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Vegetation Structure of Mountain Ridge in Midongsan, Chungcheongbuk-do

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Abstract - The Purpose of this study was to offer the raw data for drawing up the conservation plan by analysing natural vegetation in Midongsan, Chungcheongbuk-do, Korea. The period of survey was from July to October, 2004 and the size of plot was 100㎡. In the results of analyzing the physical environments, the range of altitude was 303~550m and soil pH was 5.4~6.8. The angle of slope was 3~57% and topographical factor was composed of ridgeline. In the results of analyzing a importance percentage, the dominant species in tree layer, *Pinus rigida, P. densiflora, Quercus mongolica, Q. variabilis and Q. acutissima, P. rigida, Q. mongolica, Q. acutissima, Platycarya strobilacea* and *Q. variabilis* in subtree layer, *Rhododendron mucronulatum, Symplocos chinensis* for *pilosa, Lindera obtusiloba, L. erythrocarpa, Rhus trichocarpa* and *Weigela subsessilis* in shrub layer. In the results of species diversity index, species diversity (H') was from 1.2401 to 2.5540, maximum species diversity (H'max), from 1.9459 to 2.8904, evenness (J'), from 0.5644 to 0.8836, dominance (D), from 0.1164 to 0.4356.

Key words - Natural vegetation, Environment, Dominant species, Species diversity

Introduction

The Korean peninsula belongs to the temperate region. Because the diverse plant species distribute in all area, the Korean peninsula has the excellence of biodiversity. However, in the results of an indiscreet development of land since 1960, the shapes and attributes of a forest ecosystem were transformed and fragmented. Finally, these environmental problems leaded to a ecological imbalance. As such a forest ecosystem has the diverse organism and is formed by producer, consumer and decomposer, this is a very important ecosystem. And, a forest is the origin of offering the natural resources and the indispensable space in a human and organisms. Midongsan (561m) is located in Miwon-myun, Cheongwon-gun, Chungcheongbuk-do and the spatial coordinates are in 127 degrees 41 minutes of east longitude and 36 degrees 37 minutes of north latitude. In case of Midongsan and its environs, this site is bounded by Geosan-gun on the north and Boeun-gun on the east, and the major mountains are Wunwunsan (593m) and Jwagusan (657m). The topographical characteristics are the steady hill area with centering around a valley in northeast and the mean angle of slope is under 30%. As this site is the middle inland climate, the generally annual climate outlooks are 12.0℃ in mean temperature, 1225.1mm in rainfall, 71.0% in mean humidity, 17.8℃ in max. temperature and 7.0℃ in min. temperature. Because the condition of environment is a suitability of growing a plant, this site is in good ecosystem (Kim, 2002). Chungcheongbuk-do Forest Environment Research Institute is located in Midongsan. As the arboretum is located, many people visit this site all the year round. In spite of many uses and the pressures of environment, the natural ecosystem is in good condition because of designating the provincial forest.

Therefore, the purpose of this study is to establish the conservation plan of natural vegetation by surveying and analysing the vegetation structure around Midongsan.

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Materials and Methods

Method of survey

The condition of field was grasped by a preliminary investigation in July, 2004, on the basis of this result, we accomplished the vegetation survey, October, 2004. The spots of survey were a mountain ridge connecting the peak of Midongsan and set up twenty plots (Fig. 1).

The positional information of plot was obtained that using GPS (GeoExplore, USA). The size of quadrate was 10×10m (100㎡). The factors of physical environment were altitude, aspect, angle of slope, soil pH and soil hardness. The vegetation survey was

Fig. 1. The map of surveyed plots.

inspected by stratum layer; tree layer (over 8m of height, over 2cm of diameter), subtree layer (3～8m, over 2cm) and shrub layer (below 3m, below 2cm) (Park *et al.*, 2002). The items surveyed by stratum layer were the name of species, plant height, plant width and diameter. The field notes were made out in the spot. After a partial data were simply recorded, those were calculated in a laboratory. The classification of species put Lee (1980) to use.

Method of analysis

In basis of raw data, we calculated I.P. (Importance Percentage) by stratum layer (Curtis and McIntosh, 1951), this result was as follow. I.P. = (relative density+relative coverage+relative frequency)/3. For assessing the species diversity, we used species diversity index (H'), max. species diversity index (H'max), evenness (J') and dominance (D). Especially, H' and H'max were adopted a natural logarithms (Shannon and Wiener, 1949). To examine the similarity between tree species and ecological niche, we accomplished Pearson's correlation analysis about major species using statistical program. The sectioned drawing of vegetation was described using AutoCAD 2006.

Results and Discussion

Flora

In tree layer, *Quercus mongolica, Q. variabilis, Pinus densiflora* and *P. rigida* those were observed. In subtree and shrub layer, *Prunus sargentii, Lindera obtusiloba, Symplocos chinensis* for. *pilosa, Rhododendron mucronulatum* and *Rhus chinensis* those were surveyed. The species surveyed in herbaceous layer were *Chrysanthemum zawadskii* var. *latilobum, Aster ageratoides, Atractylodes japonica, Leibnitzia anandria, Senecio integrifolius* var. *spathulatus, Pteridium aquilinum* var. *latiusculum, Miscanthus sinensis, Carex lanceolata, C. siderosticta, Allium thunbergii, Iris rossii, Hepatica asiatica, Sedum kamtschaticum* and *Pyrola japonica* etc.

Physical environment

Table 1 is the summary on the physical environment by plots. The range of altitude was from 303m to 550m. In the angle of slope, Plot 1 and 2 were from 3% to 6%, but the other plots are from 13% to 57%. In the results of slope analysis, the gentle and steep slopes

Table 1. The physical environment of the surveyed plots

plot	soil pH (pH)	soil hardness (kg/cm²)	slope (%)	altitude (m)	plot	soil pH (pH)	soil hardness (kg/cm²)	slope (%)	altitude (m)
1	5.4	3.5	3	303	11	5.8	1.2	25	464
2	5.5	1.5	6	322	12	6.0	1.0	34	502
3	6.2	1.2	15	407	13	6.2	1.0	57	540
4	6.4	1.0	13	438	14	6.8	0.5	43	540
5	6.3	1.0	19	447	15	6.5	0.5	21	550
6	6.7	1.9	22	444	16	6.8	0.9	20	517
7	6.2	0.8	46	440	17	6.5	1.5	18	472
8	6.4	2	38	480	18	6.5	0.5	39	414
9	6.5	2.2	27	450	19	6.6	2.8	25	373
10	6.2	1.5	48	444	20	6.5	1.4	24	332

showed a tendency to be different to mountain ridge. As a soil pH was from pH 5.4 to pH 6.8, that showed the characteristics of sub-acidity and neutrality. When it compared with the mean soil pH 5.5 of Korean forest (Shin *et al.,* 2002), it wasn't high acidity.

Importance percentage

The results of the importance percentage of major tree species and by stratum layer were summarized like table 2. From plot 1 to plot 3, *Pinus rigida* was dominant in tree layer and the I.P. of this was 100.0% and 48.35%. In case of plot 1, subtree layer didn't exist. The I.P. of *P. rigida* and *Quercus mongolica* were 100.0% and 55.47% in plot 2 and 3. In case of shrub layer, the I.P. of *Rhododendron muncronulatum* were 47.53%, 31.22% and 54.44%. *P. rigida* was planted for afforestation for erosion control. The species diversity of an afforested land was lower than natural land.

Especially, the plant width of a needle-leaf tree obstruct the introduction of other species. Therefore, we will thin out in the long term to grow a natural vegetation. In case of plot 4, 5 and 6, the ecological niches of *P. densiflora* were the highest, the I.P. were 52.0%, 51.78% and 46.81%. The dominant species in subtree layer were *P. densiflora* (plot 4, I.P. = 39.19%), *Quercus acutissima* (plot 5, I.P. = 25.64%) and *Q. mongolica* (plot 6, I.P. = 29.48%). *Rhododendron muncronulatum* and *Symplocos chinensis* for. *pilosa* were dominant in shrub layer. From plot 7 to plot 10, *P. densiflora* was dominant in tree layer. The I.P. was from 39.63% to 66.25%. In subtree layer, the I.P. of *Platycarya strobilacea* were 17.66%, 46.59% and 48.71%. The dominant species in shrub layer were *S. chinensis* for. *pilosa* (I.P. = 22.31%), *Lindera obtusiloba* (I.P. = 27.72%) and *L. erythrocarpa* (I.P. = 44.89%). From plot 11 to plot 20, *Q. mongolica* had a strong sphere of influence, the range of I.P. was from 26.55% to 60.02%. In tree layer, *Q. mongolica* was dominant as a whole except for plot 16 and 17. The dominant species of plot 16 and 17 were *Q. variabilis and Q. acutissima*. The dominant species of shrub layer were *S. chinensis* for. *pilosa, Lindera obtusiloba, Rhus chinensis, Weigela subsessilis* and

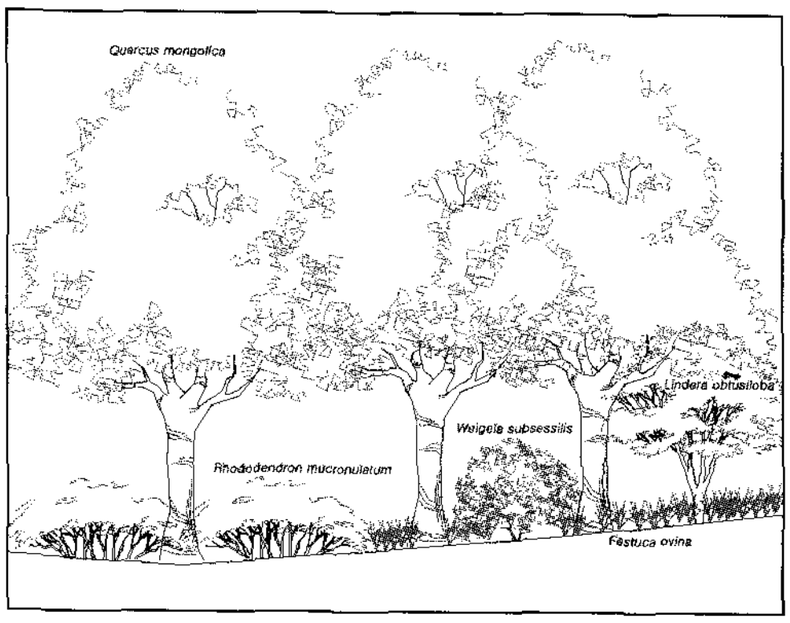
Table 2. The importance percentage of major woody species by surveyed plots

plot	1	2	3	4	5	6	7	8	9	10
T[a]	*Pr*[d] (100.00)[e]	*Pr* (100.00)	*Pr* (48.35)	*Pd* (52.00)	*Pd* (51.78)	*Pd* (46.81)	*Pd* (39.63)	*Pd* (66.25)	*Pd* (55.11)	*Pd* (63.02)
Others	0.00	0.00	51.65	48.00	48.22	53.19	60.37	33.75	44.89	36.98
ST[b]	-	*Pr* (100.00)	*Qm* (55.47)	*Pd* (39.19)	*Qa* (25.64)	*Qm* (29.48)	*Ps* (17.66)	*Ps* (46.59)	*Qv* (23.46)	*Ps* (48.71)
Others	-	0.00	44.53	60.81	74.36	70.52	82.34	53.41	76.54	51.29
S[c]	*Rm* (47.53)	*Rm* (31.22)	*Rm* (54.44)	*Rm* (47.80)	*Sc* (35.77)	*Rm* (39.11)	*Sc* (22.31)	*Lo* (27.72)	*Lo* (19.86)	*Le* (44.89)
Others	52.47	68.78	45.56	52.20	64.23	60.89	77.69	72.28	80.14	55.11

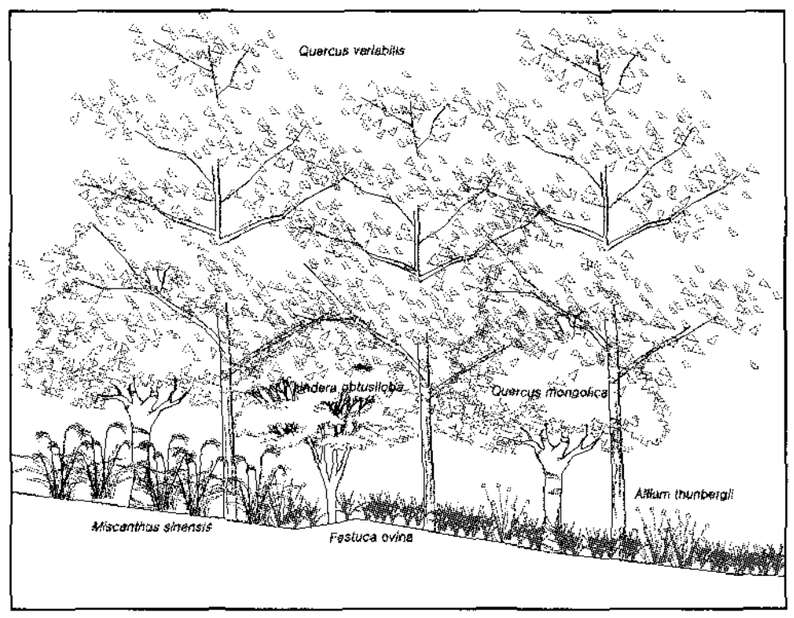
plot	11	12	13	14	15	16	17	18	19	20
T[a]	*Qm*[d] (33.86)	*Qm* (66.51)	*Qm* (79.24)	*Qm* (38.49)	*Qm* (43.66)	*Qv* (27.44)	*Qa* (38.88)	*Qm* (53.22)	*Qm* (51.32)	*Qm* (36.29)
Others	66.14	33.49	20.76	61.51	56.34	72.56	61.12	46.78	48.68	63.71
ST[b]	*Qm* (26.25)	*Qm* (44.50)	*Qm* (45.45)	*Qm* (55.79)	*Qm* (60.02)	*Qm* (27.11)	*Qm* (54.08)	*Qm* (45.08)	*Qm* (37.96)	*Qm* (53.08)
Others	73.75	55.50	54.55	44.21	39.98	72.89	45.92	54.92	62.04	46.92
S[c]	*Sc* (23.78)	*Lo* (30.22)	*Rt* (22.35)	*Lo* (30.95)	*Ws* (23.10)	*Lo* (19.13)	*Lb* (33.87)	*Lo* (21.10)	*Sc* (20.19)	*Lo* (15.81)
Others	76.22	69.78	77.65	69.05	76.90	80.87	66.13	78.90	79.81	84.19

[a] Tree layer; [b] Subtree layer; [c] Shrub layer; [d] Dominant species; [e] Importance percentage.

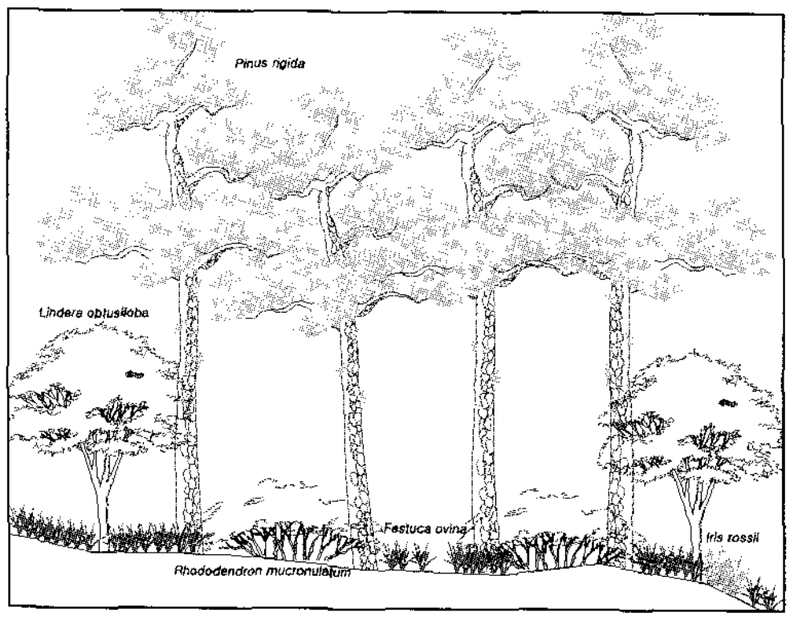
[d] *Pr: Pinus rigida; Pd: Pinus densiflora; Ps: Platycarya strobilacea; Qm: Quercus mongolica; Qv: Quercus variabilis; Qa: Quercus acutissima; Rm: Rhododendron mucronulatum; Sc: Symplocos chinensis* for. *pilosa; Lo: Lindera obtusiloba; Rt: Rhus trichocarpa; Ws: Weigela subsessilis; Lb: Lespedeza bicolor; Le: Lindera erythrocarpa.*



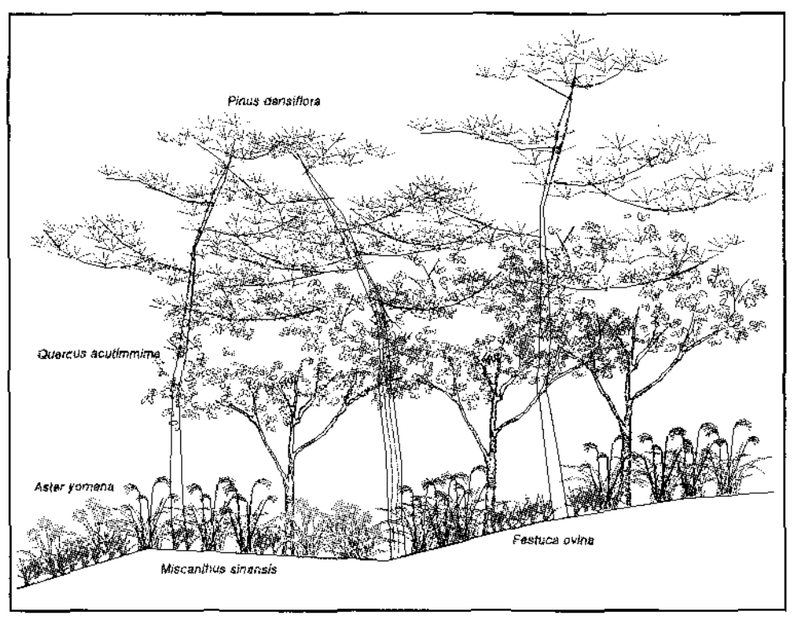
a) *Quercus mongolica* community



b) *Quercus variabilis* community



c) *Pinus rigida* community



d) *Pinus densiflora* community

Fig. 2. The sectioned drawing of vegetation in major community.

Lespedeza bicolor. As *Q. mongolica* mainly distributed in Midongsan, this was a typical species in the vegetation of mountain ridge. This species was dominant in high altitude and around a peak, and distributed from a middle area to a peak (Lee and Yun, 2002; Lim *et al.,* 2003). Therefore, *Q. mongolica* was a typical vegetation of mountain ridge. Also, because the oak trees help to decompose the forest soil and organic matter, they give the benefits to soil microorganism (Skov and Svenning, 2003). And the possibility of appearing the rare plants is high in the sound ecosystem like Midongsan. To preserve the forest, we will carry out to do the time-series study and monitoring of changing a enviroment. The sectioned drawings of major community are Fig. 2.

Finally, to conserve the ecosystem of Midongsan, we will establish a suitable plan about a development and conservation to be endowed with a DVC (Degree of Vegetation Conservation) by overlapping the degree of green naturality, the map of ecological naturality and actual vegetation. And, we try to find the plan of forest management like a cutting for promoting a species composition.

Species diversity

The results of species diversity by plots were like Table 3. The range of species diversity index (H') was from 1.2401 to 2.5540, from 1.9459 to 2.8904 in max. species diversity index (H'max), from 0.5644 to 0.8836 in evenness (J') and from 0.1164 to 0.4356 in dominance (D). The ranges of H' in other sites were from 0.7430 to 1.3025 in Mt. Suri (Lee *et al.,* 1997), from 0.5981 to 0.8047 in Gittaebong~Cheongoksan (Choo *et al.,* 2002), from 0.9274 to 1.2845 in Nogodan~Goribong (Kim and Choo, 2003), and from 1.5315 to 2.4005 in Gajisan~Neungdongsan (Kim and Choi, 2004). In comparison with Midongsan, it was higher than other sites. Therefore, the species of compositions were diverse and stable in the side of vegetational community.

Especially, H' and H'max were the highest in plot 7. Because the plot 7 was many species and individuals per the unit area, this was the diversity and stability of community (Lee *et al.,* 1995; Choi and

Table 3. The results of species diversity by plots

Plot	H'	H'max	J'	D	Plot	H'	H'max	J'	D
1	1.4771	1.9459	0.7591	0.2409	11	2.3513	2.7726	0.8480	0.1520
2	1.2401	2.1972	0.5644	0.4356	12	1.6052	2.1972	0.7306	0.2694
3	1.5873	2.3979	0.6620	0.3380	13	1.8138	2.1972	0.8255	0.1745
4	1.8249	2.3979	0.7610	0.2390	14	2.3086	2.7081	0.8525	0.1475
5	2.2274	2.7081	0.8225	0.1775	15	2.0176	2.0326	0.8762	0.1238
6	2.1405	2.4849	0.8614	0.1386	16	2.1895	2.5649	0.8536	0.1464
7	2.5540	2.8904	0.8836	0.1164	17	2.0053	2.3979	0.8363	0.1637
8	1.9272	2.4849	0.7756	0.2244	18	1.9211	2.5649	0.7490	0.2510
9	2.4093	2.7726	0.8690	0.1310	19	1.9877	2.5649	0.7750	0.2250
10	1.9230	2.3026	0.8351	0.1649	20	2.2853	2.6391	0.8659	0.1341

H' : Species diversity; H'max: Maximum species diversity; J' : Evenness; D' : Dominance.

Oh. 2003). The evenness is a relative species diversity. When this is 1, a individual by species is a uniform condition. As the evenness of plot 7 was 0.8836, this was the highest among the other plots. But this of plot 2 was the lowest. In case of plot 7, a individual by species was uniform, but plot 2 was ununiform. Because of high species diversity in this sites, the act of development will be restricted. And we will try to find a plan for conservation of vegetation introducing a rest year to prevent a soil hardening and vegetation disturbance.

Relativity

The relativity plays an important role in deciding the ecological characteristics, and is used to examine the distribution of species and condition of environment. Table 4 is the result of analysis on species relativity between individual and frequency of major species. The numbers of case on species relativity were 8; *Pinus*

Table 4. Correlation analysis between major woody species

	sp.1	sp.2	sp.3	sp.4	sp.5	sp.6	sp.7	sp.8	sp.9	sp.10	sp.11	sp.12	sp.13	sp.14
sp.1	1													
sp.2	-0.147	1												
sp.3	-0.298	-0.197	1											
sp.4	-0.338	0.179	0.216	1										
sp.5	0.520*	0.222	-0.236	-0.348	1									
sp.6	0.292	0.262	0.263	-0.271	0.203	1								
sp.7	-0.343	0.379	-0.059	0.053	0.061	0.116	1							
sp.8	-0.099	-0.220	-0.016	0.097	-0.183	-0.174	-0.094	1						
sp.9	-0.294	-0.344	-0.068	-0.231	-0.341	-0.122	0.064	0.266	1					
sp.10	-0.410	-0.239	-0.263	-0.451*	-0.157	-0.056	0.040	0.052	0.456*	1				
sp.11	-0.264	-0.025	-0.079	-0.208	-0.404	-0.226	-0.073	-0.166	0.082	0.392	1			
sp.12	-0.245	-0.397	0.587**	0.095	-0.156	0.371	-0.232	-0.141	-0.227	0.011	0.147	1		
sp.13	-0.363	-0.127	0.358	0.541*	-0.537*	0.033	-0.240	0.212	-0.232	-0.216	0.032	0.409	1	
sp.14	-0.207	0.448*	-0.204	0.534*	-0.328	-0.390	0.095	0.261	0.104	-0.104	-0.101	-0.355	0.075	1

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

sp.1: *Pinus rigida*; sp.2: *Rhus trichocarpa*; sp.3: *Symplocos chinensis* for. *pilosa*; sp.4: *Quercus mongolica*; sp.5: *Rhododendron mucronulatum*; sp.6: *Quercus serrata*; sp.7: *Quercus variabilis*; sp.8: *Prunus sargentii*; sp.9: *Quercus acutissima*; sp.10: *Pinus densiflora*; sp.11: *Platycarya strobilacea*; sp.12: *Fraxinus rhynchophylla*; sp.13: *Lindera obtusiloba*; sp.14: *Rhus chinensis*.

rigida and *Rhododendron muncronulatum, Rhus chinensis* and *R. trichocarpa, Symplocos chinensis* for. *pilosa and Fraxinus rhynchophylla, Quercus mongolica* and *Lindera obtusiloba, Q. mongolica* and *R. chinensis, Q. acutissima* and *P. densiflora, Q. mongolica* and *P. densiflora, Rhododendron muncronulatum* and *L. obtusiloba.* The results of this analysis were to examine the growth environment of species and to grasp the similarity by species.

Literature Cited

Choi, S.H. and K.K. Oh. 2003. Vegetation structure of mountain ridge form Jeongryeongchi to Bokseongijae in the Baekdudaegan. Kor. J. Env. Eco. 16(4): 421-432 (in Korean).

Choo, G.C., G.T. Kim and J.O. Kim. 2002. Studies on the structure of forest community at the ridge from Gittaebong to Cheongoksan. Kor. J. Env. Eco. 15(4): 354-360 (in Korean).

Curtis, J.T. and R.P. McIntosh. 1951. An upland forest continuum in the prairie-forest border region of Wisconsin. Ecology 32: 476-496.

Kim, H. 2002. Design of midongsan ecological park. Journal of the Korean Institute of Landscape Architecture 30(5): 89-97 (in Korean).

Kim, G.T. and G.C. Choo. 2003. Vegetation structure of mountain ridge from Nogodan to Goribong in Baekdudaegan, Korea. Kor. J. Env. Eco. 16(4): 441-448 (in Korean).

Kim, D.P. and S.H. Choi. 2004. Vegetation structure of mountain ridge from Goribong to Neungdongsan in the Nakdong-Jeongmaek. Kor. J. Env. Eco. 18(3): 279-287 (in Korean).

Lee, B.C. and C.W. Yun. 2002. A study on community classification of forest vegetation in Mt. Naeyeon. Korean J. Ecol. 25(3): 153-161 (in Korean).

Lee, K.J., W. Cho and B.H. Han. 1995. A study on the planning methods of urban environmental forest for considering ecological characteristics(Ⅰ)-in the case of Gaepo neighborhood park in the Seoul city-. Journal of the Korean Institute of Landscape Architecture 23(3): 48-58 (in Korean).

Lee, K.J., S.H. Min, B.H. Han and H.S. Kim. 1997. Plant community structure analysis in Gunpo experimental forest of Mt. Suri, Kyonggi-do. Kor. J. Env. Eco. 11(3): 290-309 (in Korean).

Lee, T.B. 1980. Illustrated Flora of Korea. Hyang-Mun Publishing Co, Seoul. pp. 990 (in Korean).

Lim, D.O., Y.S. Kim, Y.K. Park and Y.M. Ryu. 2003. Vascular plants of Manbodea, Goribong and Sujeongbong in the Backdudaegan. Kor. J. Env. Eco. 16(4): 387-403 (in Korean).

Park, S.B., S.K. Kim, J.C. Nam, S.H. Kim, Y.J. Kang and G.C. Yi. 2002. Analysis of the ecological characteristics of vegetation in the area adjacent to Sasang industrial complex in Pusan metropolitan city. Journal of the Korean Institute of Landscape Architecture 30(1): 75-86 (in Korean).

Shannon, C.E. and W. Wiener. 1949. The mathematical theory of communication. Science 185: 27-39.

Shin, H.C., N.C. Park, H.K. Song, Y.G. Jeong, J.C. Choi, Y.H. Ykwon, K.S. Lee and Y.K. Kim. 2002. Analysis of vegetation structure and vegetation-environment relationships in the *Machilus thunbergii* stands, Korea. Jour. Korean For. Soc. 91(6): 765-774 (in Korean).

Skov, F. and J-C. Svenning. 2003. Predicting plant species richness in a managed forest. Forest Ecology and Management 180: 583-593.

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