ)	.....r...	11	....	0	6
Carex nanella	......3..	11	....	0	6
Melampyrum roseum	....	0	.+......	13	6
***Querco-Fagetea crenatae* (QF)**					
E_3					
Quercus dentata	..+...a.1	33	**aaaa3...**	**63**	47
Quercus acutissima	....+..1a	33	331.....	38	35
E_2					
Quercus dentata	.......+1	22	**aa33aa.+**	**88**	53
Quercus acutissima	....++...	22	11.....	25	24
Kalopanax pictus	....	0	.+......	13	6
Acer mono	....	0	.+......	13	6
Euonymus oxyphylla	....	0	....1...	13	6
E_1					
Aster scaber	.+.++++11	78	......++	25	53
Quercus dentata	.....+1+1	44	a11a1...	63	53
Carex siderosticta	..a.a+...	33	..1...1.	25	29
Asarum heterotropoides	..rr.....	22	....+...	13	18
Pyrola japonica	....	0	....r..+	25	12
Smilax nipponica agg.	.+.....	11	....	0	6
Kalopanax pictus	..r.....	11	....	0	6

Table 8.10. Continued.

Relevé number	123456789	c	11**1**11111 01**2**34567	c	ct
Smilacina japonica	........r	11	....	0	6
Euonymus oxyphylla	....	0	....1...	13	6
Acer mono	....	0	......r.	13	6
Others					
E_3					
Castanea crenata	.1.....+.	22	....	0	12
Alnus japonica	.......1a	22	....	0	12
E_2					
Prunus leveilleana	.+.++....	33	11+..11+	75	53
Lonicera praeflorens	...++....	22	..+...1.	25	24
Robinia pseudo-acacia	....r+.1.	33	....	0	18
Castanea crenata	11	22	....	0	12
Weigela sp.	.......+1	22	....	0	12
Rosa multiflora	.......++	22	....	0	12
Parthenocissus tricuspidata	.......+.	11	.+......	13	12
Deutzia prunifolia	....	0	1....1..	25	12
Lonicera chrysantha	....	0	+...1...	25	12
Lespedeza cyrtobotrya	....	0	.1...+..	25	12
Pueraria lobata	....	0	..11....	25	12
E_1					
Spodiopogon sibiricus	11111a311	100	111a11a.	88	94
Lysimachia clethroides	...++++..	44	11+++.1+	88	65
Miscanthus sinensis	..1+a+1..	56	1.aa..+.	50	53
Chrysanthemum indicum	11....+..	33	11.1.1.+	63	47
Artemisia keiskeana	...+1++1a	67	......3a	25	47
Quercus acutissima	r.....+..	22	1++..+..	50	35
Hemerocallis minor	.+.....	11	1.....11	38	24
Rubia cordifolia var. *pratensis*	...r.....	11	....+.1+	38	24
Lespedeza cyrtobotrya	....+....	11	+..+..+.	38	24
Adenophora sp.	.....+.1+	33	......+.	13	24
Erigeron annuus	+....r...	22	..r.....	13	18
Scorzonera albicaulis	+.....+.+	33	....	0	18
Ampelopsis brevipedunculata	r++.....	33	....	0	18
Lysimachia barystachys	.1.....a1	33	....	0	18
Agrimonia pilosa	.+.....a1	33	....	0	18
Lilium lancifolium	.+.....11	33	....	0	18
Osmunda japonica	..+++....	33	....	0	18
Artemisia asiatica	..+.....	11	+.....+.	25	18
Gentiana scabra	.....1+.+	33	....	0	18
Celastrus orbiculatus	.....+1..	22	...r....	13	18
Hypericum ascyron	.....+++.	33	....	0	18
Carduus crispus	.....++r.	33	....	0	18
Rubus parvifolius	.....+.1a	33	....	0	18
Castanea crenata	.....+.++	33	....	0	18
Viola acuminata	.......++	22	......+.	13	18
Potentilla togasii Ohwi	+....1...	22	....	0	12
Lactuca bungeana	+....+...	22	....	0	12
Pulsatilla koreana	+........	11	...+....	13	12
Sanguisorba officinalis	r.......+	22	....	0	12
Potentilla sprengeliana	.+.+.....	22	....	0	12
Geum aleppicum	.+...r...	22	....	0	12
Ranunculus japonicus	.+......+	22	....	0	12
Rhus chinensis	..+....+.	22	....	0	12
Securinega suffruticosa	..+.....	11	.......+	13	12
Solidago japonica	...++....	22	....	0	12
Viola mandshurica	...+.+...	22	....	0	12
Pteridophyta no. 3 indet.	....+....	11	.+......	13	12
Platanthera sp.	....r....	11	.+......	13	12
Arundinella hirta	.....11..	22	....	0	12
Artemisia viridissima	.....11..	22	....	0	12
Iris ruthenica	.....11..	22	....	0	12
Koeleria cristata	.....1+..	22	....	0	12
Patrinia scabiosaefolia	.....++..	22	....	0	12
Potentilla sp.	......1+.	22	....	0	12
Paraixeris denticulata	......+..	11	.+......	13	12
Hemerocallis dumortieri	.......a1	22	....	0	12

Table 8.10. Continued.

Relevé number	123456789	c	11111111 01234567	c	ct
Carex disperma	11	22	....	0	12
Disporum sp.	.......1+	22	....	0	12
Smilax china	.......1+	22	....	0	12
Saussurea sp.	.......+1	22	....	0	12
Viola hirtipes	.......++	22	....	0	12
Synurus excelsus	1	11	......+.	13	12
Selaginella involvens	....	0	+.....+.	25	12
Sedum aizoon	....	0	+......r	25	12
Prunus leveilleana	....	0	.+...+..	25	12
Deutzia prunifolia	....	0	.+...+..	25	12
Silene oliganthella	....	0	.+...+..	25	12
Dictamnus dasycarpus	....	0	11	25	12
Convallaria keiskei	....	0	......1+	25	12

In one relevé only:

E_3: *Alnus sibirica* + (2), *Parthenocissus tricuspidata* + (8), *Prunus leveilleana* + (1), *Pueraria lobata* + (9);

E_2: *Acer ginnala* r (5), *Celtis sinensis* + (9), *Elaeagnus umbellata* r (5), *Euonymus* sp. + (16), *Ligustrum obtusifolium* + (2), *Lonicera* sp. + (9), *L. japonica* 1 (7), *L. maximowiczii* + (6), *Metaplexis japonica* r (2), *Morus alba* + (9), *M. bombycis* + (11), *Rhus chinensis* r (7), *Salix caprea* + (9), *Spiraea pubescens* + (5), *Ulmus macrocarpa* + (16), *Weigela subsessilis* 1 (5);

E_1: *Adenophora tetraphylla* + (1), *Acer ginnala* + (6), *Aconitum* sp. + (9), *Amitostigma gracile* + (1), *Angelica amurensis* r (9), *Artemisia messerschmidtiana* r (2), *A. sylvatica* + (1), *Asparagus officinalis* + (9), *Asperula maximowiczii* + (2), *Aster lautureanus* + (17), *Athyrium nipponicum* r (4), *Bupleurum scorzoneraefolium* + (8), *Cacalia kamtschatica* 1 (17), *Calamagrostis arundinacea* + (1), *C. langsdorfii* 1 (9), *Calystegia hederacea* + (11), *Carex leucochlora* + (11), *Carpesium* sp. + (6), *Caulophyllum robustum* r (14), *Cephalanthera longibracteata* + (9), *Chenopodium album* + (11), *Chimaphila japonica* + (3), *Cirsium maackii* r (2), *Duchesnea indica*+ (6), *Eccoilopus cotulifer* a (9), *Epimedium koreanum* 1 (16), *Euphorbia* sp. + (9), *Festuca parvigluma* + (2), *Galium verum* var. *asiaticum* Nakai + (17), *Gentiana zollingerii* r (6), *Hemistepta lyrata* + (5), *Inula salicina* 1 (6), *Isodon japonicus* + (3), *Ixeris* sp. + (13), *I. chinensis* + (3), *I. polycephala* + (2), *Leontopodium japonicum* 1 (7), *L. leiolepis* Nakai 1 (7), *Lepisorus ussuriensis* + (10), *Lilium amabile* + (2), *Liparis japonica* + (2), *Lithospermum erythrorhizon* + (8), *Lonicera* sp. + (6), *Melampyrum setaceum* + (2), *Menispermum dahuricum* + (3), *Metaplexis japonica* + (8), *Microlepia pilosella* + (3), *Monotropa hypopithys* r (6), *Orostachys sikokiana* + (11), *Paeonia obovata* + (17), *Picris japonica* + (9), *Platanthera freynii* + (6), *P. ophrydioides* r (3), *P. sachalinensis* + (8), *Poa viridula* + (2), *Potentilla chinensis* 1 (7), *P. discolor* + (7), *Pteridophyta* no. 1 indet. m (11), *Pycnostelma paniculata* r (1), *Robinia pseudo-acacia* 1 (8), *Rosa multiflora* + (8), *Rubus corchorifolius* + (6), *Sanguisorba hakusanensis* + (8), *Sanicula chinensis* r (6), *Scilla scilloides* + (11), *Scrophularia koraiensis* r (17), *Sedum kamtschaticum* + (11), *Spiraea pubescens* + (5), *Taraxacum* sp. r (1), *Thalictrum* sp. + (9), *Th. baicalense* r (2), *Th. contortum* + (8), *Themeda japonica* + (1), *Ulmus coreana* Nakai + (11), *Viburnum sargentii* r (2), *V. sargentii* f. *lutescens* (Nakai) Uyeki r (5).

Relevé data (Table 8.10):

rel. no.	altit. (m)	exp.	slope (°)	cover in % E_3	E_2	E_1	E_0	date	MS	location	author
peucedanetosum terebintacei											
1	230	WSW	20	75	30	60	0	13.06.90	L	hills over the monastery	J
2	200	W	10	85	50	70	5	13.06.90	L	1.5 from from small gorge	J
3	250	W	20	70	40	60	0	14.06.90	T	slope over the dam	J
4	240	NE	28	60	55	70	<5	02.06.88	T	N fr capitol, Chansupon P	K
5	230	ENE	33	60	50	70	0	03.06.88	T	Chansupon Peak	K
6	250	WNW	20	60	40	60	0	13.06.90	T	Mt. Taesong	K,S
7	260	SW	22	60	50	60	0	13.06.90	T	Mt. Taesong	K,S
8	250	NE	15	70	60	60	0	14.06.90	T	near shore of Taesong Lake	K,S
9	250	E	23	75	60	50	0	14.06.90	T	near Taesong Lake	K,S
lilietosum parthenenioni											
10	235	S	30	80	40	40	5	01.06.88	L	slope	K
11	235	SSW	12	80	50	30	20	01.06.88	L	slope	K
12	140	SE	30	70	50	20	<5	04.06.88	T	Chansupon Peak	K
13	140	SE	30	75	50	35	0	04.06.88	T	Chansupon Peak	K
14	185	E	20	70	50	20	<5	01.06.88	L	slope	K
15	185	W	20	70	45	30	0	01.06.88	L	slope	K
16	150	NNW	32	75	55	60	<5	04.06.88	T	Chansupon Peak	K
17	140	NW	22	55	50	55	0	04.06.88	T	Chansupon Peak	K

Table 8.11. Saso-Quercetum mongolicae quercetosum variabilis var. *typicum* (a) and var. *potentillosum fragarioidis* (b).

Variant	a	b	
	11111	1111122	
Relevé number	12345678901234	5678901	ct
Diagn. taxa - *Saso-Quercetum mongolicae quercetosum variabilis*			
E_3			
Quercus serrata (LiQ)	**33.341.333++..**	**3.1.+..**	**62**
Quercus variabilis (LiQ)	**3a3...1...341.**	**.1a..a.**	**48**
E_2			
Callicarpa dichotoma (LiQ)	**.+.1+1+....111**	**+11.1..**	**57**
Quercus serrata	**.1..+...+.....**	**.......**	**14**
Quercus variabilis (LiQ)	**.1a.....**	**.......**	**10**
E_1			
Quercus serrata (LiQ)	**.1.r....r++...**	**+.+....**	**33**
Quercus variabilis (LiQ)	**.1.....+..**	**......+**	**14**
Callicarpa dichotoma (LiQ)	**....++.....**	**+.....**	**14**
Dif. - var. *typicum*			
E_2			
Palura paniculata (RQ)	**+111+..1aa....**	**.....+.**	43
Solenolantana carlesii (LiQ)	**+++.+.....**	**.....**	19
E_1			
Sasamorpha purpurascens var. *borealis*	**44.34313444143**	**.....**	62
Astilbe koreana (RQ)	**+.++...a++....**	**.....**	29
Palura paniculata (RQ)	**...r....++....**	**.....**	14
Dif. - var. *potentillosum fragarioidis*			
E_1			
Potentilla fragarioides	**.....**	**..++r.+**	19
***Lindero-Quercion mongolicae* (LiQ)**			
E_3			
Carpinus laxiflora	....a3....1+..	11.....	33
Quercus mc-cormickii	.....11a....	.....	14
Rhus javanica	1	.....	5
E_2			
Lespedeza maximowiczii	3aaa+3.111aala	aa.++.a	86
Carpinus laxiflora	....a.....1.+	+.+.++.	33
Rhus javanica	++.....1...	.....	14
Rhus verniciflura	.....+.+....	.....	10
Quercus mc-cormickii	.....++....	.....	10
Codonopsis lanceolata	..+.....	.....	5
Viburnum wrightii	.....	..1....	5
E_1			
Lespedeza maximowiczii	11.1.1+1++.1+1	.1.+...	62
Syneilesis palmata	a.1..1+a..11..	+..rla.	52
Disporum smilacinum	+1.....	1....1.	19
Codonopsis lanceolata	..+.....+...	.r...+.	19
Oplismenus undulatifolius	..+.....	..+....	10
Carpinus laxiflora	.....	..+..+.	10
Solenolantana carlesii	.+.....	.....	5
Quercus mc-cormickii	.....+....	.....	5
Rhus javanica	.....+...	.....	5
Viburnum wrightii	.....	.....+.	5
***Pino koraiensis-Quercion mongolicae* (PkQ)**			
E_3			
Magnolia sieboldii	.....1.....	.....	5
Cornus controversa	..a.....	.....	5
E_2			
Magnolia sieboldii	1...++.a11+...	.....	33
Pinus koraiensis	....+.+.....	.....	10
Cornus controversa	..1.....	.....	5
Betula schmidtii	.....1.....	.....	5
Deutzia glabrata	.....	1	5
E_1			
Athyrium coreanum (transgr.)	.....++.....	..+..++	24
Pinus koraiensis	...+.r.....	.....	10
Diarrhena japonica	...r.....	.....r	10

Table 8.11. Continued.

Variant	a	b	
	11111	1111122	
Relevé number	12345678901234	5678901	ct
Viola collina	......+.......	....	5
Magnolia sieboldii	.........+....	....	5
Rhododendro-Quercetalia mongolicae (RQ)			
E_3			
Quercus mongolica	.a3.1a.1..1134	a444335	76
Pinus densiflora	aa.1....1+aa++	rr1ar.1	71
Acer pseudosieboldianum	.a.a..3.1a.+.a	1.11a.1	57
Styrax obassia	...a..1.3.++..	+.+.1..	38
Fraxinus rhynchophylla	..a....11...+.	.+...++	33
Prunus leveilleana	a......1.....	++...a1	29
Maackia amurensis	...1.........+	....	10
Tilia mandshurica	......+.......	1	10
Micromeles alnifolia	.......a......	...+...	10
E_2			
Acer pseudosieboldianum	a3aaaaaaaaa+a1	aa3a331	100
Benzoin obtusilobum	1aaaaaaa1a1aaa	aa11a1a	100
Styrax obassia	a13a1a+1.a111+	+.1a1m.	86
Stephanandra incisa	a11+.1+aa1+...	++1.+.1	71
Rhododendron schlippenbachii	a1..a1..1a1+13	.3a3..1	67
Fraxinus rhynchophylla	1+1.+..+11+.+.	...+.++	57
Rhus trichocarpa	+..+++......++	++++...	48
Rhododendron mucronulatum	a....1..1....a	.+aa+..	38
Quercus mongolica	.+........11.a	1.111..	38
Micromeles alnifolia	.+.+....1+.+..	...+..+	33
Weigela florida	.+...++....+..	+...+..	29
Prunus leveilleana	.+11.....1....	......+	24
Maackia amurensis	..+.+......+..	++.....	24
Corylus heterophylla	11..........	....+.+	19
Tripterygium regelii	..a++...1.....	....	19
Tilia amurensis	...1++1.......	....	19
Vitis amurensis	.+++..........	....	14
Lespedeza bicolor	+..........	.+.....	10
Pinus densiflora	..+........1..	....	10
Corylus heterophylla var. *thunbergii*	..........+.	....	5
Vaccinium koreanum	.....	.1.....	5
Fagara schinifolia	.....	......+	5
Tilia mandshurica	.....	......+	5
E_1			
Benzoin obtusilobum	+.11+111+.+1.1	a1++1+.	81
Carex lanceolata	+11..1.+.++a.1	1+11aaa	76
Ainsliaea acerifolia	1aa111a111+.+.	++..+..	71
Acer pseudosieboldianum	11.++11.11..11	.a++.+.	67
Vitis amurensis	.+m++++.r+.+..	......+	48
Styrax obassia	..1++..++....+	+....+.	38
Quercus mongolica	..+..1.....++.	111+...	38
Isodon excisus	111r.++......r	....	33
Fraxinus rhynchophylla	.1...r....+.++	++.....	33
Melampyrum roseum	..+.......+a.+	+.1r...	33
Stephanandra incisa	..1....+1.....	.++..+.	29
Rhododendron schlippenbachii	1...+...+..+..	.1.....	24
Pinus densiflora	..+....+...+..	+.r....	24
Atractylodes ovata	..........+...	1.++...	19
Hosta longipes	.....+....+...	m.....	14
Parthenocissus tricuspidata	+......+......	....	10
Hepatica asiatica	.r....1.......	....	10
Maackia amurensis	...+..........	....+..	10
Rhus trichocarpa	..........+...	+......	10
Lespedeza bicolor	+..........	....	5
Corylus heterophylla	.1..........	....	5
Hosta sieboldiana	...+..........	....	5

Table 8.11. Continued.

Variant	a	b	
	11111	1111122	
Relevé number	12345678901234	5678901	ct
Prunus leveilleana	...r.....	.....	5
Tilia amurensis	...r.....	.....	5
Meehania urticifolia (RmP)	......1.....	.....	5
Micromeles alnifolia	.....+....	.....	5
Tripterygium regelii	.....+....	.....	5
Rhododendron mucronulatum	.....	...+...	5
Fagara schinifolia	.....	......+	5
***Querco-Fagetea crenatae* (QF)**			
E_3			
Acer mono	1.aa.1+.1.+...	.....	33
Kalopanax pictus	.a.a.....+	1.....	19
Carpinus cordata	...3..4.....+	....a..	19
Actinidia arguta	11....1.....	.....	14
Quercus acutissima	......1.....3a	.....	14
Carpinus coreana	.....33a....	.....	14
E_2			
Acer mono	1+....m1.1..+.	.....1.	33
Euonymus oxyphylla	.+.....+.....	+1.++..	29
Kalopanax pictus	..++..++.....	.+.....	24
Actinidia arguta	1+.....1.....	.....	14
Carpinus cordata	......a....1.+	.....	14
Carpinus coreana	.....+a....	.....	10
Quercus acutissima	.....+1.	.....	10
Actinidia kolomicta	..1.....	.....	5
E_1			
Carex siderosticta	aaa.++a.al....	a.11a.+	62
Aster scaber	..+..++..+++.+	+.1r+m+	62
Viola keiskei	.....1++....	.....b.	19
Euonymus oxyphylla	.....+	+..+..+	19
Pyrola japonica	.....+...	...r+..	14
Acer mono	..a..+.....	.....	10
Smilax nipponica	......+....+..	.....	10
Kalopanax pictus	.....	r....+.	10
Actinidia arguta	1.....	.....	5
Athyrium yokoscense	.+.....	.....	5
Carpinus coreana	....+.....	.....	5
Carpinus cordata	......+.....	.....	5
Smilacina japonica agg.	.....	......+	5
Asarum heterotropoides	.....	......+	5
Others			
E_2			
Rhamnus davurica	.....a+....++1	+.....+	33
Lespedeza hedysaroides	.....1+.+	1+a...+	33
Viburnum dilatatum	.....+1..	+..+...	19
Clerodendron trichotomum	.+....+.....	r.....	14
Rubus crataegifolius	..+..r....+...	.....	14
E_1			
Spodiopogon sibiricus	..1.....11.+	1+++..1	43
Artemisia keiskeana	.....+..r1.+	.1+.111	43
Lysimachia clethroides	++1.....+...	+....++	33
Calamagrostis arundinacea	..1.....1.r	++....+	29
Smilax oldhamii	+11.....	.....+.	19
Smilax sp.	.....r.....	+..++..	19
Viola chaerophylloides	......+.....	..rr.1.	19
Rubus crataegifolius	+11.....	.....	14
Viola selkirkii	++1.....	.....	14
Disporum sessile	+1+.....	.....	14
Carex sp.	..a.....1...	1.....	14
Vaccinium koreanum	.....+.....	+1.....	14
Pteridophyta no. 3 indet.	.....1++....	.....	14
Boehmeria tricuspidata	.....+++....	.....	14

In two relevés:
E_2: *Callicarpa japonica* + (1, 3), *Euonymus macroptera* 1 (8), + (10);
E_1: *Agrimonia pilosa* + (3, 20), *Asperula maximowiczii* + (1, 20), *Cephalanthera longibracteata* + (2, 3), *Clematis patens* + (1), r (2), *Clerodendron trichotomum* + (2), r (15), *Disporum* sp. 1 (18), + (19), *Dryopteris saxifraga* + (1), 1 (3), *Eupatorium lindleyanum* + (1, 3), *Solidago japonica* + (14, 20), *Synurus pungens* + (1), 1 (3), *Thalictrum filamentosum* + (1, 2), *Viola* sp. + (15, 19), *V. orientalis* 1 (8), + (9).
In one relevé only:
E_3: *Actinidia polygama* 1 (4), *Carpinus japonica* 1 (3), *Castanea crenata* a (19), *Fraxinus mandshurica* 1 (1), *Tilia fusiformis* 1 (10), *T. ovalis* 1 (7);
E_2: *Acer palmatum* 1 (8), *Amphicarpaea trisperma* + (7), *Carpinus japonica* a (3), *Deutzia prunifolia* + (8), *Euonymus* sp. + (3), *E. pauciflora* + (15), *E. planipes* + (1), *Lepisorus ussuriensis* + (5), *Ligustrina reticulata* + (20), *Lonicera praeflorens* + (2), *Morus bombycis* 1 (3), *M. mongolica* + (7), *Parthenocissus tricuspidata* + (2), *Philadelphus* sp. + (19), *Rosa multiflora* + (3), *Sambucus coreana* 1 (3), *Spiraea koreana* + (3), *Staphylea bumalda* 1 (7);
E_1: *Aconitum pseudolaeve* agg. + (20), *Angelica decursiva* 1 (20), *A. gigas* + (8), *Arundinella hirta* + (18), *Aster ageratoides* + (19), *A. tataricus* + (19), *Athyrium crenatum* 1 (19), *Atractylodes koreana* + (9), *Carex ciliatomarginata* + (14), *Cimicifuga davurica* 1 (6), *Chrysanthemum indicum* + (21), *Clematis brachyura* r (15), *Commelina communis* + (3), *Corydalis pallida* + (20), *Cynanchum ascyrifolium* + (2), *Desmodium racemosum* + (3), *Dryopteris* sp. + (7), *D. subtripinnata* + (18), *Eupatorium japonicum* r (17), *Hemerocallis minor* r (21), *Hosta* sp. 1 (12), *H. minor* + (8), *Hypericum ascyron* + (3), *Isodon inflexus* a (20), *Lactuca bungeana* + (20), *Lepisorus ussuriensis* + (4), *Ligustrina reticulata* + (20), *Liparis koreana* + (3), *Osmunda cinnamomea* + (20), *O. japonica* 1 (3), *Paraixeris denticulata* r (21), *Polygonatum odoratum* var. *pluriflorum* 1 (7), *Polystichum* sp. + (7), *Pteridium aquilinum* 1 (15), Pteridophyta no.2 indet. + (8), *Rubia akane* r (17), *R. cordifolia* agg. + (3), *R. chinensis* + (7), *Rubus oldhami* + (3), *Saussurea seoulensis* r (21), *Smilax sieboldii* 1 (19), *Sorbaria sorbifolia* (L.) A. Braun + (3), *Spuriopimpinella calycina* + (3), *Stellaria bungeana* 1 (20), *Thalictrum actaefolium* + (7), *Tilia ovalis* + (7), *Trillium* sp. + (7), *Veratrum japonicum* r (15), *Viburnum* sp. + (12), *Vicia venosa* r (15), *Viola acuminata* r (21), *V. albida* + (5), *V. diamantica* + (7), *V. dissecta* + (1).

Relevé data (Table 8.11):

rel.	altit.	exp.	slope	cover in %				date	MS	location	author
no.	(m)		(°)	E_3	E_2	E_1	E_0				
var. *typicum*											
1	300	NE	28	75	65	60	20	22.06.90	K	r bank of Ondzongtschon River	K,S
2	300	E	25	80	50	70	<10	22.06.90	K	r bank of river, 4 km from Ondzongri	K,S
3	400	SW	20	75	70	50	<10	22.06.90	K	r bank of river, 5 km from Ondzongri	K,S
4	350	SSE	35	80	60	50	<10	28.06.90	K	under Kuryong Waterfall	K,S
5	200	NE	30	70	50	75	<5	28.06.90	K	forest on the block field	K,S
6	240	N	40	75	60	60	0	14.10.89	K	Kuryong Waterfall, N slope	N
7	180	NE	25	90	40	35	0	14.10.89	K	Kuryong Waterfall	B
8	170	NE	43	80	50	70	0	07.06.88	K	r bank of river, 2 km from Ondzongri	K
9	180	N	40	80	50	75	<5	07.06.88	K	r bank of river, 2 km from Ondzongri	K
10	195	NW	38	70	40	75	0	07.06.88	K	r bank of river, 2 km from Ondzongri	K
11	220	S	35	75	50	75	0	15.10.89	K	Manmoulsang Valley	N
12	200	S	45	90	60	25	0	14.10.89	K	Kuryong Waterfall, bridge over river	N,B
13	180	E	7	90	20	75	0	14.10.89	K	Kuryong Waterfall	B
14	160	E	20	70	75	40	0	14.10.89	K	Kuryong Waterfall	B
var. *potentillosum fragarioidis*											
15	300	SE	10	60	60	40	0	15.10.89	K	Manmoulsang Valley	N
16	260	W	5	75	65	70	0	14.10.89	K	under Kuryong Waterfall	N
17	200	W	30	80	70	20	0	21.10.89	C	Pagyon Valley, under waterfall	N
18	450	SW	35	90	60	20	0	21.10.89	C	Pagyon V, over Tehum-san Temple	N
19	290	E	30	90	50	40	0	21.10.89	C	Pagyon Valley, 500 m over Kwanum	N
20	380	SW	24	75	60	65	0	30.09.86	S	near the Suyan Monastery ruine	K,J
21	600	S	20	90	50	20	0	02.10.89	S	ridge un hill with transmission	N,V

Table 8.12. Artemisio-Quercetum mongolicae juniperetosum rigidae (a), var. *typicum* (a1), var. *calamagrostiosum arundinacei* (a2), *deutzietosum prunifoliae* (b) and *styracetosum obassiae* (c).

Subassociation		a			b		c				
Variant	a1	a2									
		1111111		11122222222		2233333			333	334
Relevé number	1234	567890123456	c	78901234567	c	8901234	c	ct	567	890
Diagn. taxa - *Artemisio-Quercetum mongolicae*										
E_1										
Artemisia keiskeana	**1aa+**	**111++...111+**	**81**	**++.++..1++.**	**64**	**1+1+111**	**100**	**79**	**++.**	**..1**
Melampyrum roseum (RQ)	**.+++**	**..+..+1+.3++**	**62**	**..+.+r+1..+**	**55**	**3a1+++.**	**86**	**65**	**1..**	**+.1**
Atractylodes ovata (RQ)	**1.1.**	**1+....+.....**	**31**	**.........+**	**9**	**1+1+11+**	**100**	**38**	**...**	**...**
Dif. - subass. *juniperetosum rigidae*										
E_2										
Juniperus rigida (RmP)	**+.a.**	**+1+.1+++1...**	**62**	**....r.....**	9	**.....**	0	33	**+1.**	**1++**
Fagara schinifolia (RQ)	**.+1.**	**a.1.+.+.....**	**37**	**...+.....**	9	**.....**	0	21	**...**	**++.**
E_1										
Chrysanthemum indicum	**+a1.**	**..+..++++.+r**	**62**	**.....**	0	**.....**	0	30	**a+.**	**.a.**
Arundinella hirta	**...1**	**....1a..1++.**	**37**	**.....**	0	**.....**	0	18	**..a**	**aa.**
Dif. - var. *typicum*										
E_1										
Vaccinium koreanum	**a.11**	**.....**	19	**.....a3b3..**	36	**.....**	0	21	**...**	**...**
Saussurea eriophylla	**1+a.**	**.....+...**	25	**.....**	0	**..r.+..**	29	18	**...**	**...**
Lilium lancifolium	**.++.**	**.....**	12	**.....**	0	**.....**	0	6	**r..**	**...**
Potentilla dickinsii	**...1**	**.....**	6	**.....**	0	**.....**	0	3	**..+**	**.1.**
Dif. var. *calamagrostiosum arundinacei*										
E_3										
Quercus dentata (QF)	**....**	**a3.11.....1.**	31	**.....**	0	**.....**	0	15	**...**	**...**
E_2										
Quercus dentata (QF)	**....**	**311a.a..a.1.**	43	**+.....**	9	**.....+1**	29	30	**...**	**a.4**
Rhus javanica (LiQ)	**....**	**..+r1..+1..1**	37	**...+.....**	9	**.....**	0	21	**...**	**...**
Corylus heterophylla (RQ)	**....**	**...a31.r.+..**	31	**.....1**	9	**.....1**	14	21	**...**	**r.r**
Rhamnus davurica	**....**	**....1.+++.+.**	31	**.....+**	9	**.....**	0	18	**...**	**...**
Corylus heterophylla var. *thunbergii* (RQ)	**....**	**..r+a.....1.**	25	**.....**	0	**.....**	0	12	**...**	**..a**
Indigofera kirilowii (RQ)	**....**	**..a.++.....**	19	**.....**	0	**.....**	0	9	**...**	**...**
E_1										
Calamagrostis arundinacea	**....**	**1.+1..+1.a1a**	50	**.....**	0	**.....**	0	24	**.1.**	**+.1**
Quercus dentata (QF)	**....**	**.++.+m....1r**	37	**.....**	0	**.....**	0	18	**...**	**1..**
Rhus javanica (LiQ)	**....**	**...++..++.+.**	31	**.....**	0	**.....**	0	15	**...**	**...**
Corylus heterophylla (RQ)	**....**	**a.r.....1.**	19	**.....+**	9	**.....**	0	12	**...**	**...**
Indigofera kirilowii (RQ)	**....**	**+.11.....1.**	25	**.....**	0	**.....**	0	12	**.+.**	**..+**
Isodon inflexus	**....**	**..++r+.....**	25	**.....**	0	**.....**	0	12	**...**	**+..**
Dif. - subass. *deutzietosum prunifoliae*										
E_3										
Acer pseudosieboldianum (RQ)	**....**	**.....**	0	**...11...13.**	**36**	**.....**	0	12	**...**	**...**
E_2										
Acer pseudosieboldianum (RQ)	**111.**	**.....+....**	25	**.raaa1a1aaa**	**91**	**.....1a**	29	47	**...**	**...**
Deutzia prunifolia	**....**	**..++.....**	12	**3aaa...1.1+**	**64**	**.....**	0	27	**...**	**.b.**

Table 8.12. Continued.

Subassociation		a			b		c				
Variant	a1		a2								
			1111111		11122222222		2233333			333	334
Relevé number	1234	567890123456		c	78901234567	c	8901234	c	ct	567	890
E_1											
Acer pseudosieboldianum (RQ)	1...	.....		6	**..+1+11.+a+**	**73**	.r.....	14	30	...	...
Deutzia prunifolia	....	......+.....		6	**+1.....1+.+**	**45**	.....	0	18	...	...
Sedum polytrichoides	....	.....		0	**r++....+...**	**36**	.....	0	12	...	...
Dif. - subass. *styracetosum obassiae*											
E_2											
Styrax obassia (RQ)	....	..+r.....		12	r.....	9	**a1aa11a**	**100**	30	...	...
Quercus serrata (LiQ)	....	.....		0	.....	0	**+.1+aaa**	**86**	18	...	...
Rhus verniciflura (LiQ)	....	.....		0	.....	0	**..+1.1a**	**57**	12	...	...
E_1											
Pteridium aquilinum	....	+.1.....+a.		25	.....	0	**1r+.+1+**	**86**	30	...	..+
Styrax obassia (RQ)	....	.....		0	+..++.....	27	**+++1.+.**	**71**	24	...	...
Pyrola japonica (QF)	....	+.....		6	.....+	9	**1+1+1..**	**71**	21	...	...
Viola orientalis	....	.....		0	.....	0	**++....+**	**43**	9	...	...
Quercus serrata (LiQ)	....	.....		0	.....	0	**+...1+.**	**43**	9	...	...
Hosta minor	....	.....		0	.....	0	**..1..++**	**43**	9	...	...
Iris rossi (RmP)	....	.....		0	.....	0	**..++.+.**	**43**	9	...	...
***Pino koraiensis-Quercion mongolicae* (PkQ)**											
E_3											
Betula schmidtii	....	.....		0	+..a.....	18	.....	0	6	...	...
Magnolia sieboldii	....	.....		0	.....a..	9	.....	0	3	...	...
E_2											
Betula schmidtii	....	.....		0	++.1.....	27	.....	0	9	...	...
Deutzia glabrata	....	.....		0	.....11....	18	.....	0	6	...	...
Pinus koraiensis	....	.....		0	.....+.	9	.....	0	3	...	...
Abies holophylla	....	.....		0	1	9	.....	0	3	...	...
E_1											
Betula schmidtii	....	.....		0	.+.+.....	18	.....	0	6	...	...
Magnolia sieboldii	....	.....		0	.....1+.	18	.....	0	6	...	...
Diarrhena japonica	....	.....		0	.....	0	+1.....	29	6	...	...
Pedicularis resupinata	+...	.....		6	.....	0	.....	0	3	...	...
Athyrium coreanum	....	...+.....		6	.....	0	.....	0	3	...	...
Deutzia glabrata	....	.....		0	.....1.....	9	.....	0	3	...	...
Pinus koraiensis	....	.....		0	.....+.	9	.....	0	3	...	...
Dryopteris crassirhizoma	....	.....		0	1	9	.....	0	3	...	...
Abies holophylla	....	.....		0	.....+	9	.....	0	3	...	...
***Lindero-Quercion* (LiQ)**											
E_3											
Quercus variabilis	....	..1a.r...+1.		31	.....	0	31.....	29	21	.1.	...
Carpinus laxiflora	....	.a1+.....		19	....a.....	9	.....	0	12	...	...
Quercus serrata	....	...r.....+..		12	.....	0	....1..	14	9	...	...
Rhus javanica	....	....+.....		6	.....	0	.....	0	3	...	...
Quercus mc-cormickii	....	.....		0	.....	0	...1...	14	3	...	...

Table 8.12. Continued.

Subassociation	a			b		c				
Variant	a1	a2								
		1111111		11122222222		2233333			333	334
Relevé number	1234	567890123456	c	78901234567	c	8901234	c	ct	567	890
E_2										
Lespedeza maximowiczii	....	..+....1.a.+	25	..r.....+1.	27	1.aaaaa	86	38	...	...
Quercus variabilis	....	..1.1a.1....	25	.....	0	31.....	29	18	.a.	1..
Carpinus laxiflora	....	..1+.....	12	.....	0	.....	0	6	...	..+
Quercus mc-cormickii	....	.....	0	.....	0	..1..+.	29	6	...	...
Callicarpa dichotoma	....	..+.....	6	.....	0	.....	0	3	...	..+
Solenolantana carlesii	....	...r.....	6	.....	0	.....	0	3	...	...
E_1										
Lespedeza maximowiczii	....	.....a.+	12	..++....+1+	45	..+.1.+	43	30	...	..1
Quercus variabilis	....	..r1.1....1.	25	.....	0	1+.....	29	18	...	...
Syneilesis palmata	....	...+a..1....	19	.....	0	.....a1	29	15	...	..+
Carpinus laxiflora	....	..++.....	12	.....	0	.....	0	6	...	...
Disporum smilacinum	....	......+.....	6	.....	0	......a	14	6	...	...
Oplismenus undulatifolius	....	...r.....	6	.....	0	.....	0	3	...	...
Viburnum wrightii	....	.....	0	.....+	9	.....	0	3	...	...
Codonopsis lanceolata	....	.....	0	.....r	9	.....	0	3	...	...
Solenolantana carlesii	....	.....	0	.....	0	r.....	14	3	...	...
***Rhododendro-Quercetalia mongolicae* (RQ)**										
E_3										
Pinus densiflora	1114	4aar+44a3443	100	4343b333b33	100	3334333	100	100	3aa	...
Quercus mongolica	343+	..331.a33.1.	69	aa.3313aa3.	82	.3..1..	29	65	...	...
Micromeles alnifolia	....	......+.....	6	+.a...11.a1	55	.....aa	29	27	...	...
Prunus leveilleana	....	11.....	12	...+.+..+..	27	.....	0	15	...	...
Fraxinus rhynchophylla	....	..++..+1....	25	.....	0	.....	0	12	...	...
Styrax obassia	....	...r.....	6	.....	0	.....	0	3	...	...
Maackia amurensis	....	....+.....	6	.....	0	.....	0	3	...	...
Tilia mandshurica	....	....+.....	6	.....	0	.....	0	3	...	...
Tilia amurensis	....	.....	0	...+.....	9	.....	0	3	...	...
E_2										
Rhododendron mucronulatum	aaa3	+4a.+1111.+.	81	1+1333b4a.+	91	13aaala	100	88	1.+	a31
Quercus mongolica	.a11	..33.aa33aa.	69	+1.1131a.11	82	1aaaaaa	100	79	b+.	a+a
Pinus densiflora	.+..	1++..a4...+.	43	111+...+a3b	73	a+aaa..	71	59	.aa	+.1
Rhododendron schlippenbachii	3a3+	.1.r..a3....	50	......1.31+	36	aaaaala	100	55	b..	+++
Fraxinus rhynchophylla	.++.	+.+1..++....	43	++1....+.m1	55	.....+.	14	41	.+.	...
Benzoin obtusilobum	....	.++b1.....1.	31	.....	0	+.1a.1a	71	30	...	...
Lespedeza bicolor	1...	+.....1.1	25	.....111...	27	aa.....	29	27	b.1	...
Micromeles alnifolia	++.1	1....++.....	37	....1.11...	27	.....	0	27	..1	.b.
Stephanandra incisa	....	...ar..1.++.	31	....r.....+	18	.....+1	29	27	...	+..
Prunus leveilleana	....	..+r.+.....	19	.....+..+.b	27	..++...	29	24	...	...
Weigela florida	+.+.	......++...r	31	..a.....	9	.....	0	18	...	.3.
Euonymus alata	....	..+.....	6	.....+a.+	27	.....	0	12	...	...
Maackia amurensis	....	....++.....	12	.....+.	9	.....+.	14	12	...	...

Table 8.12. Continued.

Subassociation		a			b			c				
Variant	a1	a2										
		1111111			11122222222			2233333			333	334
Relevé number	1234	5678901234 56	c		78901234567	c		8901234	c	ct	567	890
Palura paniculata	..+.	.....	6		.....	0		..1..1.	29	9	...	...
Vaccinium koreanum	....	.....	0		.....+a.1..	27		.....	0	9	...	...
Rhus trichocarpa	....	.....+..	6		.....	0		.....	0	3	...	...
Tilia mandshurica	....	.....	0		....+.....	9		.....	0	3	...	...
Tripterygium regelii	....	.....	0		.....	0		.....a	14	3	...	...
E_1												
Carex lanceolata	...a	..1++baaaaa+	69		111a1.....	45		3aaaaaa	100	68	.aa	31a
Quercus mongolica	+...	..+...+11aa.	43		+++1+a+.++1	91		..a1.1.	43	59	..1	..+
Rhododendron schlippenbachii	..+.	.a....++.+..	31		....1.1.a..	27		aa11a.1	86	41	...	...
Fraxinus rhynchophylla	..+.	.....+..	12		..1++.++.b+	64		rr.++1.	71	41	...	...
Rhododendron mucronulatum	....	.....+...1..	12		...1.a11+.+	55		1a11a.1	86	41	...	1..
Benzoin obtusilobum	...r	+a++.....+..	37		.....	0		++++.+.	71	33	...	..+
Pinus densiflora	....	..r...++...1	25		.++.....	18		+.1.1+.	57	30	..+	+..
Lespedeza bicolor	.+1.	.....	12		.....1+1...	27		++.....	29	21	..+	...
Parthenocissus tricuspidata	....	..+r+.....	19		.....r....+	18		.....a1	29	21	...	...
Carex nanella	+a..	1a.....	25		.....a...	9		.....	0	15	...	...
Platycodon grandiflorus (RmP)	....	+....r..+...	19		.....	0		..+.+..	29	15	...	...
Fagara schinifolia	....	1+.+.....+.	25		.....	0		.....	0	12	...	...
Maackia amurensis	....	.....+.....	6		..1+.....+	27		.....	0	12	...	...
Astilbe koreana	....	.....	0		.....r+.	18		.....++	29	12	...	...
Vitis amurensis	....	...r.....	6		.....+.	9		.....+	14	9	...	...
Micromeles alnifolia	....	.....+....+.	12		....+.....	9		.....	0	9	...	...
Rhus trichocarpa	....	.....1+.	12		.....	0		.....+.	14	9	...	...
Euonymus alata	....	.....	0		.....++.+	27		.....	0	9	...	...
Ainsliaea acerifolia	....	.....	0		1	9		r....1.	29	9	...	...
Juniperus rigida (RmP)	....	.....+..+...	12		.....	0		.....	0	6	...	...
Stephanandra incisa	....	.....+..	6		.....+	9		.....	0	6	...	...
Prunus leveilleana	....	.....	0		.....+....+	18		.....	0	6	...	...
Hepatica asiatica	....	.....	0		1	9		.....+	14	6	...	...
Isodon excisus	....	.....+	6		.....	0		.....	0	3	..r	...
Aralia elata	....	.....	0		.....+	9		.....	0	3	...	...
Palura paniculata	....	.....	0		.....	0		...+...	14	3	...	...
***Querco-Fagetea crenatae* (QF)**												
E_3												
Quercus acutissima	....	1..1.....	12		.....	0		.....	0	6	...	...
Acer mono	....	....+.....	6		...+.....	9		.....	0	6	...	...
Kalopanax pictus	....	.....	0		.....	0		...1...	14	3	...	...
E_2												
Acer mono	....	....+.....	6		..+.....+.	18		.....	0	9	...	...
Quercus acutissima	.+..	...a.....	12		.....	0		.....	0	6	1..	...
Kalopanax pictus	....	..1.....	6		.....+	9		.....	0	6	...	...
Euonymus oxyphylla	....	...ra.....	12		.....	0		.....	0	6	...	.+.

Table 8.12. Continued.

Subassociation	a			b		c				
Variant	a1	a2								
		1111111		11122222222		2233333			333	334
Relevé number	1234	567890123456	c	78901234567	c	8901234	c	ct	567	890
E_1										
Carex siderosticta	a...	11+++....a..	43	....+.+.1.+	36	..a1.1a	57	44	...	.+.
Aster scaber	.+..	1.....+.++.	31	11	18	+.1.++1	71	35	...	..1
Viola keiskei	....	+..........	6	.++.......1	27	..a1..a	43	18	...	...
Asarum heterotropoides	....	...r1.....	12	..........+	9	.....	0	9	...	...
Acer mono	....	.....	0	..+.+.....+	27	.....	0	9	...	...
Quercus acutissima	....	+.........1	12	.....	0	.....	0	6	...	...
Athyrium yokoscense	..+.	.....	6	.....	0	.....	0	3	...	...
Smilax nipponica	....	.....	0	1	9	.....	0	3	...	...
Actinidia arguta	....	.....	0	1	9	.....	0	3	...	...
Others										
E_2										
Lespedeza hedysaroides	...+	.....a+aaa+3	50	1a+a.....	36	.....	0	33	.1.	1.a
Pueraria lobata	....	....a.....	6	.....	0	.....aa	29	9	...	...
E_1										
Spodiopogon sibiricus	+1a+	..a1.11a1a++	81	+.+1++++...	64	a1aaa1.	86	76	11.	11a
Solidago japonica	....	.....+...++.	19	..+.....+	18	+.1+++.	71	30	...	..+
Peucedanum terebintaceum	...+	.....+..r	19	.++.....	18	+.+++..	57	27	..+	.+.
Miscanthus sinensis	....	.....+++..+1	31	.....	0	..a.aa1	57	27	++.	+.1
Atractylodes koreana	....	...++.r+....	25	.....	0	...1111	57	24	...	+.r
Lysimachia clethroides	.a..	+.1r.....+	31	.....	0	.....++	29	21	...	+.1
Potentilla fragarioides	....	....+++.+.+.	31	.....	0	..1.1..	29	21	...	1.+
Lespedeza cyrtobotrya	....	..+..1...1a.	25	.++.....	18	.....	0	18	...	1..
Smilax china	....	...r+...++..	25	.....	0	.....a1	29	18	...	...
Allium komarovianum	....	...+...+....	12	..+....+...	18	.....	0	12	.+.	+.+
Paraixeris denticulata	....	...r.+.....r	19	.r.....	9	.....	0	12	...	++.
Gentiana scabra	....	....r.....r.	12	.....	0	rr.....	29	12	...	..+
Themeda japonica	..+.	+....+.....	19	.....	0	.....	0	9	1..	...
Polygonatum humile	..+.	+.....+....	19	.....	0	.....	0	9	...	...
Asperula maximowiczii	..+.	...++.....	19	.....	0	.....	0	9	...	...
Artemisia japonica	....	1.....	6	.....	0	...+1..	29	9	+..	...
Lepisorus ussuriensis	....	.+.....	6	...+.+.....	18	.....	0	9	...	...
Hemerocallis minor	....	..r...++....	19	.....	0	.....	0	9	...	..r
Patrinia villosa	....	....++...+..	19	.....	0	.....	0	9	...	+.+
Polygonatum odoratum var. *pluriflorum*	....	....+.....	6	1	9	+.....	14	9	...	...
Viola sp.	....	.....++....	12	..........+	9	.....	0	9	...	...
Sedum takesimense	....	.....	0	1a1.....	27	.....	0	9	...	...
Sedum kamtschaticum	....	.....	0	.....1.1.+.	27	.....	0	9	...	...
Rubus crataegifolius	....	.....	0	..........+	9	.....+1	29	9	...	...
Polystichum polyblepharon	....	.....	0	.....	0	..+++..	43	9	...	...
Smilax sp.	....	...r.....1.	12	.....	0	.....	0	6	...	..+
Smilax sieboldii	....	.....+..	6	.....+..	9	.....	0	6	...	.+.
Peucedanum coreanum	....	.....	0	.....	0	..+....	14	3	...	+.r

In two relevés:
E_3: *Castanea crenata* a (8), 4 (9), *Populus koreana* + (16, 18);
E_2: *Castanea crenata* 1 (12), + (40), *Ligustrum obtusifolium* 1 (36), r (10), *Pinus rigida* + (10, 15), *Rhamnus koraiensis* a (8), + (11), *Robinia pseudo-acacia* 1 (13, 38), *Rubus crataegifolius* + (12, 16), *Tilia* sp. + (26), 1 (27), *Viburnum dilatatum* 1 (39), + (14);
E_1: *Allium chinense* G. Don. + (2, 35), *Artemisia annua* + (13, 16), *A. asiatica* + (25, 26), *A. messerschmidtiana* + (5, 35), *Asplenium viride* Huds. + (6, 25), *Aster ageratoides* r (10), + (15), *Boehmeria tricuspis* + (33, 34), *Cephalanthera longibracteata* r (26), + (27), *Chrysanthemum zawadskii* 1 (28), + (29), *Clematis brachyura* r (9, 13), *Dioscorea quinqueloba* + (16, 27), *Dryopteris* sp. + (26, 27), *Erigeron kamtschaticus* + (9, 13), *Fragaria orientalis* + (33, 34), *Hemerocallis* sp. + (2, 3), *Lactuca bungeana* 1 (2), + (3), *Lilium concolor* var. *parthenenion* r (30), + (32), *Patrinia saniculaefolia* r (28), + (30), *P. scabiosaefolia* + (26), 1 (27), *Polypodium vulgare* r (17), + (18), *Sanguisorba officinalis* r (13, 15), *Tilia* sp. + (26, 27), *Viola mandshurica* + (10, 38), *Woodsia polystichoides* r (18, 19).
In one relevé only:
E_3: *Alnus maximowiczii* r (13), *Juglans mandshurica* 1 (9), *Prunus maximowiczii* + (9), *Sorbus commixta* + (19), *Wisteria floribunda* + (10);
E_2: *Acanthopanax sessiliflorus* + (27), *Ampelopsis brevipedunculata* + (7), *Broussonetia papyrifera* + (13), *Deutzia* sp. + (26), *Lonicera monantha* + (18), *L. praeflorens* + (9), *Morus bombycis* + (13), *Parthenocissus tricuspidata* a (33), *Philadelphus schrenckii* 1 (25), *Populus koreana* + (18), *Prunus mandshurica* r (13), *Quercus aliena* + (35), *Rosa rugosa* r (16), *Securinega suffruticosa* + (39), *Smilax china* a (33), *Syringa dilatata* + (39), *Ulmus* sp. r (18), *U. davidiana* + (19);
E_1: *Acer barbinerve* + (27), *Aconitum* sp. + (5), *A. pseudolaeve* agg. r (9), *Adenophora* sp. + (26), *A. liliifolia* r (38), *Agrimonia* sp. + (3), *A. pilosa* + (9), *Amitostigma gracile* r (24), *Angelica gigas* + (34), *Artemisia* sp. + (27), *A. capillaris* a (16), *A. rubripes* 1 (11), *A. viridissima* 1 (32), *Asperula platygalia* + (5), *Aster meyendorfii* + (16), *A. pekinensis* r (9), *A. tataricus* + (12), *Athyrium crenatum* r (21), *A. nipponicum* + (9), *Calamagrostis* sp. + (25), *C. langsdorfii* 1 (30), *Campanula* sp. + (35), *Carex* sp. 1 (19), *C. tristachya* + (16), *Castanea crenata* r (17), *Cephalanthera erecta* + (27), *Cerastium caespitosum* + (6), *Chimaphila japonica* r (17), *Chrysanthemum coreanum* + (4), *Clematis koreana* + (8), *C. tubulosa* + (12), *Clerodendron trichotomum* + (5), *Convallaria keiskei* m (27), *Corchoropsis psilocarpa* + (36), *Cyperus rotundus* + (16), *Davallia mariesii* 1 (6), *Disporum sessile* + (20), *Dryopteris bissetina* a (27), *D. gymnophylla* + (9), *Elscholzia patrini* r (13), *Eupatorium japonicum* r (13), *E. lindleyanum* + (2), *Festuca* sp. 1 (26), *F. ovina* + (10), *Galium kamtschaticum* f. *intermedium* Takeda + (27), *Gentiana zollingerii* r (27), *Girardinia cuspidata* 1 (25), *Gymnocarpium jessoense* (Koidz.) Koidz. 1 (6), *Lespedeza hedysaroides* 1 (1), *Ligusticum tenuissimum* r (3), *Lilium cernuum* r (26), *L. distichum* + (27), *L. tsingtanense* r (27), *Liparis krameri* + (19), *Melampyrum ovalifolium* a (26), *Morus bombycis* + (13), *Muehlenbergia japonica* + (13), *Orostachys erubescens* r (18), *Orthodon punctatum* r (16), *Paris verticillata* + (39), *Peucedanum formosanum* r (18), *Phegopteris polypodioides* + (27), *Phlomis koraiensis* r (9), *Phragmites communis* + (16), *Pinus rigida* + (15), *Polygonatum involucratum* m (27), *P. hastatosagittatum* + (6), *Potentilla chinensis* + (16), *Rubia chinensis* + (27), *Rubus oldhami* + (34), *R. parvifolius* + (16), *Saxifraga* sp. + (30), *Scabiosa fischeri* + (31), *Scilla scilloides* + (39), *Sedum* sp. 1 (25), *S. purpureum* + (36), *S. verticullatum* + (19), *Setaria glauca* r (36), *S. viridis* + (16), *Sorbus commixta* + (19), *Stipa extremiorientalis* + (9), *Syneilesis aconitifolia* + (5), *Synurus pungens* + (5), *Thalictrum contortum* + (9), *Th. coreanum* + (5), *Th. thunbergii* r (5), *Veronica linariaefolia* + (13), *Viburnum sargentii* + (27), *Viola chaerophylloides* + (27), *Vitis* sp. + (25), *Weigela florida* r (36).

Relevé data (Table 8.12):

rel. no.	altit. (m)	exp.	slope (°)	cover in % E_3	E_2	E_1	E_0	date	MS	location	author
juniperetosum rigidae											
1	600	NNW	25	50	70	20	0	02.10.86	S	Haedju, hills over the quarry	J
2	650	SE	20	60	40	60	0	02.10.86	S	Haedju, hills over the quarry	J
3	650	SSE	25	50	60	40	0	02.10.86	S	Haedju, hills over the quarry	J
4	400	SW	10	60	30	15	0	21.10.89	C	Pagyon Valley	B
5	350	NW	25	70	60	40	0	19.10.86	-	Kail, 10 km SSE from harbor	J
6	360	NEE	45	60	75	50	20	19.10.86	-	Kail, 10 km from harbor	J
7	130	SE	20	65	75	20	0	30.09.89	S	E from waterfall, under rocks	N,V,B
8	175	SSE	15	70	80	15	0	29.09.89	S	near waterfall	N,V,B
9	230	N	10	95	80	20	0	26.09.89	L	slope near temple	N,V,B
10	150	SW	10	60	40	45	0	20.10.89	Ke	Kaesong, near cemetery in forest	N
11	460	SSW	20	80	80	20	0	02.10.89	S	Haedju, valley	N
12	380	S	40	60	70	25	0	01.10.89	S	Haedju, valley behind quarry	N,Li
13	200	S	15	80	40	20	0	26.09.89	L	slope near temple	N,V,B
14	30	E	20	80	30	85	0	13.10.89	K	over Samilpo Lake	N
15	180	SE	25	70	30	50	0	22.10.89	Ke	near vault of Kings of Koryo	N
16	150	-	0	50	60	40	0	17.10.89	Ke	Kaesong, near town	N,B
deutzietosum prunifoliae											
17	520	S	45	70	30	10	0	10.10.89	M	ridge over Hwayangam Temple	N,B
18	790	S	55	60	20	20	0	10.10.89	M	over Hwayangam Temple	N
19	?	W	20	70	20	20	15	09.10.89	M	Samwonam Temple	B,V
20	360	SE	45	80	40	30	0	10.10.89	M	near Hwayangam Temple	N
21	360	WNW	35	80	40	15	1	10.10.89	M	near Hwayangam Temple	B
22	685	W	33	70	75	60	5	17.09.86	M	below Sanwonam Monastery	K
23	665	E	44	75	70	60	<5	17.09.86	M	below Sanwonam Monastery	K
24	660	ENE	30	75	80	25	0	17.09.86	M	near Sanwonam Monastery	K
25	520	S	30	75	60	50	5	14.06.84	M	Sanwon Valley	D
26	600	S	25	85	30	50	5	15.06.84	M	Manpoktong Valley	D
27	300	NNW	10	70	70	70	0	18.06.84	M	slope over Myohyan-san Hotel	D

styracetosum obassiae											
28	110	S	25	60	60	70	5	25.06.90	K	3 km SW from Hotel Kumgang	K,S
29	300	E	30	70	60	40	<5	25.06.90	K	3 km from hotel, under ridge	K,S
30	50	WNW	33	50	70	50	0	08.06.88	K	slopes over Kumgang hotel	K
31	60	NW	40	60	70	25	0	08.06.88	K	slopes over Kumgamg hotel	K
32	100	S	35	50	45	50	15	08.06.88	K	slopes over Kumgang hotel	K
33	50	SW	25	60	70	75	0	08.06.88	K	slope over Kumgang hotel	K
34	30	N	35	70	85	45	0	08.06.88	K	slope over Kumgang hotel	K
35	320	SW	25	35	50	30	0	01.10.86	S	Haedju, over the quarry	J
36	270	SE	20	30	30	20	0	30.09.89	S	rocks near waterfal	I
37	480	S	20	20	15	15	0	21.10.89	C	Pagyon Valley	B
38	150	NE	25	0	35	40	20	20.10.89	Ke	Kaesong, hills near capitol	N,B
39	520	?	35	0	60	20	0	02.10.89	S	Haedju valley over the quarry	B
40	175	E	5	0	70	30	0	30.09.89	S	Haedju, over the quarry	N,Li

Table 8.13. Syneilesio palmatae-Carpinetum laxiflorae.

Relevé number	1	2	3	4	5	6	7	c
Char. and dif. - *Syneilesio palmatae-Carpinetum laxiflorae*								
E_3								
Carpinus laxiflora (LiQ)	a	1	a	1	4	5	3	100
E_2								
Carpinus laxiflora (LiQ)	1	a	1	1	+	3	+	100
Viburnum wrightii	.	+	+	+	.	.	.	43
Corylus mandshurica	1	+	.	.	.	.	.	29
E_1								
Carpinus laxiflora (LiQ)	+	+	+	1	.	.	.	57
Corylus mandshurica	+	.	+	+	.	.	.	43
Disporum smilacinum (LiQ)	.	+	a	m	.	.	.	43
Saussurea nivea (d)	.	+	1	1	.	.	.	43
Asperula maximowiczii	.	+	.	.	+	+	.	43
Galium trifloriforme	.	.	+	+	.	.	.	29
Osmunda claytoniana	.	.	+	+	.	.	.	29
Smilax nipponica (QF)	.	.	+	+	.	.	.	29
Viburnum wrightii	.	.	+	+	.	.	.	29
Lindero-Quercion mongolicae (LiQ)								
E_2								
Quercus variabilis	.	.	.	.	a	.	.	14
Callicarpa dichotoma	.	.	.	.	+	.	.	14
Rhus javanica	.	.	.	.	r	.	.	14
Solenolantana carlesii	.	.	.	.	r	.	.	14
E_1								
Syneilesis palmata	.	.	+	1	+	1	.	57
Lespedeza maximowiczii	.	.	+	+	.	1	.	43
Quercus variabilis	.	.	+	+	.	.	.	29
Oplismenus undulatifolius	.	.	.	.	.	+	.	14
Rhododendro-Quercetalia mongolicae (RQ)								
E_3								
Quercus mongolica	4	3	3	3	3	a	3	100
Pinus densiflora	a	1	1	1	.	+	.	71
Acer pseudosieboldianum	+	.	.	.	.	.	+	29
Styrax obassia	+	.	.	.	.	.	.	14
Magnolia sieboldii (PkQ)	.	.	.	.	.	.	1	14
Fraxinus rhynchophylla	.	.	.	.	.	.	+	14
Prunus leveilleana	.	.	.	.	.	.	+	14
E_2								
Rhododendron schlippenbachii	a	3	3	3	1	a	3	100
Rhododendron mucronulatum	a	1	a	a	1	a	a	100
Acer pseudosieboldianum	a	+	1	+	3	.	+	86
Stephanandra incisa	1	.	+	1	1	a	+	86
Quercus mongolica	+	a	+	+	1	.	1	86
Benzoin obtusilobum	a	1	.	.	a	1	1	71
Fraxinus rhynchophylla	1	+	.	.	+	+	+	71
Micromeles alnifolia	1	+	+	.	+	.	.	57
Weigela florida	+	.	+	+	+	.	.	57
Palura paniculata	1	.	.	.	1	1	.	43
Styrax obassia	.	+	+	+	.	.	.	43

Table 8.13. Continued.

Relevé number	1	2	3	4	5	6	7	c
Lespedeza bicolor	1	+	.	.	.	.	.	29
Fagara schinifolia	.	.	1	.	+	.	.	29
Corylus heterophylla	.	.	.	.	a	.	+	29
Prunus leveilleana	1	.	.	.	.	.	.	14
Deutzia glabrata (PkQ)	.	.	.	.	.	.	1	14
Magnolia sieboldii (PkQ)	.	.	.	.	.	.	+	14
E_1								
Benzoin obtusilobum	1	1	+	+	1	+	1	100
Carex lanceolata	+	.	+	+	1	+	+	86
Rhododendron schlippenbachii	1	+	+	1	.	+	.	71
Rhododendron mucronulatum	1	+	+	1	.	.	+	71
Fraxinus rhynchophylla	+	+	+	+	+	.	.	71
Acer pseudosieboldianum	1	.	.	.	+	+	+	57
Styrax obassia	r	+	+	+	.	.	.	57
Melampyrum roseum	.	1	+	+	.	+	.	57
Stephanandra incisa	.	.	+	+	+	1	.	57
Quercus mongolica	+	.	+	+	.	.	.	43
Pinus densiflora	r	+	.	.	.	r	.	43
Hepatica asiatica	.	.	1	.	.	+	1	43
Vitis amurensis	.	.	.	.	+	1	+	43
Weigela florida	+	.	.	.	.	+	.	29
Lespedeza bicolor	.	.	+	+	.	.	.	29
Prunus leveilleana	.	.	+	+	.	.	.	29
Indigofera kirilowii	.	.	.	.	+	r	.	29
Athyrium coreanum (PkQ)	.	.	.	.	+	.	1	29
Diarrhena japonica (PkQ)	+	.	.	.	.	.	.	14
Micromeles alnifolia	+	.	.	.	.	.	.	14
Parthenocissus tricuspidata	+	.	.	.	.	.	.	14
Atractylodes ovata	.	+	.	.	.	.	.	14
Carex nanella	.	+	.	.	.	.	.	14
Euonymus alata	.	+	.	.	.	.	.	14
Maackia amurensis	.	.	.	.	.	+	.	14
Corylus heterophylla	.	.	.	.	.	+	.	14
Fagara schinifolia	.	.	.	.	.	r	.	14
***Querco-Fagetea crenatae* (QF)**								
E_3								
Quercus dentata	.	.	.	.	+	.	.	14
Acer mono	.	.	.	.	.	.	+	14
E_2								
Euonymus oxyphylla	1	.	.	.	r	.	.	29
Kalopanax pictus	+	.	.	.	.	.	.	14
Acer mono	.	.	.	.	.	.	+	14
E_1								
Carex siderosticta	a	a	m	a	a	a	a	100
Aster scaber	+	.	+	+	+	+	r	86
Viola keiskei	.	.	1	+	.	1	.	43
Pyrola japonica	.	.	+	+	.	+	.	43
Asarum heterotropoides	.	.	.	.	1	+	1	43
Euonymus oxyphylla	+	.	.	.	.	.	r	29
Athyrium yokoscense	.	1	.	.	.	.	.	14
Athyrium vidalii	.	.	.	.	.	1	.	14
Quercus dentata	.	.	.	.	.	+	.	14
Others								
E_3								
Castanea crenata	a	.	.	.	+	+	.	43
E_2								
Ligustrina reticulata	.	.	+	+	.	.	.	29
E_1								
Solidago japonica	1	+	+	+	+	+	.	86
Spodiopogon sibiricus	+	+	+	+	+	+	.	86
Artemisia keiskeana	.	a	1	+	1	+	r	86
Castanea crenata	+	.	.	.	r	+	.	43
Dryopteris subtripinnata	.	1	.	.	.	+	.	29
Sanicula tuberculata	.	+	+	.	.	.	.	29
Lysimachia clethroides	.	+	+	.	.	.	.	29
Agrimonia pilosa	.	+	+	.	.	.	.	29

Table 8.13. Continued.

Relevé number	1	2	3	4	5	6	7	c
Allium komarovianum	.	+	.	+	.	.	.	29
Peucedanum terebintaceum	.	+	.	.	.	r	.	29
Thalictrum coreanum	.	.	m	a	.	.	.	29
Rubus crataegifolius	.	.	+	+	.	.	.	29
Lonicera praeflorens	.	.	+	+	.	.	.	29
Astilbe koreana	.	.	+	+	.	.	.	29
Calamagrostis arundinacea	.	.	.	.	r	+	.	29
Liparis krameri	.	.	.	.	r	r	.	29

In one relevé only:
E_2: *Betula* cf. *chinensis* + (1), *Cornus coreana* + (2); *Deutzia* sp. + (1), *Lespedeza hedysaroides* 1 (5), *Viburnum dilatatum* r (7);
E_1: *Asperula platygalia* + (1), *Aster tataricus* + (3), *Atractylodes koreana* 1 (1), *Chrysanthemum indicum* + (1), *Lactuca bungeana* + (3), *Lespedeza cyrtobotrya* 1 (6), *Lygodium japonicum* a (2), *Paraixeris denticulata* + (5), *Phegopteris polypodioides* + (1), *Polygonatum involucratum* r (1), *Potentilla fragarioides* + (6), *Quercus serrata* r (1), *Saussurea eriophylla* r (7), *S. triangulata* + (1), *Smilax* sp. + (6), *S. oldhamii* + (3), *Viola orientalis* + (1), *V. selkirkii* + (1).

Relevé data (Table 8.13):

rel. no.	altit. (m)	exp.	slope (°)	cover in % E_3	E_2	E_1	E_0	date	MS	location	author
1	420	NW	35	75	60	25	<5	05.07.90	S	E part under highest summit	K,S
2	330	N	37	60	80	50	5	30.09.86	S	near the ruine Suian Monastery	K,J
3	390	NW	28	65	75	60	0	30.09.86	S	near the ruine Suian Monastery	K,J
4	390	NW	28	60	75	45	0	30.09.86	S	near the ruine Suian Monastery	K
5	220	E	30	85	80	25	0	30.09.89	S	near waterfall	N,V,B
6	100	N	15	95	65	40	1	30.09.89	S	below waterfall, block fields	N,V,B
7	280	N	30	75	60	30	0	30.09.89	S	near waterfall	N,Li

Table 8.14. Communities of alliance *Weigelo floridae-Fagarion schinifoliae*: *Lilio lancifolii-Rhododendretum schlippenbachii* (rels 1-8); community *Indigofera kirilowii-Securinega suffruticosa* (rels 9-12).

Relevé number	1	2	3	4	5	6	7	8	c	9	1 0	1 1	1 2
Char. and dif. - *Lilio lancifolii-Rhododendretum schlippenbachii*													
E_2													
Lespedeza bicolor (RQ - transgr.)	m	a	a	1	+	.	+	+	88	.	.	.	.
Vaccinium koreanum (RQ - transgr.)	+	1	+	.	.	a	.	.	50	.	.	.	.
E_1													
Atractylodes ovata (RQ - transgr.)	1	+	1	+	+	1	+	1	100	.	+	.	.
Polygonatum humile	+	+	+	+	+	+	+	+	100	.	.	.	.
Lespedeza bicolor (RQ - transgr.)	1	1	m	+	+	+	.	+	88	.	.	.	.
Vaccinium koreanum (RQ - transgr.)	1	+	1	3	3	3	1	.	88	.	.	.	.
Hemerocallis minor	+	1	+	+	+	1	.	1	88	.	.	.	.
Lilium lancifolium	+	.	r	+	+	+	1	+	88	.	.	.	.
Chrysanthemum coreanum	1	+	+	+	+	+	.	.	75	.	.	.	.
Asplenium sarelii	+	1	1	+	+	.	.	.	63	.	.	.	.
Dif. of comm. *Indigofera kirilowii-Securinega suffruticosa*													
E_2													
Indigofera kirilowii (RQ)	.	.	.	.	.	.	.	.	0	1	a	1	1
Securinega suffruticosa	.	.	.	.	.	.	.	.	0	1	1	b	a
Stephanandra incisa (RQ)	.	.	.	.	.	.	.	.	0	a	4	.	+
Rhus javanica (LiQ)	.	.	.	.	.	.	.	.	0	+	+	1	.
Benzoin obtusilobum (RQ)	.	.	.	.	.	.	.	.	0	.	a	+	+
Rosa multiflora	.	.	.	.	.	.	.	.	0	3	a	.	.
Ligustrum obtusifolium	.	.	.	.	.	.	.	.	0	3	a	.	.
E_1													
Miscanthus sinensis	.	.	.	.	.	.	.	.	0	1	m	+	+
Rubus crataegifolius	.	.	.	.	.	.	.	.	0	1	+	+	1
Aster ageratoides	.	.	.	.	.	.	.	.	0	1	+	+	+
Smilax sieboldii	.	.	.	.	.	.	.	.	0	+	r	+	+
Paraixeris denticulata	.	.	.	.	.	.	.	.	0	+	.	+	+
Chrysanthemum lavandulaefolium	.	.	.	.	.	.	.	.	0	+	+	.	.
Boehmeria spicata	.	.	.	.	.	.	.	.	0	.	.	+	1

Table 8.14. Continued.

Relevé number	1	2	3	4	5	6	7	8	c	9	10	11	12
***Weigelo floridae-Fagarion schinifoliae* (WfF)**													
E_2													
Weigela florida (transgr.)	1	+	1	+	+	.	+	1	88	1	1	3	a
Fagara schinifolia (transgr.)	1	.	+	+	a	1	1	m	88	a	+	+	a
E_1													
Weigela florida (transgr.)	+	+	+	.	.	.	.	.	38	.	.	.	.
***Rhododendro-Quercetalia mongolicae* (RQ)**													
E_2													
Quercus mongolica	**3**	**3**	**3**	**3**	**3**	**3**	**a**	**3**	**100**	.	.	+	.
Rhododendron mucronulatum	**a**	**a**	**a**	**b**	**a**	**3**	**a**	**a**	**100**	.	+	.	.
Rhododendron schlippenbachii	**a**	**a**	**a**	**m**	**a**	**3**	**1**	**1**	**100**	.	.	.	.
Pinus densiflora	1	a	1	.	a	1	4	4	88	.	.	r	.
Acer pseudosieboldianum	+	1	+	1	+	1	+	.	88	.	.	1	.
Micromeles alnifolia	+	+	.	+	+	1	1	+	88	.	.	+	.
Juniperus rigida (RmP)	1	+	1	.	.	.	+	+	63	+	+	.	.
Fraxinus rhynchophylla	.	.	.	.	.	.	+	+	25	1	.	+	.
Prunus leveilleana	.	.	.	.	.	1	.	.	13	.	.	.	.
Aralia elata	.	.	.	.	.	.	.	.	0	+	+	.	.
Corylus heterophylla var. *thunbergii*	.	.	.	.	.	.	.	.	0	+	.	.	.
Quercus variabilis (LiQ)	.	.	.	.	.	.	.	.	0	r	.	.	.
Palura paniculata	.	.	.	.	.	.	.	.	0	.	.	.	1
E_1													
Carex nanella	**a**	**a**	**a**	**1**	**1**	**a**	**a**	**a**	**100**	.	.	.	.
Rhododendron mucronulatum	**+**	**+**	**+**	**+**	**+**	**+**	.	**1**	**88**	.	.	.	.
Rhododendron schlippenbachii	**+**	**+**	**+**	**+**	**+**	**+**	.	**1**	**88**	.	+	.	.
Pinus densiflora	+	+	+	+	+	.	1	.	75	.	r	.	.
Juniperus rigida (RmP)	+	+	1	.	.	.	+	+	63	.	.	.	.
Quercus mongolica	.	.	.	+	+	+	1	+	63	.	.	.	.
Syneilesis palmata (LiQ)	+	+	+	.	.	.	.	.	38	.	.	.	.
Benzoin obtusilobum	.	+	+	.	.	+	.	.	38	.	.	.	.
Fraxinus rhynchophylla	.	+	+	.	.	.	1	.	38	.	+	.	.
Acer pseudosieboldianum	.	.	.	1	1	+	.	.	38	.	.	.	.
Melampyrum roseum	.	.	.	.	.	+	.	+	25	.	.	.	.
Deutzia glabrata (PkQ)	.	.	.	.	.	.	+	+	25	.	.	.	.
Micromeles alnifolia	.	.	.	.	.	+	.	.	13	.	.	.	.
Platycodon grandiflorus (RmP)	.	.	.	.	.	.	.	+	13	.	.	.	.
Vitis amurensis	.	.	.	.	.	.	.	.	0	+	m	.	.
Aconitum triphyllum (PkQ)	.	.	.	.	.	.	.	.	0	+	+	.	.
Meehania urticifolia (RmP)	.	.	.	.	.	.	.	.	0	+	r	.	.
Isodon excisus	.	.	.	.	.	.	.	.	0	.	.	1	+
Codonopsis lanceolata (LiQ)	.	.	.	.	.	.	.	.	0	.	+	.	.
Corylus heterophylla	.	.	.	.	.	.	.	.	0	.	+	.	.
Carex lanceolata	.	.	.	.	.	.	.	.	0	.	.	+	.
***Querco-Fagetea crenatae* (QF)**													
E_2													
Actinidia arguta	.	.	.	.	.	.	.	.	0	.	.	+	1
Euonymus oxyphylla	.	.	.	.	.	.	.	.	0	+	.	.	.
E_1													
Carex siderosticta	m	a	1	1	1	1	.	.	75	.	.	.	.
Viola keiskei	+	+	.	.	.	.	.	.	25	.	.	.	+
Aster scaber	.	.	.	.	.	+	.	.	13	.	.	+	.
Quercus dentata	.	.	.	.	.	.	.	.	0	.	+	.	.
Others													
E_1													
Spodiopogon sibiricus	a	1	1	1	1	+	a	a	100	+	1	a	.
Artemisia keiskeana	**1**	**1**	**m**	**m**	**1**	**m**	**+**	**+**	**100**	.	.	.	.
Saussurea nivea	**+**	**+**	**+**	**+**	**+**	**+**	.	.	**75**	.	.	.	.
Agrimonia pilosa	**+**	**+**	**r**	.	**+**	**+**	.	**+**	**75**	.	.	.	.
Chrysanthemum indicum	.	+	+	+	.	+	1	+	75	.	.	1	+
Peucedanum terebintaceum	+	+	1	.	.	.	1	.	50	.	.	.	.
Lactuca bungeana	+	+	r	.	r	.	.	.	50	.	.	.	.
Sedum polytrichoides	+	+	r	.	.	.	.	.	38	.	.	.	.
Potentilla dickinsii	.	.	.	+	+	.	+		38	.	.	.	.
Sanicula tuberculata	+	+	.	.	.	.	.	.	25	.	.	.	.

Table 8.14. Continued.

Relevé number	1	2	3	4	5	6	7	8	c	9	10	11	12
Selaginella helvetica	.	.	.	1	1	.	.	.	25	.	.	.	.
Ligusticum tenuissimum	.	.	.	+	+	.	.	.	25	.	.	.	.
Allium komarovianum	.	.	.	.	r	.	+	.	25	+	+	.	.
Solidago japonica	.	.	.	.	.	+	.	.	13	r	.	.	.
Phragmites communis	.	.	.	.	.	.	.	.	0	+	a	.	.
Artemisia manshurica	.	.	.	.	.	.	.	.	0	1	1	.	.
Artemisia montana	.	.	.	.	.	.	.	.	0	+	1	.	.
Celastrus orbiculatus	.	.	.	.	.	.	.	.	0	+	+	.	.
Sanguisorba officinalis	.	.	.	.	.	.	.	.	0	+	+	.	.
Clematis tubulosa	.	.	.	.	.	.	.	.	0	+	r	.	.
Thalictrum contortum	.	.	.	.	.	.	.	.	0	r	+	.	.
Elscholzia patrini	.	.	.	.	.	.	.	.	0	.	+	1	.
Artemisia annua	.	.	.	.	.	.	.	.	0	.	.	1	+
Setaria glauca	.	.	.	.	.	.	.	.	0	.	.	+	+
Lysimachia clethroides	.	.	.	.	.	.	.	.	0	.	.	+	+
Eupatorium japonicum	.	.	.	.	.	.	.	.	0	.	.	+	+

In one relevé only:
E_2: *Clerodendron trichotomum* m (11), *Lespedeza hedysaroides* a (11), *Picrasma quassioides* + (12), *Rhamnus davurica* 1 (11), *Salix* sp. 1 (3);
E_1: *Adenophora tetraphylla* + (7), *Arundinella hirta* 1 (12), *Astilbe thunbergii* + (10), *Calamagrostis arundinacea* + (11), *Callicarpa dichotoma* + (9), *Dryopteris* sp. + (12), *Gypsophila oldhamiana* + (12), *Polystichum* sp. + (12), *Rubia cordifolia* agg. + (12), *Selaginella involvens* + (3), *Synurus deltoides* + (10), *Viola keiskei* + (12), *V. variegata* + (12).

Relevé data (Table 8.14):

rel. no.	altit. (m)	exp. (°)	slope	cover in % E_2	E_1	E_0	date	MS	location	author
Lilio lancifolii-Rhododendretum schlippenbachii										
1	590	N	40	65	50	15	02.10.86	S	slope with granite wall	K,J
2	590	NW	45	60	45	20	02.10.86	S	slope with granite wall	K
3	590	N	40	70	60	15	02.10.86	S	slope with granite wall	K
4	610	N	35	75	50	0	02.10.86	S	summit over quarry	K
5	620	N	40	85	45	0	02.10.86	S	summit over quarry	K
6	630	N	30	65	45	10	02.10.86	S	summit over quarry	K,J
7	630	SE	48	80	30	0	02.10.86	S	summit over quarry	K
8	630	SE	30	90	45	10	02.10.86	S	summit over quarry	K
Indigofera kirilowii-Securinega suffruticosa community										
9	230	W	25	75	25	0	01.10.89	S	valley behind the quarry	N,Li
10	200	W	15	90	40	0	01.10.89	S	valley behind the quarry	N
11	?	S	30	60	30	0	02.10.89	S	Haedju, Myongsokol Valley	B
12	400	SE	35	50	20	0	01.10.89	S	Haedju, Myongsokol Valley	B

Table 8.15. Synoptic table of the North Korean coniferous forests.

Column	1	2	3	4	5	*6*	7
Number of relevés	41	12	18	27	18	*3*	*4*
Rhododendro aurei-Laricetum olgensis							
E_2							
Rhododendron aureum (AP)	**88**	.	11	.	.	*1*	.
E_1							
Aquilegia japonica	**46**	17	11	.	.	.	.
Allium thunbergii	**46**	8	.	15	.	.	.
Parnassia palustris	**41**	.	.	11	.	*1*	.
Agrostis flaccida	**34**	.	.	.	.	.	.
Anthoxanthum nipponicum	**34**	.	.	.	.	.	.
Tofieldia nuda	**29**	.	.	.	.	.	.
E_0							
Cladonia uncialis	**24**	.	.	.	.	-	-
Goodyero repentis-Piceetum jezoensis							
E_3							
Usnea longissima Ach.	.	**67**	.	7	.	-	-
E_2							
Usnea longissima Ach.	.	**67**	.	.	.	-	-

Table 8.15. Continued.

Column	1	2	3	4	5	6	7
Number of relevés	41	12	18	27	18	3	4
E_1							
Goodyera repens (VP)	5	**92**	6	.	.	.	.
Listera nipponica	.	**33**	6	.	.	.	.
Lycopodium cryptomerianum (VP)	2	**33**	6	.	.	.	.
E_0							
Peltigera lepidota	.	**25**	.	.	.	-	-
Carici peiktusani-Abietetum nephrolepidis							
E_2							
Prunus padus	.	.	**61**	4	.	.	.
Acer tegmentosum	.	.	**22**	.	.	.	.
Ribes komarovii	.	.	**22**	.	.	.	.
E_1							
Carex nanella	5	.	**78**	15	.	.	*1*
Carex peiktusani	15	25	**67**	19	.	.	.
Cerastium frucatum	.	.	**61**	.	.	.	.
Sanguisorba tenuifolia	.	.	**44**	11	.	.	.
Prunus padus	.	.	**28**	.	.	.	.
Ledo decumbentis-Laricetum olgensis							
E_3							
Betula platyphylla (AP)	.	.	28	**63**	44	.	.
E_2							
Betula paishanensis	.	.	.	**26**	.	.	.
E_1							
Ledum decumbens	5	.	.	**85**	.	.	.
Artemisia stolonifera	15	.	.	**78**	.	.	*2*
Potentilla cryptotaenia	2	.	6	**41**	.	.	.
Fragaria orientalis	.	.	.	**33**	.	.	.
Valeriana fauriei	2	.	.	**33**	.	.	.
E_0							
Cladonia ternuiformis	.	.	.	**26**	.	-	-
Polysticho retroso-paleacei-Rhododendretum dahurici and ***Rhododendro dahurici-Acerion barbinervi*** **(RdA)**							
E_2							
Rhododendron dahuricum	.	.	.	7	**100**	.	.
Acer barbinerve	.	.	6	.	**56**	.	*1*
E_1							
Polystichum retroso-paleaceum	.	.	.	.	**72**	.	.
Rhododendron dahuricum	.	.	.	7	**61**	.	.
Sedum middendorffianum	.	.	.	.	**50**	.	.
Polypodium virginianum L.	.	.	.	.	**44**	.	.
E_0							
Sphagnum girgensohnii	.	8	.	4	**100**	-	-
Cladonia amaurocraea	.	.	.	.	**72**	-	-
Oncophorus wahlenbergii	.	.	.	.	**56**	-	-
Anastrophyllum minutum	.	.	.	.	**39**	-	-
Abietinella abietina	.	.	.	.	**33**	-	-
Peltigera scabrosa	.	.	.	.	**33**	-	-
Polytrichum commune	.	.	.	.	**33**	-	-
Peltigera leucophlebia	.	.	.	.	**28**	-	-
Cladonia pyxidata	.	.	.	.	**28**	-	-
Lophozia excisa	.	.	.	.	**28**	-	-
Entodon compressus	.	.	.	.	**22**	-	-
Taxo-Pinetum pumilae							
E_2							
Pinus pumila	.	.	.	.	.	***3***	.
Lonicera sachalinensis	.	.	.	.	.	***1***	.
Tripterygium regelii	.	.	.	.	.	***1***	.
Thujo koraiensis-Piceetum jezoensis							
E_1							
Scabiosa japonica var. *alpina* Takeda	.	.	.	.	.	.	***3***
Trisetum sibiricum	.	.	.	.	.	.	***2***
Laricion olgensis **(Lo)**							
E_3							
Larix olgensis	**100**	**83**	**100**	**100**	**72**	.	.
Picea koraiensis	**27**	**33**	**28**	**4**	.	.	.

Table 8.15. Continued.

Column	1	2	3	4	5	6	7
Number of relevés	41	12	18	27	18	3	4
Prunus padus	.	.	**6**	.	.	.	.
Populus davidiana	.	.	.	**4**	.	.	.
E_2							
Larix olgensis	**51**	**25**	**39**	**93**	**67**	.	.
Picea koraiensis	**29**	**33**	**28**	**26**	.	.	.
Ribes horridum	**10**	.	.	.	.	.	.
Malus baccata	.	.	**17**	**15**	.	.	.
Sorbus sambucifolia	.	.	**17**	**4**	.	.	.
Rhododendron parvifolium	.	.	**6**	**19**	.	.	.
Spiraea ulmifolia	.	.	**17**	.	.	.	.
Populus davidiana	.	.	.	**11**	.	.	.
E_1							
Viola sachalinensis	**46**	**92**	**22**	**7**	.	.	.
Larix olgensis	**37**	**8**	**11**	**70**	**33**	.	.
Ribes horridum	**29**	**42**	**11**	**19**	.	.	.
Picea koraiensis	**17**	**33**	**11**	**4**	.	.	.
Sanguisorba parviflora	**66**	.	**11**	**59**	.	.	.
Saussurea alpicola	**41**	**50**	**17**	.	.	.	.
Lonicera edulis	**34**	.	**94**	**96**	.	.	.
Bupleurum longeradiatum	**12**	.	**33**	**30**	.	.	.
Salix arctica Pall.	**12**	.	**11**	**22**	.	.	.
Ostericum maximowiczii	**5**	.	**50**	**37**	.		
Iris dichotoma	**5**	.	**39**	**15**	.	.	.
Pseudostellaria heterophylla	**2**	**33**	**39**	.	.	.	.
Pyrola dahurica	**22**	.	**11**	.	.	.	.
Rhododendron parvifolium	**2**	.	.	**15**	.	.	.
Sorbus sambucifolia	.	.	**17**	.	.	.	.
Malus baccata	.	.	**6**	.	.	.	.
Spiraea ulmifolia	.	.	**6**	.	.	.	.
***Abieti nephrolepidis-Piceion jezoensis* (AnP)**							
E_3							
Betula ermanii	.	.	.	.	**17**	.	***1***
Acer ukurundense	.	.	.	.	.	.	***1***
E_2							
Betula ermanii	.	.	.	.	**22**	***2***	***2***
Thuja koraiensis	.	.	.	.	.	***3***	***3***
Syringa wolfi	.	.	.	.	.	***2***	***1***
Acer tschonoskii	.	.	.	.	.	***1***	.
Acer ukurundense	.	.	.	.	.	.	***1***
E_1							
Calamagrostis arundinacea var. *hirsuta* Hack.	.	.	.	.	.	***3***	***3***
Dryopteris crassirhizoma	.	.	.	.	.	***2***	***1***
Betula ermanii	.	.	.	.	.	***1***	***2***
Syringa wolfi	.	.	.	.	.	***1***	***1***
Acer ukurundense	.	.	.	.	.	***1***	.
***Abieti nephrolepidis-Piceetalia jezoensis* (AP)**							
E_3							
Abies nephrolepis	20	100	100	.	11	.	*1*
Picea jezoensis	37	100	28	.	.	.	*2*
Sorbus amurensis	.	.	22	.	22	.	.
E_2							
Picea jezoensis	46	100	50	19	.	*1*	*2*
Abies nephrolepis	29	100	33	11	72	*2*	.
Lonicera edulis	37	17	83	30	6	.	.
Rosa davurica	10	.	83	7	78	.	.
Sorbus amurensis	.	.	39	4	50	*1*	.
Clematis ochotensis	2	.	6	4	.	.	.
Betula platyphylla	.	.	39	52	83	.	.
Physocarpus amurensis	.	.	6	.	.	.	.
E_1							
Clintonia udensis	44	92	72	.	.	*1*	*2*
Abies nephrolepis	32	100	94	4	33	.	.
Rosa davurica	10	8	72	74	61	.	.
Ledum palustre var. *maximum* Nakai	2	17	72	48	83	.	.
Picea jezoensis	49	100	39	37	.	.	.

Table 8.15. Continued.

Column	1	2	3	4	5	6	7
Number of relevés	41	12	18	27	18	3	4
Clematis ochotensis	17	33	67	.	.	1	.
Ligularia fischeri	.	25	33	.	.	1	3
Thalictrum contortum	.	.	17	15	.	1	2
Sorbus amurensis	2	.	22	.	.	.	1
Betula platyphylla	.	.	22	26	.	.	.
Pyrola japonica	12	.	.	.	.	.	.
Vaccinio-Piceetea (VP)							
E_3							
Pinus koraiensis	.	.	.	.	.	.	1
E_2							
Vaccinium uliginosum	15	.	17	.	.	.	.
Juniperus sibirica	10	.	.	.	.	.	.
Lonicera chrysantha	.	.	22	.	.	.	.
Pinus koraiensis	.	.	.	.	.	.	1
E_1							
Vaccinium vitis-idaea	93	92	100	100	28	.	.
Lycopodium clavatum var. *nipponicum* Nakai	7	33	67	19	28	.	.
Juniperus sibirica	100	83	39	37	.	.	.
Vaccinium uliginosum	61	8	22	81	.	.	.
Linnaea borealis	56	100	94	22	.	.	.
Lycopodium complanatum	41	100	33	4	.	.	.
Majanthemum dilatatum	17	58	83	22	.	.	.
Pedicularis resupinata	12	.	11	11	.	.	2
Orthilia secunda	22	25	50	.	.	.	.
Calypso bulbosa	2	33	6	.	.	.	.
Pyrola incarnata	.	83	89	19	.	.	.
Oxalis acetosella	.	.	33	.	.	1	1
Lonicera chrysantha	.	.	17	.	.	1	2
Phyllodoce coerulea	95	92	.	.	.	.	.
Hieracium umbellatum	20	.	.	41	.	.	.
Ligularia jamesii	5	.	11	.	.	.	.
Chimaphila japonica	2	.	6	.	.	.	.
Lycopodium obscurum	.	.	11	.	.	.	1
Majanthemum bifolium	.	.	.	.	.	1	1
Lycopodium selago	5	.	.	.	.	.	.
Lycopodium alpinum	2	.	.	.	.	.	.
Lycopodium annotinum	2	.	.	.	.	.	.
Lycopodium chinensis	.	.	.	.	11	.	.
Others							
E_2							
Dasiphora fruticosa	24	.	22	22	.	.	.
E_1							
Festuca ovina	78	58	6	67	.	.	1
Solidago japonica	71	100	94	52	.	.	1
Calamagrostis langsdorfii	78	83	67	100	.	.	.
Hypericum ascyron	2	.	22	19	.	1	.
Dasiphora fruticosa	63	.	11	74	.	.	.
Gentiana jamesii	51	42	.	19	.	.	.
Potentilla coreana Soják	44	58	.	30	.	.	.
Geranium eriostemon	27	17	11	.	.	.	.
Gentiana scabra	7	.	.	26	.	.	1
Gymnadenia conopsea	49	.	.	26	.	.	.
Bupleurum euphorbioides	29	.	.	11	.	.	.
Dianthus superbus	24	.	.	26	.	.	.
Prunella vulgaris	17	33	.	.	.	.	.
Pseudostellaria sylvatica	7	.	28	.	.	.	.
Phegopteris polypodioides	.	.	33	.	.	1	.
Pteridium aquilinum	.	.	22	7	.	.	.
E_0							
Ptilium crista-castrensis	78	100	94	48	67	-	-
Pleurozium schreberi	61	92	78	81	61	-	-
Hylocomium splendens	34	25	6	.	72	-	-
Rhytidium rugosum	34	.	.	11	44	-	-
Cetraria laevigata Rass.	20	25	.	19	.	-	-
Cladonia stellaris	20	.	.	11	33	-	-

Table 8.15. Continued.

Column	1	2	3	4	5	6	7
Number of relevés	41	12	18	27	18	3	4
Cladonia rangiferina subsp. *grisea*	10	17	.	.	89	-	-
Dicranum polysetum	2	67	.	.	50	-	-
Cladonia maxima	.	33	.	4	22	-	-
Cladonia rangiformis	37	8	.	.	.	-	-
Drepanocladus uncinatus	.	42	.	.	56	-	-
Thuidium philibertii	.	42	.	.	39	-	-
Cladonia furcata	.	17	.	48	.	-	-
Peltigera aphthosa	.	8	.	.	22	-	-
Aulacomnium palustre	.	.	.	.	22	-	-
Next accesoric species	**61**	**5**	**20**	**15**	**15**	**9**	**14**

Table 8.16. Synoptic table of the North Korean broad-leaved and mixed forests.

Column	1	2	3	4	5	6	7	8	9
Numbers of relevés	17	5	7	17	21	34	7	8	4
Lychno-Quercetum mongolicae									
E_3									
Betula schmidtii	71	.	.	.	.	6	.	.	.
E_2									
Actinidia polygama	23	.	.	.	.	.	.	.	.
Betula schmidtii	12	.	.	.	5	9	.	.	.
E_1									
Astilbe thunbergii	35	.	.	.	.	.	.	.	2
Viola diamantica	29	.	.	.	5	.	.	.	.
Actinidia polygama	23	40	.	.	.	.	.	.	.
Ligularia fischeri	17	.	.	.	.	.	.	.	.
Angelica gigas	17	.	.	.	5	3	.	.	.
Lychnis cognata	12	.	.	.	.	.	.	.	.
Primula jezoana	12	.	.	.	.	.	.	.	.
Pseudostellaria palibiniana	6	.	.	.	.	.	.	.	.
Vaccinio-Quercetum mongolicae									
E_2									
Tilia taquetii	.	60	.	.	.	.	.	.	.
Lonicera chrysantha	.	20	.	12	.	.	.	.	.
E_1									
Saussurea conandrifolia	6	80	.	.	.	.	.	.	.
Geranium koreanum var. *hirsutum* Nakai	.	60	.	.	.	.	.	.	.
Halenia corniculata	.	40	.	.	.	.	.	.	.
Lonicera chrysantha	.	40	.	.	.	.	.	.	.
Duchesnea indica	.	40	.	6	.	.	.	.	.
Acer barbinerve	.	40	.	.	.	3	.	.	.
Caulophyllum robustum	12	40	.	6	.	.	.	.	.
Tilia taquetii	.	20	14	.	.	.	.	.	.
Parthenocisso-Fraxinetum rhynchophyllae									
E_2									
Deutzia glabrata (PkQ)	6	.	57	.	.	6	14	.	.
Staphylea bumalda	6	.	43	.	5	.	.	.	.
Codonopsis pilosula	.	.	29	.	.	.	.	.	.
E_1									
Parthenocissus tricuspidata (RQ)	12	20	86	29	10	21	14	.	.
Deutzia glabrata (PkQ)	.	20	71	.	.	3	.	25	.
Lactuca bungeana	.	.	71	12	5	6	14	50	.
Aster tataricus	.	.	43	.	5	3	14	.	.
Hedera rhombea	.	.	29	.	.	.	.	.	.
Rubia hexaphylla (Mak.) Mak.	.	.	29	.	.	.	.	.	.
Staphylea bumalda	.	.	14	.	.	.	.	.	.
Festuco ovinae-Pinetum densiflorae									
E_2									
Prunus nakaii	.	.	.	12	.	.	.	.	.
Lespedeza daurica	.	.	.	6	.	.	.	.	.
E_1									
Atractylodes koreana	6	.	.	94	5	24	14	.	.
Sophora flavescens	.	.	.	65	.	.	.	.	.
Iris rossi (RmP)	.	.	.	65	.	9	.	.	.

Table 8.16. Continued.

Column	1	2	3	4	5	6	7	8	9
Numbers of relevés	17	5	7	17	21	34	7	8	4
Saussurea eriophylla	.	.	.	59	.	18	14	.	.
Clematis mandshurica (RmP)	.	.	.	53	.	.	.	.	.
Polystichum polyblepharon	.	.	.	47	.	9	.	.	.
Potentilla fragarioides	.	.	.	47	19	21	14	.	.
Lilium concolor var. *parthenenion*	.	.	.	41	.	6	.	.	.
Asparagus oligoclonus (RQ)	6	.	14	41	.	.	.	.	.
Prunus nakaii	.	.	.	29	.	.	.	.	.
Prunella asiatica	.	.	.	29	.	.	.	.	.
Rhaponticum uniflorum	.	.	.	24	.	.	.	.	.
Stevenia axillaris	.	.	.	24	.	.	.	.	.
Stipa extremiorientalis	.	.	.	24	.	3	.	.	.
Artemisia japonica	.	.	.	24	.	9	.	.	.
Platycodon grandiflorus (RmP)	.	.	.	24	.	15	.	13	.
Lespedeza daurica	.	.	.	18	.	.	.	.	.
Festuca ovina	.	.	.	18	.	3	.	.	.
Patrinia villosa	.	.	.	18	.	9	.	.	.
Saso-Quercetum mongolicae quercetosum variabilis									
E_3									
Quercus serrata (LiQ)	6	.	.	.	62	9	.	.	.
Quercus variabilis (LiQ)	.	.	.	.	48	21	.	.	.
E_2									
Quercus serrata (LiQ)	6	.	.	.	14	18	.	.	.
Quercus variabilis (LiQ)	.	.	.	.	10	18	14	.	1
E_1									
Sasamorpha purpurascens var. *borealis*	.	.	.	.	62	.	.	.	.
Quercus serrata (LiQ)	.	.	.	.	33	9	14	.	.
Quercus variabilis (LiQ)	.	.	.	.	14	18	29	.	.
Artemisio-Quercetum mongolicae									
E_1									
Pteridium aquilinum	.	.	.	.	5	30	.	.	.
Syneilesio palmatae-Carpinetum laxiflorae									
E_2									
Corylus mandshurica	6	.	.	.	.	.	29	.	.
Viburnum wrightii (LiQ)	.	.	.	.	5	.	43	.	.
E_1									
Corylus mandshurica	.	.	.	.	.	.	43	.	.
Disporum smilacinum (LiQ)	.	.	.	.	19	6	43	.	.
Asperula maximowiczii	.	.	.	6	10	9	43	.	.
Galium trifloriforme	.	.	.	.	.	.	29	.	.
Osmunda claytoniana	.	.	.	.	.	.	29	.	.
Viburnum wrightii (LiQ)	.	.	.	.	5	3	29	.	.
Smilax nipponica (QF)	6	.	.	6	10	3	29	.	.
Lilio lancifolii-Rhododendretum schlippenbachii									
E_2									
Lespedeza bicolor (RQ - transgr.)	12	20	57	.	10	27	29	88	.
Vaccinium koreanum (RQ)	6	.	.	.	5	9	.	50	.
E_1									
Polygonatum humile	.	.	.	.	.	9	.	100	.
Lilium lancifolium	.	.	.	18	.	6	.	88	.
Vaccinium koreanum (RQ)	6	40	.	.	14	21	.	88	.
Hemerocallis minor	.	.	14	24	5	9	.	88	.
Lespedeza bicolor (RQ - transgr.)	.	40	71	35	5	21	29	88	.
Chrysanthemum coreanum	6	.	.	.	.	3	.	75	.
Asplenium sarelii	.	.	.	.	.	.	.	63	.
Community of *Indigofera kirilowii-Securinega suffruticosa*									
E_2									
Securinega suffruticosa	.	.	.	.	.	3	.	.	4
Rosa multiflora	.	.	.	12	5	.	.	.	2
Ligustrum obtusifolium	.	.	.	6	.	6	.	.	2
E_1									
Miscanthus sinensis	.	.	14	53	.	27	.	.	4
Aster ageratoides	.	.	.	.	5	6	.	.	4
Smilax sieboldii	17	.	.	24	5	6	.	.	4
Rubus crataegifolius	29	20	29	.	14	9	29	.	4
Paraixeris denticulata	12	.	.	12	5	12	29	.	3

Table 8.16. Continued.

Column	1	2	3	4	5	6	7	8	9
Numbers of relevés	17	5	7	17	21	34	7	8	4
Chrysanthemum lavandulaefolium	.	.	.	.	.	.	.	.	2
Boehmeria spicata	.	.	.	.	.	.	.	.	2
Pino koraiensis-Quercion mongolicae (PkQ)									
E_3									
Cornus controversa	23	20	43	.	5	.	.	.	.
Pinus koraiensis	35	40	.	.	.	.	.	.	.
Magnolia sieboldii	55	.	14	.	5	3	14	.	.
Acer triflorum	6	.	14	.	.	.	.	.	.
Acer tegmentosum	12	.	.	.	.	.	.	.	.
Abies nephrolepis	.	20	.	.	.	.	.	.	.
Betula ermanii	.	20	.	.	.	.	.	.	.
E_2									
Magnolia sieboldii	17	60	57	.	33	.	14	.	.
Acer triflorum	12	20	14	.	.	.	.	.	.
Pinus koraiensis	23	80	.	.	10	3	.	.	.
Acer tegmentosum	17	.	43	.	.	.	.	.	.
Cornus controversa	23	.	29	.	5	.	.	.	.
Acer tschonoskii	17	.	.	.	.	.	.	.	.
Acer ukurundense	.	20	.	.	.	.	.	.	.
Abies nephrolepis	.	20	.	.	.	.	.	.	.
E_1									
Athyrium coreanum	53	20	57	.	24	3	14	.	.
Dryopteris crassirhizoma	41	20	43	.	.	3	.	.	.
Viola collina	41	60	57	12	5	.	.	.	.
Diarrhena japonica	23	60	86	.	10	6	14	.	.
Campanula punctata	17	20	14	.	.	.	.	.	.
Aconitum triphyllum	12	20	43	.	.	.	.	.	2
Magnolia sieboldii	23	20	.	6	5	6	.	.	.
Pinus koraiensis	23	60	.	.	10	3	.	.	.
Bupleurum longeradiatum	23	40	.	.	.	.	.	.	.
Acer tegmentosum	12	.	14	.	.	.	.	.	.
Cornus controversa	6	.	14	.	.	.	.	.	.
Pedicularis resupinata	6	.	.	.	.	3	.	.	.
Acer tschonoskii	6	.	.	.	.	.	.	.	.
Acer triflorum	6	.	.	.	.	.	.	.	.
Abies holophylla	6	.	.	.	.	3	.	.	.
Rhododendro mucronulati-Pinion densiflorae (RmP)									
E_2									
Juniperus rigida	12	.	.	88	.	33	.	63	2
E_1									
Meehania urticifolia	17	.	.	65	5	.	.	.	2
Juniperus rigida	.	.	.	53	.	6	.	63	.
Hieracium umbellatum	.	.	.	24	.	.	.	.	.
Leibnitzia anandria	.	.	.	18	.	.	.	.	.
Lindero-Quercion mongolicae (LiQ)									
E_3									
Carpinus laxiflora	17	.	.	.	29	12	100	.	.
Quercus mc-cormickii	.	.	.	.	14	3	.	.	.
Rhus javanica	.	.	.	.	5	3	.	.	.
E_2									
Callicarpa dichotoma	12	.	.	.	57	3	14	.	.
Carpinus laxiflora	17	.	.	.	33	6	100	.	.
Solenolantana carlesii	6	.	.	.	19	3	14	.	.
Rhus javanica	.	.	.	.	14	21	14	.	3
Lespedeza maximowiczii	29	.	.	.	86	38	.	.	.
Rhus verniciflura	.	.	.	.	10	12	.	.	.
Quercus mc-cormickii	.	.	.	.	10	6	.	.	.
Codonopsis lanceolata	.	.	.	.	5	.	.	.	.
E_1									
Lespedeza maximowiczii	6	.	.	12	62	30	43	.	.
Syneilesis palmata	12	.	.	12	52	15	57	38	.
Carpinus laxiflora	12	.	.	.	10	6	57	.	.
Oplismenus undulatifolius	12	.	.	.	10	3	14	.	.
Codonopsis lanceolata	6	.	.	.	19	3	.	.	1
Rhus javanica	.	.	.	.	5	15	.	.	.
Solenolantana carlesii	.	.	.	.	5	3	.	.	.

Table 8.16. Continued.

Column	1	2	3	4	5	6	7	8	9
Numbers of relevés	17	5	7	17	21	34	7	8	4
Callicarpa dichotoma	6	.	.	.	14	.	.	.	1
Quercus mc-cormickii	.	.	.	.	5	.	.	.	.
***Weigelo floridae-Fagarion schinifoliae* (WfF)**									
E_2									
Weigela florida (transgr.)	17	.	14	.	29	18	57	88	4
Fagara schinifolia (transgr.)	6	20	.	24	5	21	29	88	4
E_1									
Weigela florida (transgr.)	6	20	14	.	.	3	29	38	.
Fagara schinifolia (transgr.)	.	.	14	82	5	12	14	.	.
***Rhododendro-Quercetalia mongolicae* (RQ)**									
E_3									
Quercus mongolica	94	100	71	53	76	65	100	.	.
Pinus densiflora	17	20	86	100	71	100	71	.	.
Prunus leveilleana	41	20	29	6	29	15	14	.	.
Acer pseudosieboldianum	94	.	14	.	57	12	14	.	.
Fraxinus rhynchophylla	29	.	71	12	33	12	14	.	.
Micromeles alnifolia	6	40	57	.	10	27	.	.	.
Styrax obassia	35	.	.	.	38	3	14	.	.
Maackia amurensis	6	.	.	29	10	3	.	.	.
Tilia mandshurica	12	.	.	.	10	3	.	.	.
Tilia amurensis	35	.	.	.	.	3	.	.	.
E_2									
Quercus mongolica	58	60	86	76	38	79	86	100	1
Rhododendron mucronulatum	23	20	14	71	38	88	100	100	1
Micromeles alnifolia	17	40	29	35	33	27	57	88	1
Acer pseudosieboldianum	94	100	100	.	100	47	86	88	1
Fraxinus rhynchophylla	64	.	29	59	57	41	71	25	2
Pinus densiflora	6	20	14	35	10	59	.	88	1
Rhododendron schlippenbachii	41	100	29	.	67	56	100	100	.
Stephanandra incisa	29	.	29	6	71	27	86	.	3
Prunus leveilleana	12	.	29	53	24	24	14	13	.
Palura paniculata	29	20	.	24	43	9	43	.	1
Styrax obassia	47	.	57	12	86	30	43	.	.
Benzoin obtusilobum	29	.	.	53	100	30	71	.	3
Corylus heterophylla	35	.	.	41	19	21	29	.	.
Aralia elata	29	.	14	6	.	.	.	.	2
Maackia amurensis	23	.	.	41	24	12	.	.	.
Rhus trichocarpa	17	.	.	12	48	3	.	.	.
Corylus heterophylla var. *thunbergii*	17	.	.	.	5	12	.	.	1
Vitis amurensis	17	.	.	18	14	.	.	.	.
Tilia mandshurica	12	.	.	.	5	3	.	.	.
Tripterygium regelii	12	.	.	.	19	3	.	.	.
Euonymus alata	.	20	14	47	.	12	.	.	.
Indigofera kirilowii	.	.	.	12	.	9	.	.	4
Tilia amurensis	41	.	.	.	19	.	.	.	.
E_1									
Fraxinus rhynchophylla	64	80	57	59	33	41	71	38	1
Quercus mongolica	29	60	100	76	38	59	43	63	.
Melampyrum roseum	29	100	29	6	33	65	57	25	.
Rhododendron schlippenbachii	6	100	14	.	24	41	71	88	1
Acer pseudosieboldianum	71	80	100	.	67	30	57	38	.
Astilbe koreana	23	40	43	18	29	12	29	.	.
Stephanandra incisa	6	20	29	6	29	6	57	.	.
Pinus densiflora	6	.	.	41	24	30	43	75	1
Rhododendron mucronulatum	.	20	29	47	5	41	71	88	.
Vitis amurensis	64	.	.	59	48	9	43	.	2
Carex lanceolata	29	.	.	82	76	68	86	.	1
Hepatica asiatica	41	40	14	.	10	6	43	.	.
Benzoin obtusilobum	29	.	.	47	81	33	100	38	.
Styrax obassia	17	.	57	12	38	24	57	.	.
Corylus heterophylla	6	.	14	12	5	12	14	.	1
Prunus leveilleana	6	.	71	12	5	6	29	.	.
Micromeles alnifolia	.	.	14	12	5	9	14	13	.
Atractylodes ovata	6	.	.	.	19	38	14	100	1
Carex nanella	.	60	57	6	.	15	14	100	.
Ainsliaea acerifolia	47	60	14	.	71	9	.	.	.

Table 8.16. Continued.

Column	1	2	3	4	5	6	7	8	9
Numbers of relevés	17	5	7	17	21	34	7	8	4
Euonymus alata	.	60	57	24	.	9	14	.	.
Maackia amurensis	29	.	.	18	10	12	14	.	.
Isodon excisus	64	.	.	.	33	3	.	.	2
Hosta longipes	6	20	.	.	14	.	.	.	.
Indigofera kirilowii	.	.	.	76	.	12	29	.	.
Rhus trichocarpa	.	.	.	18	10	9	.	.	.
Palura paniculata	.	.	.	18	14	3	.	.	.
Tripterygium regelii	17	.	.	.	5	.	.	.	.
Hosta sieboldiana	6	.	.	.	5	.	.	.	.
Aralia elata	.	.	14	.	.	6	.	.	.
Tilia mandshurica	6	.	.	.	.	.	.	.	.
Tilia amurensis	.	.	.	.	5	.	.	.	.
***Querco-Fagetea crenatae* (QF)**									
E_3									
Acer mono	53	.	14	.	33	6	.	.	.
Quercus dentata	.	.	.	47	.	15	14	.	.
Carpinus cordata	41	.	14	.	19	.	.	.	.
Actinidia arguta	35	.	29	.	14	.	.	.	.
Kalopanax pictus	23	.	.	.	19	3	.	.	.
Quercus acutissima	.	.	.	35	14	6	.	.	.
Carpinus coreana	.	.	.	.	14	.	.	.	.
E_2									
Acer mono	64	20	100	6	33	9	.	.	.
Euonymus oxyphylla	41	.	.	6	29	6	29	.	1
Kalopanax pictus	23	.	14	6	24	6	14	.	.
Carpinus cordata	35	20	14	.	14	.	.	.	.
Actinidia arguta	6	.	29	.	14	.	.	.	2
Quercus acutissima	.	.	.	24	10	6	.	.	.
Quercus dentata	.	.	.	53	.	30	.	.	.
Actinidia kolomicta	12	.	.	.	5	.	.	.	.
Carpinus coreana	.	.	.	.	10	.	.	.	.
E_1									
Aster scaber	64	60	14	53	62	35	86	13	1
Carex siderosticta	82	100	57	29	62	44	100	75	.
Viola keiskei	23	60	43	.	19	18	43	25	1
Pyrola japonica	.	.	29	12	14	21	43	.	.
Acer mono	53	.	71	6	10	9	.	.	.
Asarum heterotropoides	35	.	.	18	5	9	43	.	.
Quercus dentata	.	.	.	53	.	18	14	.	1
Smilacina japonica agg.	.	.	29	6	5	.	.	.	.
Euonymus oxyphylla	12	.	.	6	19	.	29	.	.
Athyrium yokoscense	.	.	29	.	5	3	14	.	.
Kalopanax pictus	23	.	.	6	10	.	.	.	.
Actinidia arguta	.	.	57	.	5	3	.	.	.
Carpinus cordata	17	.	.	.	5	.	.	.	.
Actinidia kolomicta	6	.	14	.	.	.	.	.	.
Paris verticillata	12	.	.	.	.	.	.	.	.
Quercus acutissima	.	.	.	35	.	6	.	.	.
Actaea asiatica	12	.	.	.	.	.	.	.	.
Carpinus coreana	.	.	.	.	5	.	.	.	.
Athyrium vidalii	.	.	.	.	.	.	14	.	.
Others									
E_3									
Castanea crenata	12	.	14	12	5	6	43	.	.
E_2									
Lespedeza hedysaroides	35	.	.	.	33	33	14	.	1
Deutzia prunifolia	12	.	14	12	5	27	.	.	.
Rhamnus davurica	29	.	.	.	33	18	.	.	1
Lonicera praeflorens	12	.	.	24	5	3	.	.	.
Morus bombycis	6	.	.	6	5	3	.	.	.
Pueraria lobata	17	.	.	12	.	9	.	.	.
Rubus crataegifolius	29	.	.	.	14	6	.	.	.
Morus mongolica	6	.	29	.	5	.	.	.	.
Viburnum dilatatum	6	.	.	.	19	6	14	.	.
Ligustrina reticulata	6	.	.	.	5	.	29	.	.
Clerodendron trichotomum	6	.	.	.	14	.	.	.	1

Table 8.16. Continued.

Column	1	2	3	4	5	6	7	8	9
Numbers of relevés	17	5	7	17	21	34	7	8	4
Parthenocissus tricuspidata	.	.	.	12	5	3	.	.	.
Sorbaria sorbifolia (L.) A. Braun	6	.	43	.	.	.	.	.	.
E_1									
Solidago japonica (incl. *S. virgaurea*)	47	80	57	12	10	30	86	13	*1*
Artemisia keiskeana	64	80	14	47	43	79	86	100	.
Spodiopogon sibiricus	23	.	.	94	43	76	86	100	*4*
Peucedanum terebintaceum	6	60	14	47	.	27	29	50	.
Calamagrostis arundinacea	23	.	.	6	29	24	29	.	*1*
Lysimachia clethroides	6	.	.	65	33	21	29	.	*2*
Agrimonia pilosa	.	.	14	18	9	3	29	75	.
Chrysanthemum indicum	.	.	.	47	5	30	29	75	*2*
Lepisorus ussuriensis	12	.	14	6	5	9	.	.	.
Lespedeza cyrtobotrya	12	.	.	24	5	18	29	.	.
Allium komarovianum	.	.	14	.	.	12	29	25	*2*
Viola acuminata	23	.	43	18	5	.	.	.	.
Viola chaerophylloides	17	.	43	.	19	3	.	.	.
Rubia cordifolia agg.	12	.	.	35	5	.	.	.	*1*
Celastrus orbiculatus	6	.	14	18	.	.	.	.	*2*
Sanguisorba officinalis	6	.	.	12	.	6	.	.	*2*
Thalictrum contortum	.	.	29	6	.	3	.	.	*2*
Cephalanthera longibracteata	.	.	14	6	10	6	.	.	.
Arundinella hirta	.	.	.	12	5	18	.	.	*1*
Dioscorea quinqueloba	23	.	14	.	.	6	.	.	.
Sanicula chinensis	17	.	14	6	.	.	.	.	.
Rubia chinensis	29	.	.	.	5	3	.	.	.
Synurus pungens	17	.	.	.	10	3	.	.	.
Polygonatum odoratum var. *pluriflorum*	23	.	.	.	5	9	.	.	.
Lilium tsingtanense	17	20	.	.	.	3	.	.	.
Viola selkirkii	17	.	.	.	14	.	14	.	.
Disporum sessile	12	.	.	.	14	3	.	.	.
Aconitum pseudolaeve agg.	12	.	.	.	5	3	.	.	.
Impatiens noli-tangere	12	20	14	.	.	.	.	.	.
Isodon japonicus	6	40	.	6	.	.	.	.	.
Hypericum ascyron	6	.	.	18	5	.	.	.	.
Adenophora tetraphylla	12	.	.	6	.	.	.	13	.
Dryopteris subtripinnata	12	.	.	.	5	.	29	.	.
Polygonatum involucratum	12	.	.	.	.	3	14	.	.
Viola variegata	6	.	14	.	.	.	.	.	*1*
Deutzia prunifolia	6	.	.	12	.	18	.	.	.
Gentiana zollingerii	6	.	.	6	.	3	.	.	.
Viburnum sargentii	6	.	.	6	.	3	.	.	.
Clerodendron trichotomum	6	.	.	.	10	3	.	.	.
Athyrium crenatum	6	.	.	.	5	3	.	.	.
Potentilla dickinsii	6	.	.	.	.	3	.	38	.
Liparis krameri	6	.	.	.	.	3	29	.	.
Phegopteris polypodioides	6	.	.	.	.	3	14	.	.
Smilax china	.	40	.	12	.	18	.	.	.
Sedum verticullatum	.	20	14	.	.	3	.	.	.
Sedum kamtschaticum	.	.	14	6	.	9	.	.	.
Chimaphila japonica	.	.	14	6	.	3	.	.	.
Ligusticum tenuissimum	.	.	14	.	.	3	.	25	.
Castanea crenata	.	.	.	18	.	3	43	.	.
Viola orientalis	.	.	.	.	10	9	14	.	.
Eupatorium japonicum	.	.	.	.	5	3	.	.	*2*
Cardamine leucantha	35	.	29	.	.	.	.	.	.
Syringa palibiniana	.	40	29	.	.	.	.	.	.
Lysimachia barystachys	.	.	29	18	.	.	.	.	.
Sorbaria sorbifolia (L.) A. Braun	.	.	29	.	5	.	.	.	.
Rubus parvifolius	.	.	.	18	.	3	.	.	.
Sedum polytrichoides	.	.	.	.	.	12	.	38	.
Thalictrum coreanum	.	.	.	.	.	3	29	.	.
Saussurea nivea	.	.	.	.	.	.	43	75	.
Sanicula tuberculata	.	.	.	.	.	.	29	25	.
Next accesoric species	**120**	**7**	**130**	**121**	**59**	**115**	**11**	**2**	**13**

Table 8.17. Chemical composition of the soil samples of *Rhododendro aurei-Laricetum olgensis.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
3	1–6	4.45	4.00	8.5	0.691	0.8	138.3	17.1	21.8	21.2	9.80	10.9	0	7.4
6	5–15	3.85	3.70	15.6	1.283	1.8	230.0	44.8	14.0	29.2	28.90	5.8	0	14.2
7	5–15	4.15	3.75	13.8	0.578	1.4	82.0	17.8	11.0	17.8	24.77	2.9	0	5.6
15	1–20	3.35	2.79	5.9	1.142	0.5	102.7	21.5	19.2	29.9	25.28	0.2	2.2	13.9
21	5–15	4.05	3.75	16.0	1.170	1.9	162.0	32.6	17.6	21.0	29.93	22.1	0	15.4
27	1–11	4.65	4.30	13.8	0.423	1.3	138.3	12.7	21.8	16.3	19.09	0.6	0	6.5
27	25–35	5.15	4.60	5.6	0.212	0.5	51.8	4.0	16.5	6.3	6.19	3.3	0	3.1
36	5–15	4.05	4.25	10.3	0.508	1.0	148.0	12.6	11.0	12.2	6.71	0.8	0	4.7

Table 8.18. Chemical composition of the soil samples of *Goodyero repentis-Piceetum jezoensis.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
8	3–9	4.00	3.50	7.4	0.917	0.7	107.8	12.7	19.2	15.0	15.48	9.0	0	10.5
9	5–15	4.10	3.85	11.5	1.142	1.6	216.0	29.2	11.6	22.2	19.61	3.0	0	15.7

Table 8.19. Chemical composition of the soil samples of *Carici peiktusani-Abietetum nephrolepidis.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
7	10–15	3.75	3.45	9.9	0.719	1.4	116.0	23.4	11.6	13.2	40.3	2.5	3.4	6.0
10	5–15	3.80	3.50	15.6	0.860	1.4	94.0	20.4	11.0	13.0	25.8	3.0	0	5.7

Table 8.20. Chemical composition of the soil samples of *Ledo decumbentis-Laricetum olgensis.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
1	2–12	4.80	4.55	7.2	0.860	0.9	255.2	12.7	20.0	45.6	20.6	12.3	0	10.6
19	3–13	4.20	3.80	7.9	0.973	0.8	133.2	12.7	20.5	18.0	10.8	3.0	1.6	5.0

Table 8.21. Chemical composition of the soil sample of *Polysticho retroso-paleacei-Rhododendretum dahurici.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
6	1–6	3.80	3.30	8.0	1.241	0.4	97.6	8.4	17.8	18.0	33.54	4.7	3.1	8.7

Table 8.22. Chemical composition of the soil samples of *Taxo-Pinetum pumilae.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
2	3–12	4.80	4.15	18.0	1.649	3.6	394.0	50.0	16.8	75.0	24.83	18.0	117.2	18.9
2	12–25	5.05	4.05	6.0	0.428	1.0	136.0	27.0	10.8	27.0	5.43	16.6	16.7	5.7
3	2–12	4.50	4.10	10.8	1.269	1.0	224.7	30.2	9.8	24.7	9.29	0	21.3	8.0
3	12–40	4.60	4.15	5.6	0.846	0.3	112.9	12.7	9.5	12.4	7.74	0.9	4.0	4.2

Table 8.23. Chemical composition of the soil samples of *Thujo koraiensis-Piceetum jezoensis*.

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
5	2–10	4.90	4.50	9.0	1.142	0.9	265.3	30.2	12.5	28.2	23.22	0.3	0	6.5
7	1–12	3.90	3.45	8.3	1.481	0.3	234.8	21.5	19.5	28.2	27.86	1.9	18.5	19.1
7	12–30	4.30	3.95	7.9	0.790	0.8	82.4	12.7	10.0	9.0	20.64	1.9	5.8	3.5

Table 8.24. Chemical composition of the soil samples of *Lychno-Quercetum mongolicae*.

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
4	3–15	4.80	3.70	6.0	0.402	0.8	42.0	12.4	9.0	15.0	4.76	6.3	4.9	4.2
5	2–8	5.55	4.75	8.5	0.656	1.4	306.0	35.0	16.4	40.0	9.16	4.7	25.8	5.0
5	8–20	5.05	4.00	6.0	0.333	0.6	66.0	8.0	8.4	14.0	3.90	0	2.2	3.5
5	20–40	5.40	4.10	5.1	0.247	0.4	56.0	5.0	8.0	13.0	2.82	0	4.0	4.2
6	4–15	4.60	3.60	5.5	0.374	0.4	42.0	12.0	8.4	11.0	4.77	17.7	4.0	5.7

Table 8.25. Chemical composition of the soil samples of *Vaccinio-Quercetum mongolicae*.

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
1	4–10	3.90	3.30	20.1	2.186	0.8	422.9	65.3	15.2	73.5	58.82	5.2	2.15	16.2
1	10–25	4.00	3.85	12.7	0.310	0.7	16.3	12.7	7.4	3.8	21.67	7.9	2.52	2.8
2	3–7	4.85	4.50	9.6	1.424	0.4	453.3	47.7	31.1	73.4	25.8	0.9	24.92	10.2
2	7–25	4.40	4.10	4.5	0.437	0.2	21.4	17.1	12.8	6.3	11.87	6.8	3.06	2.0
5	2–7	4.90	4.70	8.3	1.311	0.4	321.2	21.5	17.8	42.1	49.54	6.8	28.56	7.2
5	8–20	4.25	4.15	6.0	0.578	0.2	51.9	8.4	12.5	9.5	25.8	9.0	5.79	2.0

Table 8.26. Chemical composition of the soil samples of *Parthenocisso tricuspidati-Fraxinetum rhynchophyllae*.

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
1	9–12	3.85	3.40	16.1	2.045	1.2	387.3	47.7	12.5	45.6	44.38	1.4	3.1	19.9
1	12–20	3.90	3.55	13.0	0.183	1.0	26.5	8.4	7.3	3.8	7.74	0	0	5.0
2	8–16	4.15	3.60	25.0	1.142	0.9	311.1	21.5	6.4	57.8	41.28	3.6	5.8	11.7
2	16–28	4.25	3.90	11.6	0.437	1.7	31.6	8.4	6.3	6.3	5.16	3.6	3.1	5.0
2	28–50	4.30	4.05	11.0	0.437	0.4	16.3	8.4	6.4	3.8	3.61	1.4	1.2	2.0
3	2–4	4.70	4.65	8.3	2.468	0.7	616.0	43.4	26.3	94.3	24.76	15.5	8.5	15.4
3	4–30	4.00	3.70	4.2	0.874	0.4	138.3	17.1	15.2	24.7	2.06	10.1	3.1	8.7
4	4–8	4.15	3.65	12.6	1.791	0.3	361.9	34.6	12.5	69.9	30.96	7.4	1.2	10.9
4	8–20	4.30	3.65	7.9	0.437	0.7	92.5	8.4	12.5	10.8	2.58	0	0	2.8
4	20–40	4.15	3.40	7.9	0.367	0.8	107.8	8.4	10.6	17.8	7.22	7.9	2.2	5.0
5	2–5	4.95	4.90	9.3	1.297	1.0	453.3	34.6	32.5	76.9	38.70	11.2	4.0	10.2
5	37–45	4.30	4.00	5.4	0.437	0.8	148.4	8.4	13.9	10.5	6.19	3.0	0	5.0
5	6–35	3.95	3.85	7.0	0.324	0.9	51.9	8.4	16.5	6.5	2.58	11.2	0	5.7
6	3–15	5.65	5.55	16.1	1.551	2.9	641.4	65.3	28.5	80.9	46.44	7.4	59.5	11.7
6	15–35	5.15	4.55	5.9	0.451	1.1	189.1	21.5	7.2	17.8	29.93	1.9	3.1	4.2
7	3–10	5.90	5.70	8.2	1.650	1.9	1058.1	30.2	23.2	75.2	13.42	2.5	55.0	10.2
7	10–40	5.55	5.15	3.4	0.508	0.9	250.0	17.1	9.9	12.8	2.58	16.6	3.1	3.9

Table 8.27. Chemical composition of the soil samples of *Festuco ovinae-Pinetum densiflorae.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
4	2–5	5.90	5.85	7.1	0.790	1.3	280.0	16.8	11.6	19.7	37.98	3.1	12.2	6.7
8	5–15	6.15	4.80	5.8	0.119	0.7	68.0	18.0	9.0	17.0	1.5	7.9	5.8	5.0
8	15–25	5.40	4.10	4.5	0.052	0.6	50.0	15.0	8.4	12.0	1.0	9.0	2.2	9.0
10	1–5	6.20	5.90	6.5	0.254	0.5	110.0	19.2	9.0	11.4	3.10	11.2	4.5	3.5
12	3–10	5.55	5.45	8.3	0.353	1.1	200.0	34.6	8.6	20.7	3.1	10.6	5.4	13.8
14	1–5	5.80	5.50	5.8	0.747	1.6	294.0	27.0	12.6	31.0	28.45	9.6	18.9	6.5
15	1–5	4.70	4.30	7.8	0.437	0.5	88.0	19.6	11.6	17.6	31.54	5.8	3.4	5.0
16	3–10	4.75	4.50	12.6	0.733	1.3	242.0	23.2	14.4	29.7	32.8	16.1	9.3	13.9

Table 8.28. Chemical composition of the soil samples of *Saso-Quercetum mongolicae.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
1	3–9	5.05	3.85	4.5	0.324	1.9	42.0	14.0	8.0	11.0	4.54	0	0	2.0
1	9–25	4.90	4.00	3.6	0.099	0.4	10.0	10.4	6.8	5.0	2.27	3.6	0	2.0
3	1–25	5.25	4.15	4.3	0.145	1.4	60.0	6.0	8.0	17.0	2.95	3.6	2.2	3.5
4	3–15	5.15	4.10	4.3	0.242	0.3	24.0	13.0	8.4	7.0	3.22	17.7	3.1	2.0
8	20–30	4.65	4.25	6.0	0.324	0.5	30.0	14.0	9.2	8.1	0.26	12.3	0.9	5.1
10	15–20	4.20	4.05	13.7	0.691	1.0	26.0	12.2	9.0	4.9	9.29	10.6	3.8	4.2
20	8–15	4.55	4.05	12.0	0.705	0.2	26.5	8.4	13.9	8.5	18.58	81.4	0	12.6

Table 8.29. Chemical composition of the soil samples of *Artemisio-Quercetum mongolicae.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
22	2–7	4.05	3.65	10.0	1.946	0.2	554.9	52.1	20.5	83.9	70.18	9.0	4.0	17.6
22	7–20	3.95	3.80	5.6	0.169	0.7	26.5	8.4	13.9	7.3	2.58	2.5	0	5.4
30	10–15	4.55	4.30	8.5	0.437	0.7	40.0	10.8	13.0	11.1	13.42	10.1	0	6.2
32	10–15	4.65	4.25	7.6	0.296	1.9	52.0	9.2	11.0	4.9	20.64	6.1	0	4.8
28	1–15	5.15	4.05	3.6	0.096	0.4	30.0	11.0	7.6	8.0	2.79	1.4	0	3.5
28	15–30	5.10	4.05	4.8	0.050	0.4	11.0	6.4	8.0	5.0	0.76	12.3	0	4.2

Table 8.30. Chemical composition of the soil sample of *Syneilesio palmatae-Carpinetum laxiflorae.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
2	4–15	4.20	3.95	6.5	0.282	0.4	11.2	4.0	13.0	6.3	10.84	10.6	0	4.2

Table 8.31. Chemical composition of the soil sample of *Lilio lancifolii-Rhododendretum schlippenbachii.*

Relevé number	horizon (depth) (cm)	pH (H_2O)	pH (KCl)	N-NH_4^+ (ppm)	N tot (%)	P-PO_4^- (ppm)	Ca^{2+} (ppm)	K^+ (ppm)	Na^+ (ppm)	Mg^{2+} (ppm)	C ox (%)	Cl^- (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)
1	4–10	3.80	3.25	14.0	1.170	0.2	87.5	12.7	25.8	18.0	25.28	18.8	2.3	11.7