Vegetation Composition and Structure of *Sorbus commixta* - Native Forests in South Korea

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ABSTRACT

Vegetation composition and structure of *Sorbus commixta* - native forests of South Korea were studied using phytosociological procedures and its ecological characteristics analyzed with special respect to species correlations, importance values, and constancy classes. Vegetation types were divided (great division) into *Tripterygium regelii* - *Quercus mongolica* (Inland high mountain type) and *Acer tapsesimense* - *Fagus crenata* var. *multinervis* (Ulleung Island type) and ten accompanying vegetation units. In between *S. commixta* and life-forms, 120 correlations were positive with 23 of these having a p-value < 0.01 for trees, 21 for shrubs, 10 for woody vines, and 25 for herbs. In trees, there was a positive correlation between *S. commixta* and *A. tapsesimense* and *T. insularis* on the 1% level. In shrubs, there was a positive correlation between *S. commixta* and *Sasa kurilensis*, *Callicarpa japonica*, *Ligustrum foliosum* on the 5% level. In woody vines, there was a negative correlation between *S. commixta* and *Tripterygium regelii* and *Actinidia rufa* on the 1% level. In herbs, there was a positive correlation between *S. commixta* and *Majanthemum dilatatum* and *Solidago virga-aurea* var. *gigantea* on the 1% level.

Key words: Vegetation composition and structure, Phytosociological procedures, Vegetation types, Vegetation units

I. INTRODUCTION

A plant community is an organized complex with typical floristic composition and morphological structure which have resulted from the interaction of species populations through time (Shimwell, 1971). The distribution of a species population depends upon several factors directly related to phenotypic plasticity, genotypic adaptability, and competitive, reproductive, and tolerance capacities of the species. The ecological amplitude of the species is thus quite important to its existence in a particular habitat. Generally, an ecological technique for conserving and managing the forest vegetation in a given area is based on vegetation units classified by composition and structure of the plant society. Classifying vegetation units is helpful for better understanding how to manage different plant communities and for facilitating further systematic and coordinated conservation and management of forest vegetation (USDA Forest Service, 1989). *S. commixta* is the deciduous broad-leaf subtree which grows in deep mountains at an
II. STUDY AREAS AND METHODS

During the summers of 2000 to 2003, fifteen $S.\ commixta$-native forest sites were sampled in South Korea (Fig. 1). $S.\ commixta$-native forests (SCNF) are found mostly near the ridge tops. $S.\ commixta$, Taxus cuspidata, Rhododendron brachycarpum, and Dryopteris crassirhizoma were the consistent species. A survey was conducted in two hundred one plots within the SCNF sites. Plots of 10 m × 10 m were used to analyze the floristic composition and structure of these sites. All strata were estimated according to the Braun-Blanquet cover-abundance scale (r, +, 1, 2, 3, 4, 5). Details of the approach can be found in Mueller-
Dombois & Ellenberg (1974).

The delineation of forest plant communities is based on floristic-structural relevés which were established using the floristic-physiognomic approach introduced by Braun-Blanquet (Braun-Blanquet, 1964; Mueller-Dombois and Ellenberg, 1974). The taxonomically pre-defined term ‘association’ (Braun-Blanquet, 1964) was not used because character species in their strict sense (Knapp, 1971) could not be defined. The central vegetation unit was termed ‘community’. No synsystematical ranking of the vegetation units was attempted and their hierarchical positions are not yet clear. Communities were arranged in ‘community groups or types’ if clear floristic and structural similarities existed. The term ‘group’ was used for floristically recognizable differences within the community which cannot be ascribed to obvious ecological divergencies.

The term ‘subgroup’ has been adopted to describe floristic differences within a subgroup. From these data various ecological characteristics such as importance value of each species, constancy classes, interspecific correlation, species diversity, and community similarity was analyzed (Peet, 1974; Clarke, 1994; Mueller-Dombois and Ellenberg 1974). Nomenclature follows Lee (1985).

III. RESULTS AND DISCUSSION

3.1. Vegetation classification

The forest communities, where S. commixta is distributed naturally, were classified using the phytosociological procedures of S. Korea. It is greatly divided into an inland high mountain type and Ulleung Island type. A description of these vegetation types and their subordinate units is as follows.

I. Tripterygium regelii - Quercus mongolica community group (Inland high mountain type; VT I)

This vegetation type develops chiefly at a high mountain zone with thin soil in somewhat humid conditions of an inland and Mt. Halla. This is recognized as having T. regelii, Rhododendron schlippenbachii, Vaccinium koreanum, Q. mongolica, etc. of the species group 2. This is further subdivided into two communities, four groups, and four subgroups with a total of six vegetation units by a combination of the species groups 3 to 11 and Dryopteris crassirhizoma, Taxus cuspidata of the species group 12. C. lanceolata - A. koraisens community is found mainly in southern temperate zones such as Mt. Halla, Mt. Jiri, Mt. Dogyu, and Mt. Kaya. This is subdivided into two lower units of the B. ermanii var. saitoana - T. cuspidata group and R. mucronulatum group. R. mucronulatum group is further subdivided into two lowest units of P. densiflora subgroup and Dendzia parviflora - P. koraiensis subgroup by a combination of the species groups 6 to 7. The C. siderosticta - A. nosophleps community is found mainly in the central temperate zone and developed mostly in and around the Taebaek range, which comprises the frame of Baekdudaegan. This is subdivided into two lower units of Syringa wolffii - T. koraisens group and Melehaia uriticifolia - Acer mono group by a combination of the species groups 9 to 10. M. uriticifolia - A. mono groups further subdivided into two lowest units of Dryopteris crassirhizoma - T. cuspidata subgroup and Tilia amurensis subgroup by a combination of species groups 11 to 13. The D. crassirhizoma - T. cuspidata subgroup is developed mostly on rocky sites in Mt. Jumbong, Mt. Ode, Mt. Taebaek, and Mt. Hambaek. The T. amurensis subgroup developed on the upper slope of Mt. Solwangbeong, Jingogae, Hwangenbong, Kumdaebong, Durubong, and Yaksubong.

II. Acer takesimense - Fagus crenata var. multinervis community group (Ulleung Island type; VT II)

This vegetation type is found mainly at the Ulleung Island. This is distinguished from the inland high mountain type by the presence of species groups 13 as the character species. This is further subdivided into two communities, four groups, and a total of four vegetation units by combinations of the species in groups 14 to 18. The Dystaenia takeshimana - Acer okamotoanum community is distinguished from the R. brachycarpum - T. sieboldii community by having the differential species group 14, but lacking the 17. It is a secondary community developed on the vertical middle part of the mountains at elevations of 500 m to 800 m. This is further subdivided into two types of Hepatica maxima group and Aster glehni - Pirus thunbergii group by differential species groups 15 and 16. H. maxima group, with the differential species group 15, develops in places slightly influenced by man. The A. glehni - P. thunbergii group, with differential species group 16, develops on the lower slopes where man’s influence is strong. The R. brachycarpum - Tsuga sieboldii community is recognized by having T. sieboldii and P. parviflora of
Table 1. Vegetation types and its units of S. commixta-native forests: synoptic table

<table>
<thead>
<tr>
<th>Vegetation types hierarchy</th>
<th>A</th>
<th>B</th>
<th>A</th>
<th>B</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of species</td>
<td>40</td>
<td>35</td>
<td>122</td>
<td>138</td>
</tr>
<tr>
<td>Mean total no. of species (100%v)</td>
<td>24</td>
<td>20</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Mean total cover (100%v)</td>
<td>213</td>
<td>196</td>
<td>164</td>
<td>186</td>
</tr>
</tbody>
</table>

| Number of species         | 5 | 3 | 36 | 13 |

| Total number of species   | 50| 35| 132| 138|
| Mean total no. of species (100%v) | 24 | 20 | 25 | 25 |
| Mean total cover (100%v)   | 213 | 196 | 164 | 186 |

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| Number of species         | 5 | 3 | 36 | 13 |
the species group 17 as character species. According to Horikawa & Sasaki (1959), this community can be identified with the Iliceto - Tsugetum sieboldii. It is a natural forest developed on ridges or prominence sites of the mountain. This is further subdivided into two lower units of the Polypodium vulgare - Camellia japonica group and typical group by the presence of the differential species group 18. The _P. vulgare - C. japonica_ group is developed on the lower part of the mountain where human influence is slight. A typical group is developed on a ridge or prominence of the mountain where human influence is not as strong.

### 3.2. Ecological characteristics

#### 3.2.1. Coverage by stratum

Compared to the total cover (trees, sub-trees, shrubs...
and herbs) by each vegetation unit, the highest cover is encountered in vegetation unit no.2 (215.2%). The total cover in the VT I and in the VT II is also the same (181.4 and 166.9%, respectively). Compared to the average cover of the four strata, VT I consists of the upper 68.6%, lower 22.5%, shrubs 35.9%, and herbs 39.9% and VT II, the upper 82.1%, lower 34.4%, shrubs 29.2%, and herbs 35.7%, respectively. VT II was 20% to 30% greater than VT I. This is because VT I has various sites whereas VT II is limited to sites on the top or on ridges.

3.2.2. Community similarity

Table 2 shows the similarity of the component species among the vegetation units. The similarity coefficient (CCs) between the two-vegetation types shows less than 20% similarity. This means that the similarity of the two groups is almost nonexistent. VT I, except vegetation unit 1, showed quite a different composition from other vegetation units; the similarity among the vegetation units appeared to be mostly about 50% and so they were considered as identical communities. In the VT II, the similarity among the vegetation units appeared to be over 70% and they were considered as identical communities. A low similarity between strata and stands indicates microclimatic variations and hence a different species composition.Wikum and Walii (1974) and Saxena and Singh (1982) have pointed out the significant role of site characteristics in plant distribution and similarity.

3.2.3. Interspecific correlations

In each life-form, 120 correlations were positive with 23 of these having p-values 0.01 for trees, 21 for shrubs, 10 for vines, and 25 for herbs, respectively. In trees, a positive correlation was found between S. commixta and A. takesimense and T. insularis at the 1% level and between F. crenata var. multinervis and P. parviflora at 5%. A negative correlation was found between S. commixta and inland type species such as A. koreana, P. densiflora, and Acer tschonoskii var. rubripes at the 5% level. In shrubs, a positive correlation was found between S. commixta and Sasa kurilensis, Callicarpa japonica, Ligustrum foliosum at the 5% level and there was a negative correlation between S. commixta and R. mucronulatum and R. schlippenbachii at the 1% and 5% level, respectively. In woody vines, there was a negative correlation between S. commixta and Tritherygium regelii and Actinidia rufa at the 1% level. In herbs, there was a positive correlation between S. commixta and Majanthemum dilatatum, and Allium victorialis var.
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...platyphyllum at the 1% and 5% level, respectively (Fig. 2).

### 3.2.4. Importance values and constancy classes

In total IV, *S. commixta* - native forests of our...
country exhibit a pattern of weak dominance (Fig. 3), meaning that no single species had an importance value greater than 25%. In trees, only *S. commixta* had IVs of 10% or greater. In shrubs, *R. schlippenbachii*, *R. brachycarpum*, and *Tripterygium regelii* had IVs of 10% or greater. Both *S. commixta* and *A. koreana* had relatively higher IVs than other species. The next dominant species were *T. cuspidata*, *Q. mongolica*, and *P. parviflora*. These had high IVs due to their high frequency. For the mid-constancy classes (III), the number of the component species does not differ from each other. However, in the total ratio of the component species, VT II is three times as abundant as VT I. This shows that VT II has greater variability of site conditions than VT I. In total constancy classes, the lower classes (≤II) have 99.4% of the forest plants occurring in this area, the mid-classes (III) 0.4%, and the higher classes (≥IV) have only 0.2%.

### 3.2.5. Species diversity

Diversity is a combination of two factors: the number of species present, referred to as species richness, and the distribution of individuals among the species, referred to as evenness or equitability. Single species populations are defined as having a diversity of zero, regardless of the index used. Species diversity, therefore, refers to the variations that exist among the different forms. In the present study the Shannon-Wiener index of diversity has been used.

The average number of species per unit area (100 m²) was 22.4 ± 9.3. VT I is more abundant, 10 kind, than VT II. Compared to the component ratio of species by life-forms, a difference did not exist, particularly in two vegetation types. They consist of trees 20.9%, subtrees 14.3%, shrubs 18.3% and herbs 46.9%. The average number of species was most abundant in the VT 6 vegetation type I. The total number and diversity of species were higher in the inland type. The value of diversity ranged from 1.57 to 2.25 for vegetation units. The range of diversity in the inland forest is certainly higher than the Ulleung Island type; however, it is lower than reported for other forests in Korea. The value of species richness ranged from 12.0 to 38.6 for vegetation units.
무 등이≤5%이며, 단목류는 미역줄나무, 다래 등이≤1%이며, 그리고 초본류는 큰두루미꽃, 울릉미역취 등이≤41% 유의수준에서 각각 정의 관계를 나타낼 수 있었다. 본 연구 결과는 양 후한국산 마가목의 자연지리적 연구와 유용자원식물인 마가목의 지속가능한 보전과 이용에 있어서 효율적인 자료로 활용될 것으로 판단된다.

REFERENCES