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Actual Vegetation and Potential Natural Vegetation of Naejangsan National Park, Southwestern Korea

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內藏山 國立公園의 現存植生과 潛在自然植生

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ABSTRACT

The potential natural vegetation of Naejangsan national park area, southwestern Korea, was inferred from the actual vegetation. With the phytosociological classification, ordinations and field surveys, the actual vegetation map of the area was made in scale 1 : 25,000, including ten communities of *Pinus densiflora*, *Quercus mongolica*, *Quercus variabilis*, *Carpinus laxiflora*, *Daphniphyllum macropodum*, *Carpinus tschonoskii*, *Quercus aliena-Carpinus tschonoskii*, *Cornus controversa-Lindera erythrocarpa*, *Torreya nucifera-Zelkova serrata* and *Acer mono-Zelkova serrata* community.

The analyses of species richness, age structure and various informations on vegetation changes suggest the three pathways of late stage succession from *P. densiflora* forest to climatic climax. The first of them is through *Q. variabilis* forest to *Q. mongolica* forest in the upper parts of the mountain, the second through *Q. variabilis* and *Q. serrata* forest to *C. laxiflora* forest in the middle parts and the third through *Q. aliena* forest to *C. tschonoskii* forest in lower parts.

Considering the actual vegetation and informations on the vegetation changes including human activities, the potential natural vegetation of the mountain mainly composed of *Q. mongolica*, *C. laxiflora*, *C. tschonoskii*, *P. densiflora* and *Z. serrata* forest as climatic climax and/or edaphic climax was inferred. The present situation of nature conservation in the area was estimated by the examination on the actual vegetation and potential natural vegetation map.

INTRODUCTION

Among 662 vascular plants listed in previous three papers (Kim and Yim, 1988a,b,c) the lucidophyll species of six trees and 13 herbs were known as the northern limit distribution species (Park, 1974 ; Park and Park, 1974 ; Lee and Oh, 1974 ; Lee, 1979). These species occurred in warm-temperate forest zone of Korea are distributed in lower slopes especially southern ravines of the mountain, while most tree species in the moun-

tain are cool-temperate deciduous broadleaf species. Therefore, the mixed forest of the area has significance for recognition about characteristics of cool-temperate zone and transition zone between cool-temperate and warm-temperate zone.

Plant species are the building blocks of the plant communities that together constitute the vegetation of the different regions (Walter, 1979). Present ranges of species and community distribution, however, do not indicate their natural ranges. Today it is intimately linked with the history of the region and the result of a long development in the plant and animal world, including even human life. As a result, we can never afford to neglect the historical factors of plant and plant community to realize the vegetation of Mt. Naejang area.

To discern the potential natural vegetation and species distribution range, the analyses on the age structures of plant communities, the behaviors of different species and species richness within plant communities in relation to abiotic environmental factors were carried out.

MATERIALS AND METHODS

Floral characteristics

The disrtibutions of 662 vascular plants listed were examined to grasp the characteristics of area, especially on the lucidophyll species as followings: *Daphniphyllum macropodum*, *Torreya nucifera*, *Orixa japonica*, *Hedera rhombea*, *Trachelospermum asiaticum* var. *intermedium* and *Zanthoxylum planispisum* in trees and *Arisaema ringens*, *Cremastra variabilis*, *Vexillabium nakaianum*, *Hetaeria sikokiana*, *Carex ligulata*, *Lycoris aurea*, *Coniogramme japonica*, *Cytomium bortuenig*, *Asplenium salerii*, *Phegopteris decursive-pinnata*, *Athyrium wardii*, *Athyrium mesosorum* and *Lemmaphyllum microphyllum* in herbs.

Age structure and species richness analyses

For detection the behaviors of plant species in population and community level, species richness and community structure, especially dbh class-frequency were analyzed with the same data of the previous studies (Kim and Yim, 1988a, b, c). The tress over 3 cm in dbh, seedlings (dbh$<$0.5 cm) and saplings (0.5 cm$\leq$dbh$<$3 cm) in different plant community were censused for age structure analyses and the determination of successional stage (Kim, 1977 ; Despain, 1983). The species richnesses(r) of the ten communities by phytosociological classification (Kim and Yim, 1988a) were calculated by $r=S/\log A$ (Whittaker, 1975). Here, S is the number of species in a sample and A is the sample area.

Vegetation mapping

The actual vegetation map of the area was made in scale 1 : 25,000 based on the results of phytosociological classification and ordinations by Kim and Yim (1988a, b, c) and field surveys (Brush *et al.*, 1980 ; Babalonas, 1980; Abbott, 1981 ; Schroeder, 1983).

The potential natural vegetation map was made in scale 1 : 25,000 with the analyses of the actual vegetation and the physical conditions limiting vegetation distribution and the examinations of informations on the vegetation changes including human impacts (Küchler, 1967 ; Stumpel and Kalkhoven, 1978 ; Suzuki *et al.*, 1979 ; Toyohara *et al.*, 1983 ; Kim and Yim, 1986, 1987).

RESULTS AND DISCUSSION

Actual vegetation

In the actual vegetation map four distributional types were shoun: *Quercus variabilis* and *Pinus densiflora* community on large area; *Carpinus laxiflora*, *Carpinus tschonoskii*,

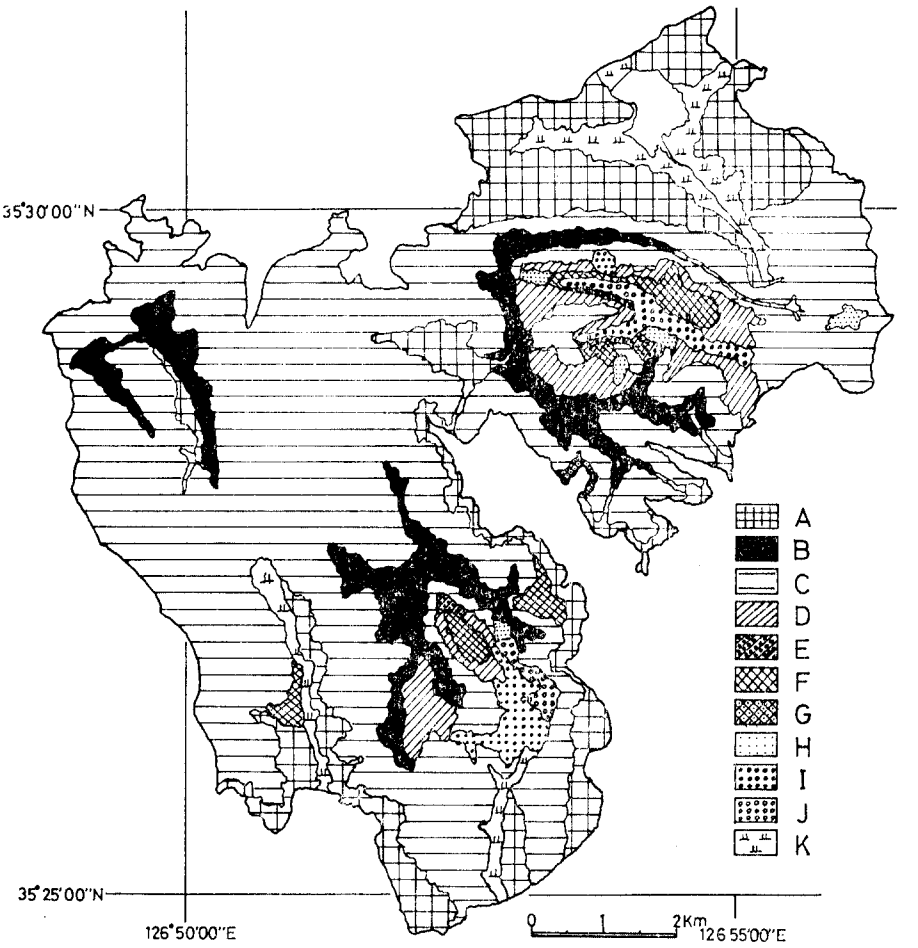

Fig. 1. Actual vegetation map of Mt. Naejang. A : *Pinus densiflora*, B : *Quercus mongolica*, C : *Quercus variabilis*, D : *Caspinus laxiflora*, E : *Daphniphyllum macropodum*, F : *Carpinus tschonoskii*, G : *Quercus aliena-Carpinus tschonoskii*, H : *Cornus controversa-Lindera erythrocarpa*, I : *Torreya nucifera*, J : *Zelkova serrata* community, K : crop land.

Daphniphyllum macropodum and *Torreya nucifera* community on restricted area around the Naejang and Baekyang Temple; *Zelkova serrata*, *Cornus controversa* and *Lindera erythrocarpa* community on narrow area in well drained stony slopes and ravines; *Quercus mongolica* community on xeric upper slopes (Fig. 1). *Q. variabilis* and *P. densiflora* forests are the secondary forests reformed after destroyed by human activities. Most of upper tree layer had been repeatedly cut for home use and undergrowth had been also grazed for domestic animals, edible plants and shifting agriculture. Since appointed as the national park in 1971, however, the forests of the area have been preserved under the nature conservation law. *Daphniphyllum macropodum* and *Torreya nucifera* forest, natural monument No. 91 and No. 153, must be paid attention to as the reflection of vegetational change and some mild climate of the area.

Changes in actual vegetation

Q. variabilis forests at above 500 m in altitude (Table 1) are composed of *Q. variabilis* in a few of large size trees and *Q. mongolica* in a number of small trees. The numbers of seedlings and saplings of *Q. mongolica* in the forest are 7 times much more than those of *Q. variabilis*. It means that *Q. variabilis* forest at above 500 m elevation

Table 1. Dbh class distribution of different species in *Quercus variabilis* forest in south slope of Mt. Naejang

Species	Seed-lings	Sap-lings	dbh class(cm) 3~6	~9	~12	~15	~18	~21	~24	~27	~30	~33
Quercus variabilis	100		4	2	2	3	1				2	1
Quercus mongolica	700	21	9		6	2	1					
Acer pseudo-sieboldianum	300	15	4									

Arabic numerals are number of individuals in quadrat No. 65 (altitude: 500 m) by Kim and Yim (1988a).

of the mountain can be replaced by *Q. mongolica* forest in successional seres.

Q. variabilis forests at below 500 m in altitude (Table 2), however, trees are composed of *Q. variabilis* in a few of large trees and *C. laxiflora* in a number of small

Table 2. Dbh class distribution of different species in *Quercus variabilis* forest in north slope of Mt. Naejang

Species	Seed-lings	Sap-lings-	dbh class(cm) 3~6	~9	~12	~15	~18	~21	~24	~27	~30	~33	~36	~40
Quercus variabilis	50							1			2	1	1	4
Quercus serrata	150	25		1	1	1	1	1		2	2		1	
Carpinus laxiflora	400	100	10					1			1			
Acer pseudo-sieboldianum	75	50	7											

Arabic numerals are number of individuals in quadrat No. 5 (altitude: 400 m) by Kim and Yim (1988a)

Table 3. Dbh class distribution of different species in *Quercus aliena* forest in north slope of Mt. Naejang

Species	Seed-lings	Sap-lings	dbh class(cm) 3~6	~9	~12	~15	~18	~21	~24	~27	~30	~50	~60
Quercus aliena						1						1	2
Carpinus tschonoskii	275	150	9	3		1	2	1	2	1	3		
Acer pseudo-sieboldianum var. *koreanum*	300	75	2							1			

Arabic numerals are number of individuals in quadrat No. 86 (altitude: 370 m) by Kim and Yim (1988a).

trees. The numbers of seedlings and saplings of *C. laxiflora* in the forest are 10 times much more than those of *Q. variabilis*. It also means that the *Q. variabilis* forest can be replaced by *C. laxiflora* forest in successional seres.

Quercus aliena forests at mesic-lower slopes (Table 3) are composed of *Q. aliena* in a few of large trees and *C. tschonoskii* in a number of small trees. All of seedlings and saplings in the forest are *C. tschonoskii*. It suggests that it is in the successional change from *Q. aliena* forest to *C. tschonoskii* forest at mesic-lower slopes and flat lands as in Mt. Seonum (Kim and Yim, 1987).

Species richness index in different communities showed largely large values in secondary forests such as *Q. aliena*, *Q. variabilis* and *P. densiflora* forest, while small values in natural forests such as *C. laxiflora*, *Z. serrata*, *D. macropodum* and *T. nucifera* forest (Table 4). It indicates the decreasing tendency of species richness in successional seres, as pointed by Shafi and Yarranton (1973).

Potential natural vegetation

The results of phytosociological classification, ordinations and the analyses of age structure and species richness in different community suggest three pathways of late stage succession from *P. densiflora* forest to climatic climax in the mountain. The first of them is through *Q. variabilis* forest to *Q. mongolica* forest at above 500 m elevation, The second through *Q. variabilis* and *Q. serrata* forest to *C. laxiflora* forest at below 500 m elevation and the third through *Q. aliena* forest to *C. tschonoskii* forest in mesic-lower parts and flat lands of the mountain;

Pinus densiflora forest → *Quercus variabilis* forest → *Quercus mongolica* forest
Pinus densiflora forest → *Quercus serrata* forest → *Carpinus laxiflora* forest
Pinus densiflora forest → *Quercus aliena* forest → *Carpinus tschonoskii* forest

P. densiflora forest on hillock or exposed ridge line and *Z. serrata* forest on well drained stony slopes or streamsides may be considered as a topographic or edaphic climax forest in this mountain. Therefore, the potential natural vegetation of the mountain will be mainly composed of *C. laxiflora*, *C. tschonoskii*, *Q. mongolica*, *P. densiflora* and *Z. serrata* forest (Fig. 2).

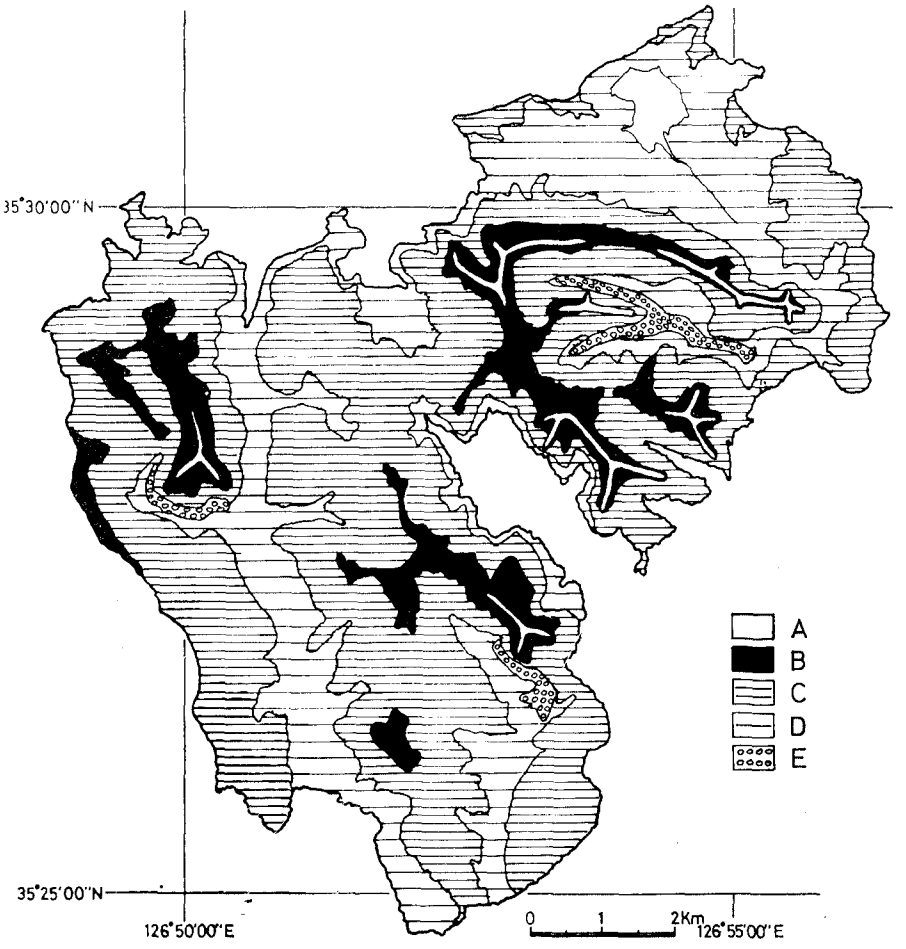

Fig. 2. Potential natural vegetation map of Mt. Naejang. A : *Pinus densiflora*, B : *Quercus mongolica*, C : *Carpinus laxiflora*, D : *Carpinus tschonoskii*, E : *Zelkova serrata* forest.

Table 4. Species richness index (r) in different communities in Mt. Naejang

Community	r
Pinus densiflora	14.57
Quercus mongolica	14.28
Carpinus laxiflora	11.28
Daphniphyllum macropodum	10.47
Carpinus tschonoskii	13.70
Quercus aliena	33.50
Cornus controversa-Lindera erythrocarpa	13.22
Torreya nucifera	12.42
Zelkova serrata	10.98
Quercus variabilis	13.28

The differences between actual vegetation and potential natural vegetation map were found in the large area destroyed by human activities except restricted area around the Naejang and Baekyang temple. The actual vegetation and potential natural vegetation map and/or many informations obtained by this study will be contributed to the nature conservation. Therefore, the protection of natural vegetations and the plantation planned for potential natural vegetations mentioned above are required for the restoration of nature.

摘 要

內藏山 國立公園 森林群集의 分類와 傾度分析, 群集內의 種豊富性 및 年齡組成 分析을 通하여 森林植生의 氣候的 極相과 土壤的 極相을 밝혀 潛在自然植生의 分布를 推察하였다. 이 地域에는 現在 소나무, 신갈나무, 굴참나무, 서어나무, 굴거리나무, 개서어나무, 갈참나무, 비목나무, 비자나무와 느티나무林이 分布하고 있다. 이들 植物群集의 種豊富性, 年齡組成 그리고 人爲的 影響 等을 分析하여 이들 群集의 氣候的 極相에 이르는 後期遷移過程에는 陽樹林인 소나무林으로부터 始作하여 高地帶의 굴참나무林을 거쳐 신갈나무의 極相林에 이르는 過程과 中間部의 굴참나무林과 졸참나무林을 거쳐 서어나무의 極相林에 이르는 過程, 그리고 低地帶의 갈참나무林을 거쳐 개서어나무 極相林에 이르는 세 系列이 있음이 밝혀졌다. 이리하여 同地域의 潛在自然植生은 氣候와 地形 또는 土壤的 條件에 따라 신갈나무, 서어나무, 개서어나무, 소나무와 느티나무의 極相林이 分布할 것으로 보인다. 이들을 土臺로 하여 만든 現存植生圖와 潛在 自然植生圖를 比較檢討하여 同地域의 自然保存 狀態를 評價하였다.

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