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Ecological Studies on the Vegetation of *Castanea crenata* Community and Both Sides

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Abstract

The characters of *Castanea crenata* community which is associated with human activities recently extended around the field of Saengbiryang-myeon at Sanseong-gun in Gyeongsangnam-do. The *C. crenata* community and its outskirts were investigated for several ecological parameters and the results can be summarized as fellows. *C. crenata* is prevailing in the plantation area, whereas *Pinus densiflora* and *Quercus mongolica* are prevailing in its outskirts. The mean species diversity of plantation was lower than that of natural forests. In stratification of investigated areas, overstory tree layer was dominant in the zone of plantation and dominant layers in the natural forest were understory tree layer, shrub, and herb. Plant biomass and net production which estimated from degree of green naturality were much higher in natural forests than those of the plantation community. Least significant differences (LSD) post hoc analysis revealed that *P. densiflora* and *Q. mongolica* community had significantly greater than densities than *C. crenata* community.

Key Words : *Castanea crenata, Pinus densiflora, Quercus mongolica*

1. Introduction

Worldwide, agricultural fields are expending both in size and populations. As a result of mechanized farming, native vegetation is reduced and fragment a landscape mosaic in which both the amount of impervious surface is increased, and the structure and comparison of the remaining vegetation is progressively altered[1,2].

Improvement of farmland adjacent to natural areas often results in simplification of habitats and a community of plant, which lead to fewer species dominated by habitat patch size to species richness, increasement of immigration and extinction rates, and have been applied to habitat patch dynamics in fragmented rural scenery[3].

The destruction and fragmentation of habitats result in the conservation of relatively continuous ecosystems, such as forests, into archipelago of natural habitats surrounded by a 'sea' of urban development[4]. Populations or community in fragmented ecosystems are more likely to become extinct due to the effects associated with size reduction of remnant habitat, greater isolation from neighboring populations, and increased amounts of 'edge' habitat, and this should consequently lead to an overall reduction in biological diversity in the region[5]. The effects of fragmentation have been assessed indirectly by testing for a decline in diversity with decreasing fragment size and/or isolation[6~8].

The purpose of the precent investigation was to investigate diversity patterns in a fragmented forested landscape. It was conducted on sloping six plots (100 x 100 m plots) that was representative of the three fragmented forests, where the canopy has well developed. What is the nature of floristic diversity and

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species richness patterns generally, and what are the effects of habitat fragmentation? We examined trees and understory species separately, to examine the relationship between floristic diversity patterns and plant life forms.

2. Methods

2.1. Study area

The Saengbiryang-myeon is located in the Sanseong-gun in Gyeongsangnam-do, Korea (35°15'22"N, 128°03'05") (Fig. 1). The three forests in this areas are all highly fragmented. The topography is gently sloping in the lower and middle altitudes, and rather steep at higher altitude. The areas were typically developed and truly *Pinus densiflora* (Pinaceae) (A) and old-growth evergreen broad-leaved *Quercus mongolica* (Fagaceae) (C) forests. The site B is located between Sites A and C and planted *Castanea crenata.*

2.2. Data analysis

Within each forest fragment, two placed 100 x 100 m plots per site were set up on the site with the most developed canopy and were completely censussed for all trees with a diameter at breast height (DBH) $\geq$ 10 m.

For the second part of this study, quadrate analyses were completely censussed non-tree vegetation (herbs plus shrubs). Plots were positioned along running from edge to interior. Numbering and measuring the individuals was done systematically, with plants being marked to avoid re-censussing.

Analysis of variance and least significant differences post hoc tests were used with SYSTAT 9 to compare results among forest fragments[3].

The Shannon-Weiner index of diversity was used to measure species richness and abundance[9,10]. It was calculated as:

$$H' = -\sum_{i=1}^{s} (pi)(\ln pi)$$

where s is the total number of species and *pi* is the proportion of all individuals in a sample that belong to the *i*th species.

Species diversity may be thought of as being composed of two components. The first is the number of species in the community, which ecologists often refer to as species richness. The second component is species evenness or equitability. Two well-known richness indices are as follows: R1 and R2 indices[11].

$$R1 = \frac{s-1}{\ln(n)}$$

$$R2 = \frac{s}{\sqrt{n}}$$

s: the total number of species in a community, *n*: the total number of individuals observed.

The common evenness indices used by ecologists

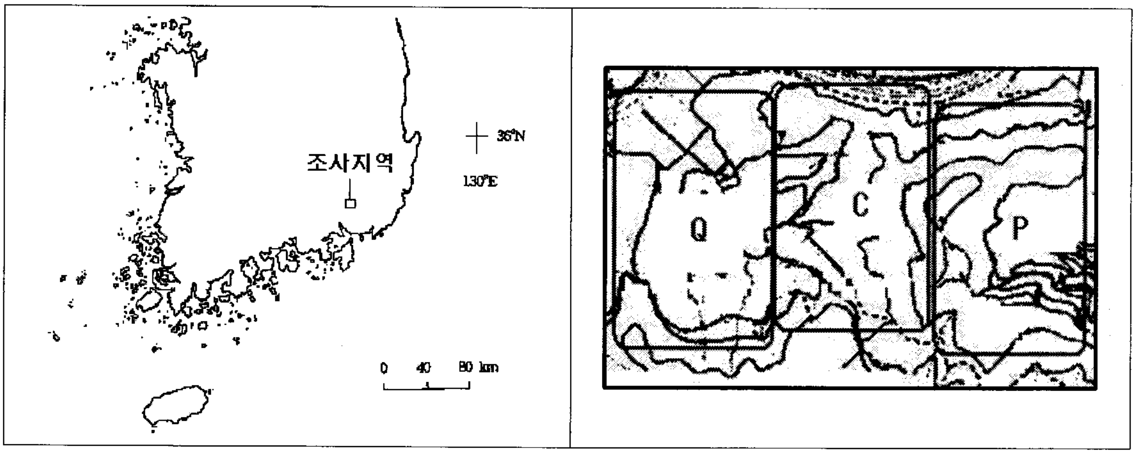

Fig. 1. Map showing sampled sites.
Q: *Quercus mongolica* community, C: *Castanea crenata* community, P: *Pinus densiflora* community.

are E1-E5[12]).

Jaccard's coefficient (J) of similarity for six 100 x 100 m plots was used to compare the number of species shared between plots in different shared fragments.

J = number of shared species between plot A and plot B / number of species in plot A + number of species in plot B.

3. Results

Overall across the fragments, total 410 plants were identified and measured in the six 100 x 100 m plots. These were a total of 28 species and 13 families present in the three sites (Table 1). There were 12 understory species in all forest plots of three sites. Average density (tree per plot) differed significantly among fragments ($F = 19.44$, $p < 0.001$). Mean number of species per plot differed significantly among the three fragments ($F = 11.26$, $p<0.01$). Mean number of families per site varied between 2 (site B) and 9 (sites A and C), giving a total of 13 over all sites. Shannon-Wiener functions differed significantly among forests ($F = 5.34$, $p<0.05$), with site C forest having significantly higher value (2.360) than the others (0.121) for site B and 1.087 for site A) (Table 1). The richness indices R1 and R2 were shown a significant differences among three sites. varying from 0.187 to 2.367. The evenness indices except E2 and E4 were shown a significant differences among three sites.

Least significant differences (LSD) post hoc analysis for stem and leaves revealed that fragments site A and C had significantly greater than densities than site B (Fig. 2). Post hoc LSD tests for branches showed that there are not a significant difference among three sites.

Two pine species, *P. densiflora* and *P. thunbergii*, were typical on sub-sites A-1 and A-2. The most common species in the site A forest *P. densiflora*, according for 65.4% of the individuals sampled in 100 x 100 m plots.

In marked contrast, the most common tree species in the site B and C fragments were *C. crenata* and *Q. mongolica* accounted for 98.1% and 37.44%, respectively.

Restricting analysis gradually to higher dominant species, the dependency of species variance on environmental factors was still variances a little more. When we restricted the species to more than 5% in dominance (10 species), the first axis explained 12.8% of the species variation (data not shown).

The comparison of the three sites as in Table 2 reveals striking differences in degrees of green naturality. The grade <7> of the sites A and C was significantly higher than for *C. crenata* dominant the site (B). The sum of plant biomass and net production by degree of green naturality in the site B was lower than in both

Table 1. Diversity, richness, and evenness indices at the three communities

		Pinus	*C. crenata*	*Quercus*	Total
No. of trees		136	115	159	410
No. of species		10	3	22	28
No. of families		9	2	9	13
Mean no. of trees per plot		22.6	26.5	30.4	ns
Mean no. of species per plot		3.5	1.1	5.5	***
Mean no. of families per plot		3.0	1.0	3.0	ns
Shannon-Weiner index		1.087	0.121	2.360	**
Richness index	R1	1.628	0.211	2.367	***
	R2	0.772	0.187	1.031	***
Evenness index	E1	0.495	0.174	0.920	*
	E2	0.330	0.564	0.815	*
	E3	0.246	0.128	0.799	***
	E4	0.653	0.934	0.911	*
	E5	0.476	0.421	0.902	**

*, **, and ***: Significant at the 0.05, 0.01, and 0.001 levels, respectively.
ns : Non-significant.

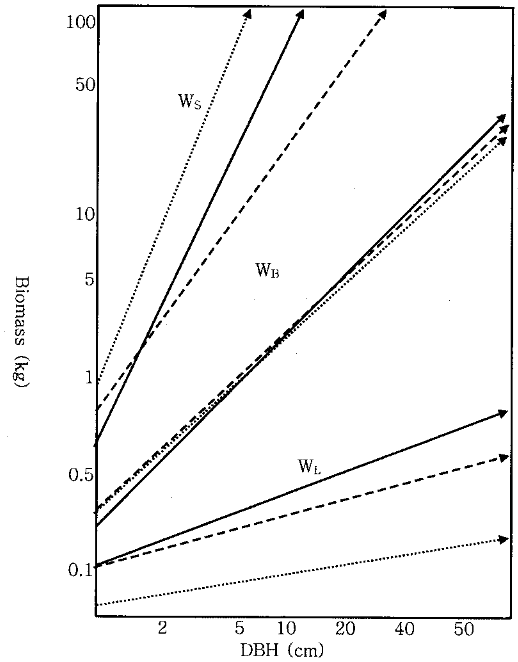

Fig. 2. The relative growth of each part of plant and diameter of breast height (DBH). W_S: Weight of stem, W_B: Weight of branches, W_L: Weight of leaves. —: *Pinus densiflora*, -----: *Quercus mongolica*, ··········: *Castanea crenata*

the site A with *P. densiflora* and the site C (*Q. mongolica*) (Table 3).

Jaccard's coefficient (*J*) of similarity for six plots was used to evaluate relatedness among sub-sites. The estimate of *J* ranged from 0.717 to 0.998 (Table 4).

4. Discussion

Many studies on plants in fragmented habitats have focused primarily on the relationship between species diversity and fragment size and isolation[6,7,13)]. In general, those or these their studies indicate that larger fragments have greater diversity than smaller fragments[13)]. However, differences in diversity cannot always be attributed to fragmentation per se; this relationship is often a result of greater environmental heterogeneity in larger fragments, and that the influence of successional stage and site history can be more important than fragment size[7)]. Other problems limit the utility of these studies as well: sample sizes are often small, inappropriate controls are used by necessity, and juvenile trees are usually considered an indication of future canopy composition, an inference that does not allow for differential mortality rates among species[3,14)]. Moreover, none of these studies provide direct evidence supporting the principal prediction that has emerged from theoretical work on habitat fragmentation that populations are more likely to become extinct in fragmented habitats[15)].

In this study, fragment size was not related directly to estimates of recruitment for several tree species. However, smaller habitat that is consisted of a greater proportion of edge habitat that is unsuitable for outcrossing mating system species than inbreeding species and larger fragments[16)]. Accurately determining the distance into forests that is unsuitable for all species is

Table 2. Degree of green naturality in investigated areas

Community	Grade	Number of quadrat	Area(m^2)	Rate(%)	No. species
Pinus	<1>	1.25	500	0.9	0
	<5>	2.50	1,000	1.8	5
	<6>	5.75	2,300	4.2	1
	<7>	121.50	48,600	89.3	3
	<8>	5.00	2,000	3.7	2
	Total	136.00	54,400	100.0	9
Castanea crenata	<1>	4.50	1,800	3.3	0
	<3>	131.50	52,600	96.7	2
	Total	136.00	54,400	100.0	2
Quercus	<1>	1.75	700	1.3	0
	<5>	15.75	6,300	11.6	6
	<6>	0.75	300	0.6	4
	<7>	117.75	47,100	86.6	5
	Total	136.0	54,400	100.0	13

Table 3. Plant biomass and net production by degree of green naturality

Community	Grade	Biomass (ton)	Total	Net production (ton/yr)	Total
Pinus	<1>	0.255	326.895	0.115	32.387
	<5>	2.320		0.730	
	<6>	15.318		2.760	
	<7>	295.002		27.702	
	<8>	14.000		1.080	
Castanea crenata	<1>	0.918	131.366	0.414	49.858
	<3>	130.448		49.444	
Quercus	<1>	0.357	302.868	0.161	31.967
	<5>	14.616		4.599	
	<6>	1.998		0.360	
	<7>	285.897		26.847	

Table 4. Jaccard's coefficient of similarity (below diagonal) and t-tests (above diagonal) among forest plots

Plot	A-1	A-2	B-1	B-2	C-1	C-2
A-1	-	ns	**	**	*	ns
A-2	0.992	-	**	***	*	*
B-1	0.784	0.729	-	ns	**	*
B-2	0.726	0.717	0.982	-	*	**
C-1	0.840	0.781	0.745	0.677	-	ns
C-2	0.859	0.755	0.970	0.741	0.998	-

*, **, ***, and ns: Same as Table 1.

not yet possible and would require better projections for populations using measures of mortality and survivorship over multiple years. Still, these is a marked reduction in recruitment at site near edges.

A total of 28 species occurred at an abundance in only natural sites (A and C) (Table 1). Among understory species, most species were also found at abundance in natural forests.

Considering just the most common species, the community comparison of the fragments is strikingly different. The site A is primarily a *P. thunbergii* forest, whereas the site C fragments are all dominant by *Q. mongolica*. Three rare species appeared in the only site A: *Pyrola japonica*, *Styrax japonica*, and *Chionanthus retusa*. No unique species was found in B except *C. crenata*.

The spatial distribution in the Saengbiryang-myeon in Gyeongsangnam-do is very heterogeneous and reflects by most species having patchy distributions. In addition there were significant differences among the three forest fragments in this study in terms of Shannon-Weiner index of diversity, number of trees, species richness, family richness, species evenness, species composition, plant biomass, net production.

In recent year, we have come to recognize that farmland is ecological systems, too. If ecology is the relationship between organisms and their environment, what could be more ecological than studying how humans impact other species and our environment? Although the *C. crenat* community at Saengbiryang-myeon is not very large and is not serious environmental destroy in forest, however, we consider that chestnuts are not provided a nutritions to poor children.

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