

Ecological Characteristics and Distribution of Native *Scrophularia takesimensis* in Ulleung-do Island

Young-Hee Ahn

Department of Applied Plant Science, Chungang University, Ansung 456-756, Korea

(Manuscript received 6 December, 2005; accepted 27 December, 2005)

Scrophularia takesimensis Nakai called "Sum-Hyun-Sam", growing about 1m in high is a perennial plant of Scrophulariaceae. Because the number of these species is very limited in the world, the Ministry of Environment has appointed *S. takesimensis* as a preserved plant. The Korea Forest Service also protects it strictly by the law since *S. takesimensis* is an out-of-the-way plant and possible to be exterminated soon in Korea. Investigation for distribution and ecological characteristics of the habitat for *S. takesimensis* was carried out in Ulleung-do Island. *S. takesimensis* has a tendency to emerged with *Calystegia soldanella* Roem. et Schultb. and *Artemisia japonica* subsp. *littoricola* Kitam. *C. soldanella* community were developed on the dry and well-lighted as east or north facing conditions. *A. japonica* subsp. *littoricola* community have tendency to developed on the properly lighted as west or north facing and well maintained soil or air humidity. *C. soldanella* community were developed on the sandy gravel or gravel and grew with *Farfugium japonicum*, (L.) Kitam., *Lonicera japonica* Thunb., and *Peucedanum japonicum* Thunb.. *A. japonica* subsp. *littoricola* communities were emerged on the rock beds or pile of rocks and grew with *Sedum oryzifolium* Makino, *Sedum takesimensense* Nakai, and *Spergularia marina* (L.) Griseb..

Key Words : Sum-Hyun-Sam, Habitat, Out-of-the-way plant, Ulleung-do Island

1. Introduction

This study was conducted to investigate the native *Scrophularia takesimensis* in Ulleung-do Island for their distribution and ecological characteristics. *S. takesimensis*, called as "Sum-Hyun-Sam", is very rare plant which is only restricted in Ulleung-do Island¹⁾. It is a plant out of 64 endangered plant species designated by department of environment²⁾. The Korea Forest Service designated it as a rare and endangered plant and protect it thoroughly³⁾. *Scrophularia* species are distributed world widely; about 300 species are in Europe and Asia and 12 species are in North and tropical America⁴⁾. Root of *Scrophularia* species are thick and has lots of medicinal ingredients⁵⁾. Its root is called as "Hyun-Sam", its medicinal name, and which is known for its effect of fever subsidence and anti-inflammation. Recently it is used variously as hypertensive depressor, anti-inflammatory agent, pain-

killer, diuretic, and so on. Five species such as *S. takesimensis* are known to natively grow in Korea⁶⁾. However their definite distribution and ecological characteristics of native site is not known at all. There is no information of native site in Ulleung-do Island, so it is not possible to protect and even restoration of *S. takesimensis*. Also there is no knowledge of ecological characteristics of *S. takesimensis*. Therefore it is not possible to utilize it as a useful plant resource because of impracticability to artificial propagation and culture.

There are more than 4,000 native plant species in Korea. However, there are few precedent that various native plants were developed as plant resources. This was due to there is not enough study of native plants in wild situation. There is little scientific report of nation wide distribution of native plants and their native sites. A succeeded to culture native *Hibiscus hamabo* based on the result of ecological research⁷⁾. However there is few results of ecological research which enable to develop native plants to valuable resources⁸⁻¹⁰⁾. Therefore we investigated the distribution of *S. takesimensis* and ecological characteristics of native site in

Corresponding Author : Young-Hee Ahn, Department of Applied Plant Science, Chungang University, Ansung 456-756, Korea

Phone: +82-31-670-3041

E-mail: ahn3041@post.cau.ac.kr

Ulleung-do Island. This may be useful to basic data as protect and restoration of native sites and culture it as a plant resource.

2. Materials and Methods

This study was carried out in the area of Ulleung-do Island, Ulleung-gun county, Kyung-sang-pook-do province, native site of *S. takesimensis*. It was carried out from June to September 2005. Investigation plots were established quadrat on the herb layer including *S. takesimensis*. Areas of the quadrates were 5x10m ~ 3x8m which represent the ecological characteristics of native sites¹¹⁾. Coverage, sociability, height of vegetation, and cover of vegetation of emerging plants were investigated¹²⁾. Exact location points were decided by GPS(global position system, GPSIII PLUS). Also altitude(Pretel, Alti-D2, USA), degree of slope(Suunto PM-5, Japan), light condition(Delta, OHM HD-8366, France), exposition, soil condition, and so on was investigated. Especially lighting condition was described as percentage comparing the intensity of illumination of native and other sites. The vegetation of native sites were investigated by phytosociological method of Braun-Blanquet^{11,12)}. The communities on native sites were classified through phytosociological table work. Coverage index was represented based on rank of coverage for identify the basal coverage of various plant species emerged on the communities¹³⁾. Species diversity was analyzed through investigation of species and number of plants composing the communities. Species diversity was indicated by Simpson and Shannon-Wiener index¹⁴⁾. Every individual on each sites were inves-

tigated for identifying the growing state of *S. takesimensis*.

3. Results and Discussion

There were eight native sites in all over the island. Every native site were located near the seashore road(Fig. 1). Locations of the native sites were indicated roughly to protect them from indiscretion people(Table 1). Average annual temperature was 11.5°C and annual rain fall was 1955.3mm according to weather data of recent 10 years. It shows typical oceanic climate as average day minimum temperature of January, the coldest month, was 1.6°C and absolute minimum temperature was -11.5°C in 2003.

The native sites were discovered several plants in the small plant communities at the area from 3m to 16m above the sea level in the seashore of Ulleung-do Island. Especially they were observed on the vegetation of rock beds or slopes of seashore

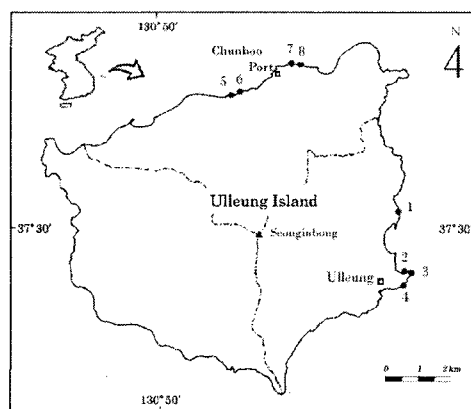


Fig. 1. Sampling station in Ulleung-do Island.

Table 1. The habitat area and number of the individual plant of *Scrophularia takesimensis*

Habitat No.	Place	Latitude	Longitude	Area of Habitat (m2)	No. of Individual plant
1	Ulleung-Gun Ulleung-Eup Jeodong 3-Ri	37° 30' O"	130° 54' O"	36	11
2	Ulleung-Gun Ulleung-Eup Jeodong-Ri	37° 28' O"	130° 55' O"	24	8
3	Ulleung-Gun Ulleung-Eup Dodong-Ri	37° 28' O"	130° 55' O"	18	5
4	Ulleung-Gun Ulleung-Eup Dodong-Ri	37° 28' O"	130° 54' O"	20	8
5	Ulleung-Gun Pook-Myon Choosan-Ri	37° 31' O"	130° 51' O"	40	9
6	Ulleung-Gun Pook-Myon Choosan-Ri	37° 31' O"	130° 51' O"	20	10
7	Ulleung-Gun Pook-Myon Chunboo 2-Ri	37° 32' O"	130° 54' O"	200	14
8	Ulleung-Gun Pook-Myon Chunboo 2-Ri	37° 32' O"	130° 54' O"	40	5

road. Therefore the areas were considered to be damaged by traffic or people repeatedly and artificially or physically affected. These areas were severe areas of competition and selection among plant species. Growth condition and flora of these areas may shift according to level of artificial environmental pressure and management⁷⁾. Therefore we suggest that environmental management should be necessary to conserve genetic resources of *S. takesimensis* growing natively in Ulleung-do Island. Most of native sites were sunny because they were consisted with herbal plants instead of tall trees. Therefore enough lighting should be necessary to artificial culture. Also woody plants should be considered to be removed for protecting native sites. The native sites were close to sea and affected by strong wind. Therefore it may be salt tolerant, strong and sun plants.

The composition of species was investigated with establishment of minimum quadrat plots on the native sites (Table 2). The average vegetation height of herb layer in the native sites was 0.68m and average cover of vegetation of height of vegetation was 30.0%. Average 9.9 species were emerged on a plot. *S. takesimensis* has a tendency to emerge with *Calystegia soldanella* and *Artemisia japonica* subsp. *littorica*. *C. soldanella* community were developed on the dry and well-lighted as east or north facing conditions. *A. japonica* subsp. *littorica* community have tendency to develop on the properly lighted as west or north facing and well maintained soil or air humidity. *C. soldanella* community was developed on the sandy gravel or gravel and grew with *Farfugium japonicum* (L.) Kitam., *Lonicera japonica* Thunb., and *Peucedanum japonicum* Thunb.. *A. japonica* subsp. *littorica* community were emerged on the rock beds or pile of rocks and grew with *Sedum oryzifolium* Makino, *Sedum takesimensis* Nakai, and *Spergularia marina* (L.) Griseb.. Eventually it is considered that *S. takesimensis* favored soil ventilation, adequate humidity and always maintained air humidity. Ahn and Choi¹⁵⁾ already discussed that distribution of native plants and characteristics of the plants were closely related with soil and weather condition of the native sites through the research of ecological study of native *Rhapontica uniflora*.

The analysis of vegetation through table work also reveals that two types of community which are classified by manipulation of phytosociological table⁷⁾.

Particularly in this investigation, 6.7 species were found in the *S. takesimensis* communities accompanying *C. soldanella*. However 11 species were found in the communities accompanying *A. japonica* subsp. *littorica*. The species diversity of *C. soldanella* community including *S. takesimensis* was higher in both Simpson and Shannon-Wiener index than those of *A. japonica* subsp. *littorica* (Table 3). This was probably due to relatively favorable soil conditions of *C. soldanella* community than those of *A. japonica* subsp. *littorica* community. The poor soil conditions of rock bed slopes, *A. japonica* subsp. *littorica* community mostly found, were considered to be unfavorable to general plants¹⁶⁾. The coverage index of each plant species accompanying *C. soldanella* and *A. japonica* subsp. *littorica* communities was in Table 4. The coverage index of *C. soldanella* and *A. japonica* subsp. *littorica*, dominant species on each community, were the highest in each communities. The coverage index of *C. soldanella* in the community was 5625, but that in the *A. japonica* subsp. *littorica* community was 0. Also, the coverage index of *A. japonica* subsp. *littorica* in the *C. soldanella* community was 336.67, but that in the communities was 6250. Eventually, the result of this study shows that classification of plant communities with native *S. takesimensis* was proper.

4. Conclusion

There are 8 sites which identified as native site of *Scrophularia takesimensis*, protected by department of Environment as an endangered species. All the native sites were found near to seashore road in Ulleung-do Island. They are sunny slope near to seashore from 3m to 16m above sea level. It is natively grew several plants in *Calystegia soldanella* or *Artemisia japonica* subsp. *littorica* community. *C. soldanella* community were developed in the coarse sandy slope facing east or south. *A. japonica* subsp. *littorica* community were developed rock bed or coarse gravel soils facing west or north. As the result of vegetation analysis through table work method, there were 2 types of communities classified by phytosociological table. In species diversity, *C. soldanella* community were higher than those of *A. japonica* subsp. *littorica* community. Dominant species of each communities were higher in coverage index.

Table 2. A phytosociological table on the plant community in Ulleung-do Island

Vegetation unit	A*				B				No. of appearance
	1	2	3	4	5	6	7	8	
Running No.	1	2	3	4	5	6	7	8	
No. of relevés	10.5	14.5	13.5	10.9	15.9	5	8	7	8
Altitude(m)	EES	EEN	EEN	EEN	NNW	N	NE	N	3.6
Exposition	23	30	30	78	40	20	20	40	40
Slope(°)	55.8	47.2	47.2	54	56.6	55.5	59.9	63.5	63.5
Air humidity(%RH)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Light intensity	72.72	84.38	84.38	49.1	72.75	60.62	79.33	54.85	54.85
percentage of lighting(%)	sandy gravel	pile of rocks	sandy gravel	Base rock	pile of rocks	Base rock	pile of rocks	pile of rocks	
Soil	gravel	gravel	gravel	rock	gravel	rock	rock	rock	
Quadrat dimension(m)	2X5	2X2	2X4	1X2	2X4	1X2	1X3	1X3	1X3
Height of Herb(m)	0.62	0.6	0.7	0.45	0.8	0.65	0.4	0.5	0.5
Coverage of Herb(%)	70	70	80	60	85	60	50	60	60
No. of Species	12	7	9	12	14	8	7	11	11
<i>Serophytaria takesimensis</i>	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	8
<i>Calysetegia soldanella</i>	4.4	4.4	4.4	3.3					4
<i>Artemisia japonica</i> subsp. <i>littoricola</i>		+		3.3					7
<i>Aster spathulifolius</i> var. <i>oharai</i>	1.1	1.1	+	1.1	4.4	4.4	4.4	4.4	6
<i>Sedum oryzifolium</i>				+		2.2	1.1	1.1	4
<i>Farfugium japonicum</i>		1.1	1.1	2.2		1.1			3
<i>Artemisia princeps</i> var. <i>orientalis</i>	2.2				1.1				2
<i>Artemisia takeshimana</i>	1.1								2
<i>Lonicera japonica</i>	1.1								1
<i>Plantago asiatica</i>	1.1				+				1
<i>Cyrtium falcatum</i>	+			+		+			3
<i>Sonchus oleraceus</i>	+			+					3
<i>Campanula takesimana</i>	1.1						1.1		2
<i>Cheilanthes majus</i> var. <i>asiaticum</i>	+				+				2
<i>Achyranthes japonica</i>	+								2
<i>Lysimachia mauritiana</i>			+	1.1					2
<i>Setaria viridis</i>					+				1
<i>Chenopodium virgatum</i>					+				2
<i>Miscanthus sinensis</i>					+				3
<i>Coccineus trilobus</i>		+				+			2
<i>Pucedanum japonicum</i>									2
<i>Chenopodium album</i>									2
<i>Oxalis corniculata</i>		2.2		+	1.1				1
<i>Arabis stelleri</i> var. <i>japonica</i>				+	+		+		3
<i>Aster gléhai</i>				+					1
<i>Melandryum oldhamianum</i>				+					1
<i>Sedum takesimense</i>						1.1			1
<i>Paederia scandens</i>				+					1
<i>Reynoutria sachalinensis</i>				+					1
<i>Stellaria aquatica</i>				+					1
<i>Spergularia marina</i>				+					1
<i>Aralia cordata</i>				+			1.1		3
<i>Amelopsis heterophylla</i>									+

* Vegetation unit

A : *Calysetegia soldanella* community
 B : *Artemisia japonica* subsp. *littoricola* community

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Table 3. Species diversity of the each vegetation units from Ulleung-do Island

	Simpson' index	Simpson dominance index	Shannon's-wiener's index
A*	0.877	0.123	1.1141
B	0.849	0.151	1.0738

* Vegetation unit

A : *Calystegia soldanella* community

B : *Artemisia japonica* subsp. *littorica* community

Table 4. Composition of the coverage index of major species among the vegetation units in Ulleung-do Island

	A*	B
<i>Scrophularia takesimensis</i>	500	500
<i>Calystegia soldanella</i>	5625	.
<i>Artemisia japonica</i> subsp. <i>littorica</i>	336.67	6250
<i>Aster spathulifolius</i> var. <i>oharai</i>	336.67	916.67
<i>Sedum oryzifolium</i>	10	336.67
<i>Farfugium japonicum</i>	916.67	.
<i>Artemisia princeps</i> var. <i>orientalis</i>	1750	500
<i>Dystaenia takesimana</i>	500	500
<i>Lonicera japonica</i>	500	.
<i>Plantago asiatica</i>	500	10
<i>Cytomium falcatum</i>	10	10
<i>Sonchus oleraceus</i>	10	10
<i>Campanula takesimana</i>	500	500
<i>Chelidonium majus</i> var. <i>asiaticum</i>	10	10
<i>Achyranthes japonica</i>	255	.
<i>Lysimachia mauritiana</i>	10	.
<i>Setaria viridis</i>	10	10
<i>Chenopodium virgatum</i>	10	10
<i>Miscanthus sinensis</i>	10	10
<i>Cocculus trilobus</i>	10	10
<i>Peucedanum japonicum</i>	1750	.
<i>Chenopodium album</i>	10	500
<i>Oxalis corniculata</i>	10	10
<i>Arabis stelleri</i> var. <i>japonica</i>	10	.
<i>Aster glehni</i>	10	10
<i>Melandryum oldhamianum</i>	.	500
<i>Sedum takesimense</i>	.	10
<i>Paederia scandens</i>	.	10
<i>Reynoutria sachalinensis</i>	.	10
<i>Stellaria aquatica</i>	.	10
<i>Spergularia marina</i>	.	173.33
<i>Aralia cordata</i>	.	10
<i>Ampelopsis heterophylla</i>	.	10

* Vegetation unit

A : *Calystegia soldanella* community

B : *Artemisia japonica* subsp. *littorica* community

Acknowledgement

This research was supported by the academic funding of Chung-Ang University.

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