

Study of Habitat Environment and Species Diversity-based on Alien Plant, *Phytolacca americana* L. in Korea

Dong-Hui Choi, Tae-Bok Ryu, DeokKi Kim, Dong-Eon Kim, Jung-Hyo Lee and Nam-Young Kim*
Division of Ecological Conservation Bureau of Ecological Research, National Institute of Ecology, Seocheon 33657, Republic of Korea

Abstract

The characteristics of 124 *Phytolacca americana* present areas and 88 surrounding absent areas over the country were investigated and compared from July 2016 to Sept 2017. The *Phytolacca americana* was confirmed as having been nationally distributed and is usually found in roadsides at an altitude of 380 m (26%), forest edges (24%), forests (19%), sunny spots (60%), dry soils (53%), sandy loams (31%) and sand + gravel soils (22%). 321 taxons consisting of 79 families, 209 genera, 289 species, 2 subspecies, 26 varieties and 4 cultivars and 286 taxons consisting of 76 families, 195 genera, 256 species, 2 subspecies, 24 varieties and 4 cultivars were found in the *Phytolacca americana* present areas and the absent areas, respectively. The relative net contribution degree was found highest in the *Phytolacca americana* (100) followed by *Robinia pseudoacacia* (29.4), *Humulus japonicus* (8.8) and *Artemisia princeps* (6.0) in the present areas, while it was found highest in *Robinia pseudoacacia* (100) followed by *Humulus japonicus* (44.4), *Artemisia princeps* (35.9), *Pueraria lobata* (18.6) and *Setaria viridis* (12.3) in the absent areas. The Raunkier's life form in the present/absent areas was found highest in the therophytes (34%/34%), followed by hemicryptophytes (17%/18%), megaphanerophytes and mesophanerophytes (18%/17%), nanophanerophytes (11%/11%) and geophytes (9%/11%). There was no significant difference in the species diversity between the present (2.141) and the absent (2.124) areas. However, the allelopathic agent and light blocked-out by the *Phytolacca americana* could possibly inhibit germination and the development of other species; especially, where a difference in species diversity was found high in forests, compared to other habitats ($p=0.0605$). Accordingly, it is suggested to review possible disturbances of native species habitats in shady spots including forest gaps, although the effect of *Phytolacca americana* on the ecological system in the suburban open and disturbed areas is not large.

Key Words: alien plant, *Phytolacca americana*, ecological characteristics, habitat environment, species diversity

Introduction

Alien plants are easily found around and the introduction to South Korea has consistently increased. Recently, it tends to be more diversified as unique or rare alien plants, in particular, are introduced as pets or for home-gardening purposes (NIE 2015).

The invasive alien plants were set as one of the 20 objectives to achieve for biological diversity preservation by 2020 at the 10th Conference of the Parties under the Convention on Biological Diversity (Leadley et al. 2014), and the regulations to control trades in wildlife as used as a pet or ornamental between countries, which are known as a major migratory route of alien life, were discussed as a part

Received: February 28, 2018. Revised: May 15, 2018. Accepted: May 15, 2018.

Corresponding author: Nam-Young Kim

Division of Ecological Conservation Bureau of Ecological Research, National Institute of Ecology, Seocheon 33657, Republic of Korea
Tel: 82-41-950-5329, Fax: 82-41-950-5934, E-mail: nykim@nie.re.kr

of important trends and measures to note, at the global level at the 12th Conference of the Parties (NIE 2017b).

The *Phytolacca americana* L. is a perennial herb in Phytolaccaceae that is native to North America, which germinates from its seed or from root during the months May to June, and grows up to 1-3 m. The plant blooms from June to Sept and bears 10 fruits from the 10-15 cm of racemous inflorescence, and it is consistently scattered from June to early winter (Park 2009). It is hardly distributed in the areas where the temperature is below -29°C and will flourish in areas where the temperature is above 20°C in the summer (Sauer 1952). It distributes its seeds via birds and habitats in empty lots near houses, forest edges and sunny forest gaps (McDonnel et al. 1984). It is known as being dispersed since the time of the Korean War in South Korea, and its distribution was confirmed in metropolitan cities and some of the southern part of the country in 1980, while currently it has been distributed over the country by frequent habitat disturbance and spreads via the birds since the Industrialization era (Lee and Kim 1961; Yim and Jeon 1980; Park 2009; Lee et al. 2011; Jung 2014).

The extract from the leaves of *Phytolacca americana* L. inhibits germination and growth of the native plants or crops (Bae et al. 1997; Lee et al. 1997). When ingested by humans, there are physical adverse events such as abdominal pain, vomit, stupor, excitation, visual hallucination and the Babinski sign, and deep tendon reflex rise, etc. were reported (Kim et al. 2008).

In addition, an assumption that the *Phytolacca americana* L. acidifies soils raised social conflicts, which were noted as a lack of clues as seen in the additional studies (Park et al. 1999). However, there have been movements of civil organization to remove the *Phytolacca americana* L. as the issue of its risk is open to dispute, due to its characteristics such as rapid and wide spread of seeds in large scale by birds, easy settlement in the disturbed areas, and inhibition of germination and growth of native plants.

Therefore, this study was aimed at determining the characteristics of *Phytolacca americana* L. habitats over the country, and understanding the risk to ecological systems by a comparison between the present and the surrounding absent areas, to provide useful and basic data for the establishment of a management plan.

Materials and Methods

Research areas

There were a total 212 spots including 124 *Phytolacca americana* L. present areas as well as 88 surrounding absent areas which were selected over the country on the basis of the pre-existing literature to undertake this vegetation research (Fig. 1). The on-site research was conducted from the time of July 2016 to Sept 2017, which aligned with the blossoming and fruiting seasons where the identification and distribution of individual plants are easily determined (NIE 2017a).

Type of habitats and characteristics of growth and development

The type of each research area was classified as roadsides, forest edges, forests, cultivated lands, riversides, waste deposit, coasts, grasslands, etc. The soil texture was

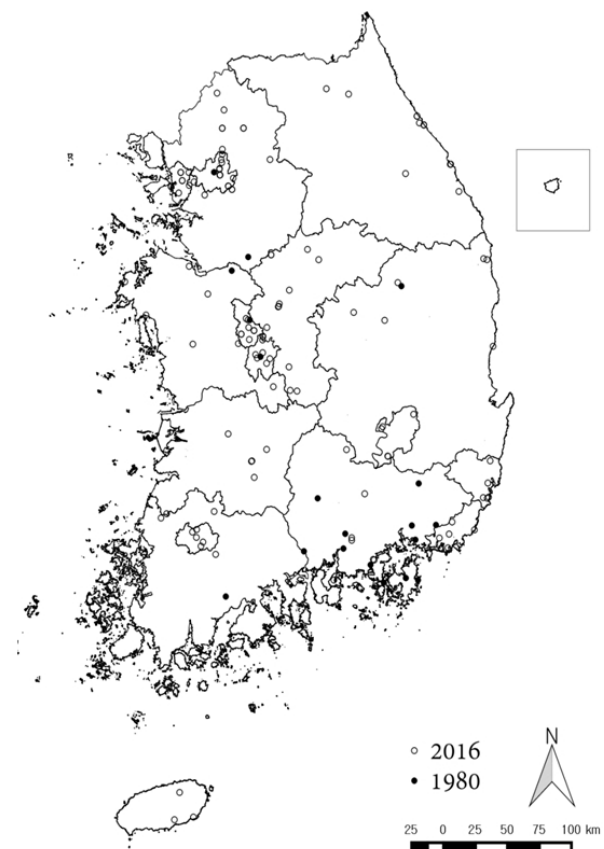


Fig. 1. The distribution and sampling site of the *Phytolacca americana* L. in 1980 (Yim and Jeon) and 2016.

classified as 9 stages such as gravels, sands + gravels, sandy soils, sandy loams, loams, silt loams, clay loam soils, central soils, and other. The soil moisture was classified as 5 stages such as dry, favorably moist, wet, excessively wet, and underwater. The light condition was thereby classified into 3 stages such as sunny, half-shadow, and shadow.

Flora and species diversity

The quadrat in 10 m × 10 m was set by the research area to record the cover rate of the overstory flora, while the smaller quadrat in 5 m × 5 m was set in the center of the research area to record the cover rate of the nano-phanerophyte and the herbaceous layer floras. Based on the result of research, the relative net contribution degree (Kim and Manyko 1994) was calculated to select the main species of the *Phytolacca americana* L. community. The trend of the emerging species was based on the illustrated plant books by Park (2009), Lee (1993 and 2003). The botanical naming was completed according to the Korean Plant Name Index of the Korea National Arboretum (KNA 2014); the ratios of alien plants and Raunkiaer (1934) life forms were calculated from the list of emerging species and the ecosystem disturbance species, floristic regional indicator plants (Kim 2000), and rare plants (KNA 2008) were therefore scrutinized. In addition, the species diversity index by Shannon (1948) was calculated for each research area and then compared between the *Phytolacca americana* L. present and the absent areas.

*NCD: net contribution degree

$$NCD_i = (\sum C_i / N) \times (n_i / N) \quad (C_{\min} \leq NCD \leq C_{\max})$$

$\sum C_i$: the sum of coverage of species i in the unit

N : the total number of relevé in the unit

n_i : the number of relevé possessing species i

* $rNCD$: relative net contribution degree

$$rNCD = (NCD_i / NCD_{\max}) \times 100$$

NCD_i : net contribution degree of species i

NCD_{\max} : the maximum NCD_i value in the unit

*Shannon-wiener index

$$H' = - \sum P_i \times \ln(P_i) \quad (P_i = C_i / \sum C_i)$$

C_i : the coverage of species i

Results and Discussion

Type of habitats and characteristics of growth and development

The *Phytolacca americana* L. was generally found in the habitats such as near roadsides at ≤ 380 m altitude, forest edges, and forests (Fig. 2, 3). The *Phytolacca americana* L. was found to be distributed in several divergent spots: roadsides (26%), forest edges (24%), forests (19%), cultivated lands (10%), riversides (5%), etc. The light conditions were mainly shown as the sunny and half-shadow spots. For soil texture, the sandy loams took the highest proportion at 31%, followed by the sands + gravels (22%), sandy soils (14%), and silt loams (13%). For soil moisture, the dry took the highest proportion as 53%, followed by the favorably moist conditions (37%) (Fig. 3).

The *Phytolacca americana* L. easily germinates in the sunny spots (Kang et al. 1997) and shows excellent growth and development at $\geq 33\%$ of relative roughness (Park et al. 1998; Choi et al. 2009). The determined light conditions of

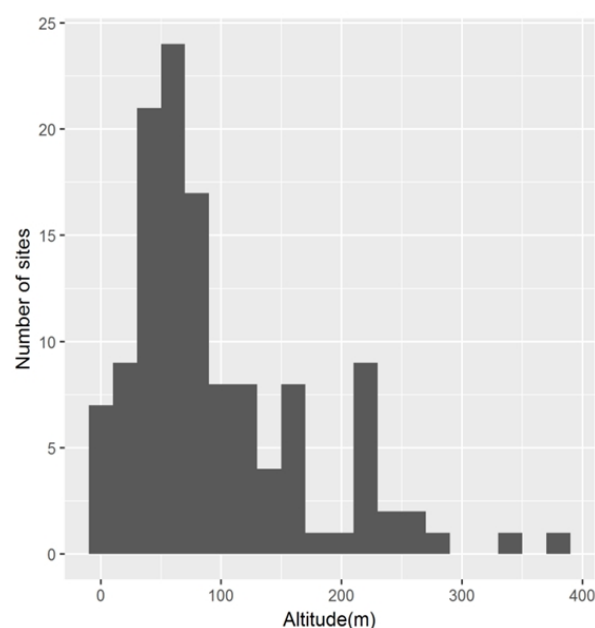


Fig. 2. Number of sites by altitude.

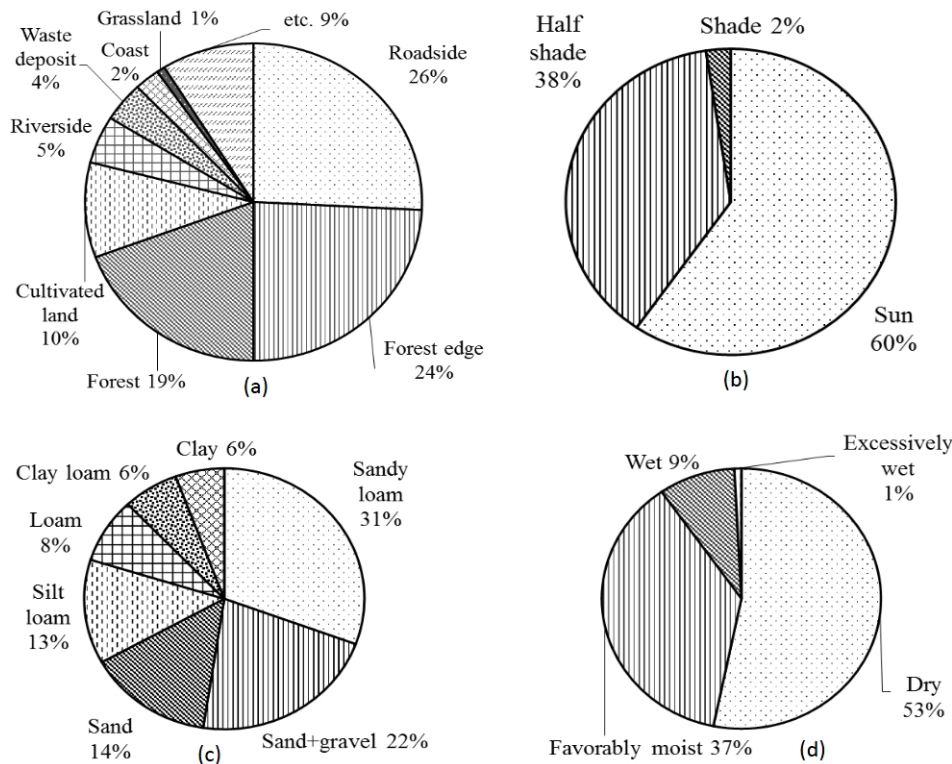


Fig. 3. Habitat conditions of *Phytolacca americana* L. (a) habitat type, (b) light, (c) soil texture, (d) soil moisture.

the habitat seem to reflect these characteristics. The roadways and the cultivated lands have good light conditions, but might be affected by car exhaust fumes or pesticide pollution. However, it is known that the *Phytolacca americana* L could inhabit the areas characterized by acid soils with high contents of heavy metal and organic matter (Ri and Chun 1996). Accordingly, the *Phytolacca americana* L. is determined to spread across the country well, while adapting itself to hardly viable environments such as the half-shadow and acid soils.

Flora in *Phytolacca americana* L. habitats

A total 321 taxons of tracheophyte, consisting of 79 families, 209 genera, 289 species, 2 subspecies, 26 varieties and 4 cultivars, were determined in the *Phytolacca americana* L. habitats. A total 286 taxons of tracheophyte, consisting of 76 families, 195 genera, 256 species, 2 subspecies, 24 varieties and 4 cultivars, were determined in the *Phytolacca americana* L. absent areas, while a total 283 taxons of tracheophyte, consisting of 73 families, 186 genera, 253 species, a subspecies, 25 varieties and 4 cultivars, were determined in the *Phytolacca americana* L. present areas. The

relative net contribution degree was found to be the highest in *Phytolacca americana* L. followed by *Robinia pseudoacacia* L., *Humulus japonicus* Siebold & Zucc., *Artemisia princeps* Pamp., *Setaria viridis* (L.) P.Beauv., *Pueraria lobata* (Willd.) Ohwi and *Pinus densiflora* Siebold & Zucc. in the *Phytolacca americana* L. present areas, while it was found the highest incidence in *Robinia pseudoacacia* L. followed by *Humulus japonicus* Siebold & Zucc., *Artemisia princeps* Pamp., *Pueraria lobata* (Willd.) Ohwi, *Setaria viridis* (L.) P.Beauv., *Pinus densiflora* Siebold & Zucc. and *Conyza canadensis* (L.) Cronquist in the absent areas (Appendix 1).

The rate of life form of the determined plant species was shown to be high in therophytes (Th), hemicryptophytes (H), megaphanerophytes and mesophanerophytes (MM), nanophanerophytes (N), and geophytes (G) in both *Phytolacca americana* L. present and absent areas (Table 1). It seems to reflect the characteristics of habitats including the disturbed areas and forest edges.

For alien plants, 58 (20%) and 53 (19%) taxons were determined in the *Phytolacca americana* L. present and absent areas, respectively, among which there were 9 ecosystem disturbance species including *Rumex acetosella* L., *Sicyos an-*

Table 1. Raunkiaer's life form ratio in survey sites where *Phytolacca americana* L. is present or is absent ($p=0.9946$)

	Th	H	MM	N	G	M	Ch	HH
Present	34%	17%	18%	11%	9%	6%	4%	1%
Absent	34%	18%	17%	11%	11%	6%	3%	1%

Th, Therophytes; G, Geophytes; H, Hemicryptophytes; Ch, Chamaephytes; N, Nanophanerophytes; M, Microphanerophytes; MM, Megaphanerophytes and Mesophanerophytes; HH, Helophytes and Hydrophytes.

Table 2. Species diversity indices difference according to *Phytolacca americana* L. presence ($p=0.2512$)

Habitat type	N	H _{absent}	H _{present}	H _{absent} -H _{present}
Roadside	27	2.020±0.092*	2.072±0.097	-0.052±0.091
Forest edge	21	2.219±0.086	2.288±0.075	-0.070±0.064
Forest	14	2.579±0.055	2.392±0.067	0.187±0.091
Cultivated land	7	2.003±0.189	2.054±0.207	-0.052±0.145
Riverside	5	1.911±0.323	1.887±0.279	0.024±0.215
Waste deposit	4	1.760±0.189	2.166±0.040	-0.406±0.185
Coast	3	1.819±0.034	1.945±0.078	-0.126±0.069
Other	7	1.941±0.197	1.799±0.165	0.142±0.244
All type	88	2.124±0.051	2.141±0.047	-0.017±0.045

*Mean±S.E.

gulatus L., *Ambrosia artemisiifolia* L., *Ambrosia trifida* L., *Aster pilosus* Willd., *Eupatorium rugosum* Houtt., *Hypochaeris radicata* L., *Lactuca scariola* L., and *Solidago altissima* L. were confirmed.

For floristic regional indicator plants, the total of 28 species including 16 Class I, 5 Class III, 5 Class IV, and 2 Class V species were confirmed, among which 21 species in the *Phytolacca americana* L. present areas and 15 species in the absent areas were shown to take 7.4% and 5.2% of each flora, respectively. For rare plants, there were 4 species including *Thuja orientalis* L. (LC), *Arisaema heterophyllum* Blume (LC), *Senecio nemorensis* L. (VU), and *Prunus yedoensis* Matsum. (CR) were confirmed, among which *Thuja orientalis* L. and *Prunus yedoensis* Matsum. seems to have been planted.

Overall, there was not a big difference in the relative net contribution degree, the rate of life form, and the naturalized ratio between the *Phytolacca americana* L. present and the absent areas, which might reflect the characteristic of sunny habitats where the disturbance is frequent. In addition, the Class V, *Senecio nemorensis* L. might be in a habitat competition with the *Phytolacca americana* L., suggesting that the *Phytolacca americana* L. needs to be controlled for

protection of floristic regional indicator plants and rare plants.

Species Diversity by Distribution and Habitat Type of Phytolacca americana L.

The species diversity index in the *Phytolacca americana* L. present areas was found to have a negative correlation with the cover rate of *Phytolacca americana* L., while there was no significant difference in species the diversity index between the *Phytolacca americana* present (2.141) and the absent (2.124) areas ($p=0.7066$) and by habitat type (Table 2). *Humulus japonicus* Siebold & Zucc., *Artemisia princeps* Pamp., *Pueraria lobata* (Willd.) Ohwi, and *Conyza canadensis* (L.) Cronquist was dominant even in the areas where the *Phytolacca americana* L. is absent, indicating that the species diversity has not become high. The difference in the species diversity by habitat type between the *Phytolacca americana* L. present and the absent areas was not statistically significant, while the difference between the present and the absent areas was found to be in relatively large in forests ($p=0.0605$). The *Phytolacca americana* L. was shown to rapidly germinate and spread upon and when it was disturbed in forests and inhibits the development of low

vegetation by blocking the light and secreting allelopathic agents (Bae et al. 1997; Lee et al. 1997; Hyatt 1999). The effect of *Phytolacca americana* L. needs to be studied in forests by classifying the habitat types as artificial plantations, second-growth forests, and natural forests; particularly to its effect on the species with high rarity in forests needs to be confirmed. The effect of *Phytolacca americana* L. on species diversity in other regions seems to be minor.

Conclusion

The *Phytolacca americana* L. is being distributed in every region over the country and forms colonies in various geographical conditions. It is implied that the alien plant, *Phytolacca americana* L. has been spread throughout most of the domestic regions and incorporated into the domestic ecological system. In South Korea, the *Phytolacca americana* L. inhabits both sunny and half-shadow places and forms large-scale colonies mainly in the disturbed areas such as within empty lots, slopes, roadsides, cultivated lands, and orchards. It matches with the habitat types found in the country of origin. For the composition of plant species in the habitats of *Phytolacca americana* L., the proportion of megaphanerophytes and mesophanerophytes was found to be relatively high, as a number of *Phytolacca americana* L. colonies have been made in forest edges at the area of the condition of half-shadow. It might be attributed to that the half-heliophobus perennial tall plant, *Phytolacca americana* L. which has high competitive power to form a large number of colonies in where the > 1 m-tall nanophanerophytes inhabit, by virtue of its relatively progressive succession. In contrast, the heliophilous annual plants in disturbed areas are not well-invasive into the area of a half shadow effect. In addition, the *Phytolacca americana* L. seems to rapidly spread out alongside the roads while producing a large number of seeds. As the various types of birds feed themselves with the fruits of *Phytolacca americana* L., a scattering of the undigested seeds might match the habitats of birds. The scattering characteristics are shown in the colonies of *Phytolacca americana* L. surrounding the forest trails and mountain passes. However, the *Phytolacca americana* L. is not appeared to be well developed in shadowy areas, indicating that its limited spread to the disturbed areas also in forests, such as with mountain passes.

The *Phytolacca americana* L. is a perennial measuring 2 m tall and with canopy structure, has a wide range of environmental adaptability to tolerate various stress conditions such as contamination, dryness and disturbance and produces a large number of seeds. It is not easy to inhibit its development due to these ecological characteristics. However, the utilization of the *Phytolacca americana* L. as the half-heliophobus plant does not seem to specifically grow well in the forest with the effects of a shadow as exhibited in the growth area. In addition, considering its characteristics as the perennial herbaceous plant, of which growth and development period and life cycle are longer than annual plants, its development growth might be greatly inhibited by the consistent and physical removal.

Acknowledgements

This study was conducted via the close scrutiny of the alien species (NIE-2016-08) and the ecological system risk assessment and risk-concerned species finding research (NIE-2016-09) by the National Institute of Ecology.

References

- Bae CH, Nou IS, Kang KK, Koh YJ. 1997. In vitro test on allelopathic effects of leaf extracts from *Phytolacca americana* and *Armoracia rusticana*. Korean J Crop Sci 42: 652-665. (in Korean)
- Choi KR, Park BJ, Park YM. 2009. The effect of light regimes on pokeberry (*Phytolacca americana* L.) growth. Korea J Weed Sci 29: 83-88. (in Korean)
- Hyatt LA. 1999. Differences between seed bank composition and field recruitment in a temperate zone deciduous forest. Am Midl Nat 142: 31-38.
- Jung SY. 2014. A study on the distribution characteristics of invasive alien plant (IAP) in South Korea. Ph.D. thesis. Andong National Univ, Andong, Korea. (in Korean)
- Kang JH, Ryu YS, Kim DI, Lee OS, Kim SH. 1997. Effect of priming, temperature and light quality on germination of pokeweed (*Phytolacca americana*) seed. Korean J Crop Sci 42: 153-159. (in Korean)
- Kim CH. 2000. Assessment of natural environment - I. selection of plant taxa -. Korean J Environ Biol 18: 163-198. (in Korean)
- Kim JW, Manyko YI. 1994. Syntaxonomical and synchronological characteristics of the cool-temperate mixed forest in the Southern Sikhote Alin, Russian far east. Korean J Ecol 17: 391-413.
- Kim YW, Yoon YS, Kim MR, Park SH, Choi JC. 2008. Two cases of *Phytolacca americana* intoxication with confusion and abdomi-

- nal cramping. *J Korean Soc Clin Toxicol* 6: 146-148. (in Korean)
- Korea National Arboretum (KNA). 2008. Rare plants data book in Korea. Pocheon, Korea. pp 332. (In Korean)
- Korea National Arboretum (KNA). 2014. Korean Plant Names Index. <http://www.nature.go.kr/kpni/index.do>. Accessed 9 Feb 2018. (in Korean)
- Leadley PW, Krug CB, Alkemade R, Pereira HM, Sumaila UR, Walpole M, Marques A, Newbold T, Teh LSL, van Kolck J, Bellard C, Januchowski-Hartley SR, Mumby PJ. 2014. Progress towards the Aichi biodiversity targets: an assessment of biodiversity trends, policy scenarios and key actions. Secretariat of the Convention on Biological Diversity, Montreal, Canada. Technical Series 78. pp 488.
- Lee DB, Kim YC. 1961. A historical review of some plants of American origin in Korea. *J Plant Biol* 4: 25-30. (in Korean)
- Lee HJ, Kim YO, Chang NK. 1997. Allelopathic effect on seed germination and fungus growth from the secreting substances of some plants. *Korean J Ecol* 20: 181-189. (in Korean)
- Lee TB. 1993. Illustrated flora of Korea. Hyangmunsa, Seoul, pp 323. (in Korean)
- Lee TB. 2003. Coloured flora of Korea. Hyangmunsa, Seoul, pp 298. (in Korean)
- Lee YM, Park SH, Jung SY, Oh SH, Yang JC. 2011. Study on the current status of naturalized plants in South Korea. *Korean J Plant Taxon* 41: 87-101. (in Korean)
- McDonnell MJ, Stiles EW, Cheplick GP, Armesto JJ. 1984. Bird-dispersal of *Phytolacca americana* L. and the influence of fruit removal on subsequent fruit development. *Amer J Bot* 71: 895-901.
- National Institute Ecology (NIE). 2015. Nationwide survey of non-native species in Korea. Seochon, Korea. pp 342. (in Korean)
- National Institute Ecology (NIE). 2017a. Ecological studies of alien species (III). Seochon, Korea. pp 154. (in Korean)
- National Institute Ecology (NIE). 2017b. The study on the inhabitation status of nutria (*Myocastor coypus*). Seochon, Korea. pp 199. (in Korean)
- Park BJ, Choi KR, Park YM. 1998. Effects of light and nitrogen on the growth of pokeberry. *Korean J Ecol* 21: 329-335.
- Park SH. 2009. New illustrations and photographs of naturalized plants of Korea. Ilchokak, Seoul, pp 18-19. (in Korean)
- Park YM, Park BJ, Choi KR. 1999. pH changes in the rhizosphere soil of pokeberry. *Korean J Ecol* 22: 7-11. (in Korean)
- Raunkiaer C. 1934. The life forms of plants and statistical plant geography. The Clarendon Press, Oxford, pp 632.
- Ri CU, Chun JI. 1996. Adapted Environmental Factors for a Neophyte Pokeweed (*Phytolacca americana*). *Korean J Life Sci* 6: 87-93.
- Sauer JD. 1952. A geography of pokeweed. *Ann Mo Bot Gard* 39: 113-125.
- Shannon CE. 1948. A mathematical theory of communication. *Bell Syst Tech J* 27: 379-423, 623-656.
- Yim YJ, Jeon ES. 1980. Distribution of naturalized plants in the Korean peninsula. *J Plant Biol* 23: 69-83. (in Korean)

Appendix 1. Floristic list on study area and specific characteristics

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	F.R.D. ⁶⁾
	Present	Absent					
Equisetaceae (속새과)							
<i>Equisetum arvense</i> L. (쇠뜨기)	○	○	G				
Osmundaceae (고비과)							
<i>Osmunda japonica</i> Thunb. (고비)		○	G				
Dryopteridaceae (편마과)							
<i>Dryopteris chinensis</i> (Baker) Koidz. (가는잎죽제비고사리)	○	○	H				
Aspleniaceae (꼬리고사리과)							
<i>Athyrium niponicum</i> (Mett.) Hance (개고사리)	○	○	G				
<i>Athyrium vidalii</i> (Franch. & Sav.) Nakai (산개고사리)		○	H				
<i>Athyrium yokoscense</i> (Franch. & Sav.) Christ (뱀고사리)	○	○	H				
<i>Pteridium aquilinum</i> var. <i>latiusculum</i> (Desv.) Underw. ex A.Heller (고사리)	○	○	G				
Ginkgoaceae (은행나무과)							
<i>Ginkgo biloba</i> L. (은행나무)	○	○	MM				
Pinaceae (소나무과)							
<i>Larix kaempferi</i> (Lamb.) Carrière (일본잎갈나무)	○	○	MM				
<i>Pinus densiflora</i> Siebold & Zucc. (소나무)	○ (3.0)	○ (12.2)	MM				
<i>Pinus koraiensis</i> Siebold & Zucc. (잣나무)	○	○	MM				I
<i>Pinus rigida</i> Mill. (리기다소나무)	○	○	MM				
<i>Pinus thunbergii</i> Parl. (곰솔)	○	○	MM				
Taxodiaceae (낙우송과)							
<i>Metasequoia glyptostroboides</i> Hu & W. C. Cheng (메타세쿼이아)	○	○	MM				
Cupressaceae (측백나무과)							
<i>Chamaecyparis obtusa</i> (Siebold & Zucc.) Endl. (편백)	○		MM				
<i>Chamaecyparis pisifera</i> (Siebold & Zucc.) Endl. (화백)		○	MM				
<i>Juniperus chinensis</i> L. (향나무)	○		MM				III
<i>Juniperus rigida</i> Siebold & Zucc. (노간주나무)	○		MM				
<i>Thuja orientalis</i> L. (측백나무)	○		MM			LC	IV
Salicaceae (버드나무과)							
<i>Populus deltoides</i> Marsh. (미루나무)	○		MM				
<i>Populus tomentiglandulosa</i> T. B. Lee (은사시나무)	○	○	MM				
<i>Salix babylonica</i> L. (수양버들)		○	MM				
<i>Salix dependens</i> Nakai (개수양버들)		○	MM				
<i>Salix gracilistyla</i> Miq. (갯버들)		○	N				
<i>Salix koreensis</i> Andersson (버드나무)	○	○	MM				
Juglandaceae (가래나무과)							
<i>Juglans regia</i> L. (호두나무)	○		MM				
Betulaceae (자작나무과)							
<i>Dioscorea quinqueloba</i> Thunb. (오리나무)	○	○	MM				
<i>Alnus sibirica</i> Fisch. ex Turcz. (물오리나무)	○		MM				I
<i>Betula platyphylla</i> var. <i>japonica</i> (Miq.) H. Hara (자작나무)	○		MM				
<i>Betula schmidtii</i> Regel (박달나무)	○	○	MM				I
<i>Carpinus turczaninowii</i> Hance (소사나무)		○	M				
<i>Corylus heterophylla</i> Fisch. ex Trautv. (개암나무)	○	○	M				
Fagaceae (참나무과)							
<i>Castanea crenata</i> Siebold & Zucc. (밤나무)	○ (6.0)	○ (1.8)	MM				
<i>Lithocarpus edulis</i> Nakai (돌참나무)	○		M				
<i>Quercus acutissima</i> Carruth. (상수리나무)	○ (1.6)	○ (6.6)	MM				

Appendix 1. Continued 1

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	F.R.D. ⁶⁾
	Present	Absent					
<i>Quercus aliena</i> Blume (갈참나무)	○	○	MM				
<i>Quercus dentata</i> Thunb. (떡갈나무)	○	○ (2.2)	MM				
<i>Quercus mongolica</i> Fisch. ex Ledeb. (신갈나무)	○	○	MM				
<i>Quercus serrata</i> Murray (졸참나무)	○	○	MM				
<i>Quercus variabilis</i> Blume (굴참나무)	○	○	MM				
Ulmaceae (느릅나무과)							
<i>Celtis sinensis</i> Pers. (팽나무)	○	○	MM				
<i>Ulmus davidiana</i> var. <i>japonica</i> (Rehder) Nakai (느릅나무)	○	○	MM				
<i>Zelkova serrata</i> (Thunb.) Makino (느티나무)	○	○	MM				
Moraceae (뽕나무과)							
<i>Ficus carica</i> L. (무화과나무)	○		M				
<i>Morus alba</i> L. (뽕나무)	○	○	MM				
Cannabaceae (삼과)							
<i>Humulus japonicus</i> Siebold & Zucc. (환삼덩굴)	○ (8.8)	○ (44.4)	Th				
Urticaceae (쐐기풀과)							
<i>Boehmeria nivea</i> (L.) Gaudich. (모시풀)	○	○	G				
<i>Boehmeria pannosa</i> Nakai & Satake (왕모시풀)	○	○	Ch				
<i>Boehmeria spicata</i> (Thunb.) Thunb. (쭈깨잎나무)	○	○	N				
<i>Pilea mongolica</i> Wedd. (모시물통이)		○	Th				
Polygonaceae (마디풀과)							
<i>Aconogonon alpinum</i> (All.) Schur (싱아)	○	○	H				
<i>Persicaria hydropiper</i> (L.) Delarb. (여뀌)	○	○	Th				
<i>Persicaria lapathifolia</i> (L.) Delarb. (흰여뀌)	○	○	Th				
<i>Persicaria longiseta</i> (Brujin) Kitag. (개여뀌)	○	○	Th				
<i>Persicaria perfoliata</i> (L.) H.Gross (머느리배꼽)	○	○	Th				
<i>Persicaria pubescens</i> (Blume) H. Hara (바보여뀌)		○	Th				
<i>Persicaria sagittata</i> (L.) H.Gross (미꾸리뉘시)	○	○	Th				
<i>Persicaria senticosa</i> (Meisn.) H.Gross ex Nakai (머느리밑씻개)	○	○	Th				
<i>Persicaria thunbergii</i> (Siebold & Zucc.) H.Gross (고마리)	○	○	Th				
<i>Rumex acetosella</i> L. (애기수영)	○		H	○		○	
<i>Rumex crispus</i> L. (소리쟁이)	○	○	H	○			
<i>Rumex obtusifolius</i> L. (돌소리쟁이)	○		H	○			
Chenopodiaceae (명아주과)							
<i>Chenopodium album</i> L. (흰명아주)	○	○	Th	○			
<i>Chenopodium album</i> var. <i>centrorubrum</i> Makino (명아주)	○	○	Th				
<i>Chenopodium ficifolium</i> Smith (좀명아주)	○	○	Th	○			
<i>Kochia scoparia</i> var. <i>scoparia</i> (L.) Schrad. (땃싸리)		○	Th				
Amaranthaceae (비름과)							
<i>Achyranthes fauriei</i> H.Lév. & Vaniot (털쇠무릎)	○	○ (1.2)	G				
<i>Achyranthes japonica</i> (Miq.) Nakai (쇠무릎)	○	○	G				
<i>Amaranthus hybridus</i> L. (긴털비름)	○	○	Th	○			
<i>Amaranthus lividus</i> L. (개비름)	○	○	Th	○			
<i>Amaranthus palmeri</i> S.Watson (긴이삭비름)	○		Th	○			
<i>Amaranthus viridis</i> L. (청비름)	○		Th	○			
Phytolaccaceae (자리공과)							
<i>Phytolacca americana</i> L. (미국자리공)	○ (100)		G	○			
Molluginaceae (석류풀과)							

Appendix 1. Continued 2

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	FR.D. ⁶⁾
	Present	Absent					
<i>Mollugo pentaphylla</i> L. (석류풀)	○		Th				
Portulacaceae (쇠비름과)							
<i>Portulaca oleracea</i> L. (쇠비름)	○	○	Th				
Caryophyllaceae (석죽과)							
<i>Dianthus chinensis</i> L. (패랭이꽃)	○	○	H				
<i>Spergularia marina</i> (L.) Besser (갯개미자리)		○	Th				
<i>Stellaria aquatica</i> (L.) Scop. (쇠별꽃)	○		Th				
<i>Stellaria media</i> (L.) Vill. (별꽃)	○		Th				
Ranunculaceae (미나리아재비과)							
<i>Clematis apiifolia</i> DC. (사위질빵)	○	○ (1.7)	N				
<i>Clematis terniflora</i> var. <i>mandshurica</i> (Rupr.) Ohwi (으아리)		○	N				
Lardizabalaceae (으름덩굴과)							
<i>Akebia quinata</i> (Houtt.) Decne. (으름덩굴)	○	○	N				
Menispermaceae (방기과)							
<i>Cocculus trilobus</i> (Thunb.) DC. (맹맹이덩굴)	○	○	N				
Magnoliaceae (목련과)							
<i>Liriodendron tulipifera</i> L. (백합나무)	○	○	MM				
<i>Magnolia denudata</i> Desr. (백목련)	○		MM				
<i>Magnolia obovata</i> Thunb. (일본목련)	○	○	MM				
Lauraceae (녹나무과)							
<i>Lindera obtusiloba</i> Blume (생강나무)	○	○	N				
Papaveraceae (양귀비과)							
<i>Chelidonium majus</i> var. <i>asiaticum</i> (H. Hara) Ohwi (애기똥풀)	○	○	Th				
Cruciferae (십자화과)							
<i>Capsella bursa-pastoris</i> (L.) L.W.Medicus (냉이)	○		Th				
<i>Cardamine flexuosa</i> With. (황새냉이)	○		Th				
<i>Lepidium apetalum</i> Willd. (다닥냉이)	○	○	Th	○			
<i>Rorippa palustris</i> (Leyss.) Besser (속속이풀)		○	Th				
Platanaceae (버즘나무과)							
<i>Platanus orientalis</i> L. (버즘나무)	○	○	MM				
Rosaceae (장미과)							
<i>Agrimonia pilosa</i> Ledeb. (짚신나물)		○	G				
<i>Chaenomeles sinensis</i> (Thouin) Koehne (모과나무)	○		MM				
<i>Duchesnea indica</i> (Andr.) Focke (뽕딸기)		○	Ch				
<i>Potentilla anemonefolia</i> Lehm. (가락지나물)	○		Ch				
<i>Potentilla fragarioides</i> var. <i>major</i> Maxim. (양지꽃)	○	○	Ch				
<i>Prunus davidiana</i> (Carrière) Franch. (산복사나무)	○		M				IV
<i>Prunus mume</i> (Siebold) Siebold & Zucc. (매실나무)	○		M				
<i>Prunus padus</i> L. (귀룽나무)		○	MM				
<i>Prunus persica</i> (L.) Batsch (복사나무)	○	○	M				
<i>Prunus sargentii</i> Rehder (산벚나무)	○	○	MM				
<i>Prunus serrulata</i> var. <i>spontanea</i> (Maxim.) E.H.Wilson (벚나무)	○	○ (1.7)	MM				
<i>Prunus tomentosa</i> Thunb. (앵도나무)	○	○	N				
<i>Prunus yedoensis</i> Matsum. (왕벚나무)	○	○	MM			CR	V
<i>Rosa multiflora</i> Thunb. (절레꽃)	○	○	N				
<i>Rubus coreanus</i> Miq. (복분자딸기)	○	○	N				
<i>Rubus crataegifolius</i> Bunge (산딸기)	○	○ (1.4)	N				

Appendix 1. Continued 3

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	F.R.D. ⁶⁾
	Present	Absent					
<i>Rubus hirsutus</i> Thunb. (장딸기)	○	○	N				I
<i>Rubus ikenoensis</i> H.L.év. & Vaniot (오엽딸기)	○		N				IV
<i>Rubus oldhamii</i> Miq. (줄딸기)	○	○	N				
<i>Rubus parvifolius</i> L. (명석딸기)	○	○	N				
<i>Rubus phoenicolasius</i> Maxim. (곰딸기)	○		N				
<i>Rubus ribisoides</i> Matsum. (섬딸기)	○		N				IV
<i>Sanguisorba officinalis</i> L. (오이풀)	○		G				
<i>Sorbaria sorbifolia</i> var. <i>stellipila</i> Maxim. (쉬땅나무)	○		N				III
<i>Sorbus alnifolia</i> (Siebold & Zucc.) C.Koch (팔배나무)	○	○	MM				
<i>Spiraea japonica</i> L. f. (일본조팝나무)	○		N				
<i>Spiraea prunifolia</i> f. <i>simpliciflora</i> Nakai (조팝나무)	○	○	N				
<i>Stephanandra incisa</i> (Thunb.) Zabel (국수나무)	○	○	N				
Leguminosae (콩과)							
<i>Aeschynomene indica</i> L. (자귀풀)	○	○	Th				
<i>Albizia julibrissin</i> Durazz. (자귀나무)	○	○	M				
<i>Amorpha fruticosa</i> L. (죽제비싸리)	○	○ (1.2)	N	○			
<i>Amphicarpea bracteata</i> subsp. <i>edgeworthii</i> (Benth.) H. Ohashi (새콩)	○	○	Th				
<i>Cercis chinensis</i> Bunge (박태기나무)	○		N				
<i>Chamaecrista nomame</i> (Siebold) H. Ohashi (차풀)	○	○	Th				
<i>Glycine soja</i> Siebold & Zucc. (돌콩)	○ (1.1)	○	Th				
<i>Indigofera kirilowii</i> Maxim. ex Palib. (땅비싸리)	○	○	N				
<i>Indigofera pseudotinctoria</i> Matsum. (낭아초)	○		Ch				III
<i>Kummerowia stipulacea</i> (Maxim.) Makino (둥근매듭풀)	○	○	Th				
<i>Kummerowia striata</i> (Thunb.) Schindl. (매듭풀)	○	○	Th				
<i>Lespedeza bicolor</i> Turcz. (싸리)	○	○	N				
<i>Lespedeza cuneata</i> G. Don (비수리)	○	○	H				
<i>Lespedeza cyrtobotrya</i> Miq. (참싸리)	○	○ (1.9)	N				
<i>Lotus corniculatus</i> L. (서양벌노랑이)	○	○	H	○			
<i>Medicago polymorpha</i> L. (개자리)		○	Th	○			
<i>Melilotus suaveolens</i> Ledeb. (전동싸리)	○		Th	○			
<i>Pueraria lobata</i> (Willd.) Ohwi (췌)	○ (3.5)	○ (18.6)	Ch				
<i>Robinia pseudoacacia</i> L. (아까시나무)	○ (29.4)	○ (100)	MM	○			
<i>Sesbania exaltata</i> (Raf.) Rydb. (Sesbania exaltata)		○	Th	○			
<i>Sophora flavescens</i> Aiton (고삼)	○		G				
<i>Trifolium pratense</i> L. (붉은토끼풀)		○	H	○			
<i>Trifolium repens</i> L. (토끼풀)	○	○	Ch	○			
<i>Vicia amoena</i> Fisch. ex DC. (갈퀴나물)		○	G				
<i>Vigna angularis</i> var. <i>nipponensis</i> (Ohwi) Ohwi & H. Ohashi (새팥)	○	○	Th				
<i>Wisteria floribunda</i> (Willd.) DC. (등)	○	○	MM				IV
Geraniaceae (취손이풀과)							
<i>Geranium thunbergii</i> Siebold & Zucc. (이질풀)	○		H				
Oxalidaceae (괘이밥과)							
<i>Oxalis corniculata</i> L. (괘이밥)	○	○	Ch				
Rutaceae (운향과)							
<i>Euodia officinalis</i> Dode (오수유)	○	○	M				
<i>Zanthoxylum schinifolium</i> Siebold & Zucc. (산초나무)	○	○ (1.7)	M				
Simaroubaceae (소태나무과)							

Appendix 1. Continued 4

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	F.R.D. ⁶⁾
	Present	Absent					
<i>Ailanthus altissima</i> (Mill.) Swingle (가죽나무)	○	○	MM	○			
Euphorbiaceae (대극과)							
<i>Acalypha australis</i> L. (깨풀)	○	○	Th				
<i>Euphorbia humifusa</i> Willd. ex Schlttdl. (땅빈대)	○	○	Th				
<i>Euphorbia maculata</i> L. (큰땅빈대)	○	○	Th	○			
<i>Mallotus japonicus</i> (L.f.) Müll.Arg. (예덕나무)	○	○	MM				I
<i>Phyllanthus urinaria</i> L. (여우구슬)	○		Th				
Buxaceae (회양목과)							
<i>Buxus koreana</i> Nakai ex Chung & al. (회양목)		○	N				I
Anacardiaceae (웃나무과)							
<i>Rhus javanica</i> L. (붉나무)	○	○ (1.4)	M				
<i>Rhus trichocarpa</i> Miq. (개웃나무)	○	○	M				
<i>Rhus verniciflua</i> Stokes (웃나무)	○	○	MM				
Celastraceae (노박덩굴과)							
<i>Celastrus orbiculatus</i> Thunb. (노박덩굴)	○		M				
<i>Euonymus fortunei</i> var. <i>radicans</i> (Siebold & Miq.) Rehder (줄사철나무)	○		M				I
<i>Euonymus japonicus</i> Thunb. (사철나무)	○	○	N				I
Aceraceae (단풍나무과)							
<i>Acer buergerianum</i> Miq. (중국단풍)	○		MM				
<i>Acer palmatum</i> Thunb. (단풍나무)	○	○	MM				III
<i>Acer tataricum</i> subsp. <i>ginnala</i> (Maxim.) Wesm. (신나무)	○	○	M				
Balsaminaceae (봉선화과)							
<i>Impatiens textori</i> Miq. (물봉선)	○	○	Th				
Rhamnaceae (갈매나무과)							
<i>Ziziphus jujuba</i> var. <i>inermis</i> (Bunge) Rehder (대추나무)	○	○	MM				
Vitaceae (포도과)							
<i>Ampelopsis heterophylla</i> (Thunb.) Siebold & Zucc. (개머루)	○	○	N				
<i>Cayratia japonica</i> (Thunb.) Gagnep. (거지덩굴)	○		G				I
<i>Parthenocissus tricuspidata</i> (Siebold & Zucc.) Planch. (담쟁이덩굴)	○	○	M				
<i>Vitis amurensis</i> Rupr. (왕머루)	○	○	MM				
<i>Vitis coignetiae</i> Pulliat ex Planch. (머루)	○	○	MM				
Tiliaceae (피나무과)							
<i>Triumfetta japonica</i> Makino (고슴도치풀)		○	Th				
Malvaceae (아욱과)							
<i>Hibiscus syriacus</i> L. (무궁화)	○	○	N				
Sterculiaceae (벽오동과)							
<i>Corchoropsis tomentosa</i> (Thunb.) Makino (수까치깨)	○	○	Th				
Theaceae (차나무과)							
<i>Camellia sasanqua</i> Thunb. (애기동백나무)	○	○	M				
Violaceae (제비꽃과)							
<i>Viola acuminata</i> Ledeb. (줄방제비꽃)		○	H				
<i>Viola keiskei</i> Miq. (잔털제비꽃)	○		H				
<i>Viola mandshurica</i> W.Becker (제비꽃)	○	○	H				
<i>Viola papilionacea</i> Pursh (종지나물)	○		H	○			
<i>Viola verecunda</i> A.Gray (콩제비꽃)	○	○	H				
Cucurbitaceae (박과)							
<i>Cucurbita moschata</i> Duchesne (호박)	○	○	Th				

Appendix 1. Continued 5

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	F.R.D. ⁶⁾
	Present	Absent					
<i>Sicyos angulatus</i> L. (가시박)	○	○	Th	○	○		
<i>Trichosanthes kirilowii</i> Maxim. (하늘타리)	○	○	G				
Lythraceae (부처꽃과)							
<i>Lagerstroemia indica</i> L. (배롱나무)	○	○	M				
Onagraceae (바늘꽃과)							
<i>Ludwigia prostrata</i> Roxb. (여뀌바늘)	○	○	Th				
<i>Oenothera biennis</i> L. (달맞이꽃)	○	○ (2.4)	Th	○			
Araliaceae (두릅나무과)							
<i>Aralia elata</i> (Miq.) Seem. (두릅나무)	○	○	M				
<i>Kalopanax septemlobus</i> (Thunb.) Koidz. (음나무)		○	MM				
Umbelliferae (산형과)							
<i>Angelica polymorpha</i> Maxim. (궁궁이)	○		G				
<i>Hydrocotyle sibthorpioides</i> Lam. (피막이)	○		Ch				
<i>Ledebouriella seseloides</i> (Hoffm.) H. Wolff (방풍)		○	H				
<i>Oenanthe javanica</i> (Blume) DC. (미나리)	○		HH				
<i>Torilis japonica</i> (Houtt.) DC. (사상자)		○	Th				
Cornaceae (충충나무과)							
<i>Cornus controversa</i> Hemsl. (충충나무)	○	○	MM				
<i>Cornus officinalis</i> Siebold & Zucc. (산수유)	○		M				
Ericaceae (진달래과)							
<i>Rhododendron indicum</i> (L.) Sweet (영산홍)	○	○	N				
<i>Rhododendron mucronulatum</i> Turcz. (진달래)		○	N				
<i>Rhododendron yedoense</i> f. <i>poukhanense</i> (H.Lév.) M.Sugim. ex T.Yamaz. (산철쭉)	○	○	N				
Primulaceae (앵초과)							
<i>Lysimachia clethroides</i> Duby (큰까치수염)	○	○	G				
Ebenaceae (감나무과)							
<i>Diospyros kaki</i> Thunb. (감나무)	○	○	MM				
Symplocaceae (노린재나무과)							
<i>Symplocos chinensis</i> f. <i>pilosa</i> (Nakai) Ohwi (노린재나무)	○	○	N				
Styracaceae (때죽나무과)							
<i>Styrax japonicus</i> Siebold & Zucc. (때죽나무)	○	○	MM				
<i>Styrax obassia</i> Siebold & Zucc. (쪽동백나무)	○	○	MM				
Oleaceae (물푸레나무과)							
<i>Forsythia koreana</i> (Rehder) Nakai (개나리)	○	○	N				
<i>Fraxinus rhynchophylla</i> Hance (물푸레나무)	○		MM				
<i>Ligustrum obtusifolium</i> Siebold & Zucc. (취퐁나무)	○	○	M				
Asclepiadaceae (박주가리과)							
<i>Metaplexis japonica</i> (Thunb.) Makino (박주가리)	○	○	G				
Convolvulaceae (메꽃과)							
<i>Calystegia hederacea</i> Wall. (애기메꽃)	○		G				
<i>Calystegia sepium</i> var. <i>japonicum</i> (Choisy) Makino (메꽃)	○	○	G				
<i>Calystegia soldanella</i> (L.) Roem. & Schultb. (갯메꽃)	○	○	G				I
<i>Cuscuta japonica</i> Choisy (새삼)	○		Th				
<i>Cuscuta pentagona</i> Engelm. (미국실새삼)	○	○	Th	○			
<i>Ipomoea hederacea</i> Jacq. (미국나팔꽃)	○	○	Th	○			
<i>Ipomoea lacunosa</i> L. (애기나팔꽃)	○	○	Th	○			
<i>Ipomoea purpurea</i> (L.) Roth (동근잎나팔꽃)	○	○	Th	○			

Appendix 1. Continued 6

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	F.R.D. ⁶⁾
	Present	Absent					
<i>Ipomoea triloba</i> L. (별나팔꽃)	○	○	Th	○			
<i>Pharbitis nil</i> (L.) Choisy (나팔꽃)		○	Th				
<i>Quamoclit coccinea</i> Moench (둥근잎유홍초)	○	○	Th	○			
Verbenaceae (마편초과)							
<i>Callicarpa japonica</i> Thunb. (작살나무)	○	○	M				
<i>Clerodendrum trichotomum</i> Thunb. (누리장나무)	○		MM				
Labiatae (꿀풀과)							
<i>Agastache rugosa</i> (Fisch. & Mey.) Kuntze (배초향)	○	○	H				
<i>Ajuga decumbens</i> Thunb. (금창초)		○	H				
<i>Clinopodium chinense</i> var. <i>parviflorum</i> (Kudo) H. Hara (층층이꽃)	○	○	H				
<i>Lamium amplexicaule</i> L. (광대나물)	○		Th				
<i>Leonurus japonicus</i> Houtt. (익모초)	○	○	Th				
<i>Lycopus lucidus</i> Turcz. ex Benth. (썩싸리)		○	HH				
<i>Meehania urticifolia</i> (Miq.) Makino (별개덩굴)	○	○	H				
<i>Mosla dianthera</i> (Buch.-Ham. ex Roxb.) Maxim. (취개풀)		○	Th				
<i>Mosla punctulata</i> (J.F.Gmelin) Nakai (들개풀)		○	Th				
<i>Perilla frutescens</i> var. <i>japonica</i> (Hassk.) H. Hara (들깨)	○	○	Th				
<i>Phlomis umbrosa</i> Turcz. (속단)	○		H				
<i>Salvia plebeia</i> R.Br. (배암차즈기)		○	Th				
Solanaceae (가지과)							
<i>Physalis wrightii</i> A.Gray (노란꽃망파리)	○		Th	○			
<i>Solanum americanum</i> Mill. (미국까마중)	○		Th	○			
<i>Solanum nigrum</i> L. (까마중)	○	○	Th				
Scrophulariaceae (현삼과)							
<i>Melampyrum roseum</i> Maxim. (꽃머느리밥풀)		○	Th				
<i>Paulownia coreana</i> Uyeki (오동나무)	○		MM				
<i>Veronica persica</i> Poir. (큰개불알풀)		○	Th	○			
Bignoniaceae (능소화과)							
<i>Campsis grandiflora</i> (Thunb.) K. Schum. (능소화)	○		MM				
Acanthaceae (취꼬리망초과)							
<i>Justicia procumbens</i> L. (취꼬리망초)	○	○	Th				
Phrymaceae (파리풀과)							
<i>Phryma leptostachya</i> var. <i>asiatica</i> H. Hara (파리풀)	○	○	G				
Plantaginaceae (질경이과)							
<i>Plantago asiatica</i> L. (질경이)	○	○	H				
Rubiaceae (꼭두서니과)							
<i>Galium spurium</i> var. <i>echinospermon</i> (Wallr.) Hayek (갈퀴덩굴)	○		Th				
<i>Galium verum</i> var. <i>asiaticum</i> Nakai (솔나물)	○		H				
<i>Paederia scandens</i> var. <i>scandens</i> (Lour.) Merr. (계요등)	○	○	Ch				
<i>Rubia akane</i> Nakai (꼭두서니)	○	○	G				
Caprifoliaceae (인동과)							
<i>Lonicera japonica</i> Thunb. (인동덩굴)	○	○	M				
<i>Weigela subsessilis</i> (Nakai) L.H.Bailey (병꽃나무)	○		N				
Valerianaceae (마타리과)							
<i>Patrinia villosa</i> (Thunb.) Juss. (뚝갈)	○	○	H				
<i>Valeriana fauriei</i> Briq. (취오줌풀)		○	G				
Compositae (국화과)							

Appendix 1. Continued 7

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	F.R.D. ⁶⁾
	Present	Absent					
<i>Ambrosia artemisiifolia</i> L. (돼지풀)	○	○ (1.4)	Th	○	○		
<i>Ambrosia trifida</i> L. (단풍잎돼지풀)	○	○	Th	○	○		
<i>Artemisia annua</i> L. (개똥쭉)	○		Th				
<i>Artemisia capillaris</i> Thunb. (사철쭉)		○	G				
<i>Artemisia gmelinii</i> Weber Stechm. (더위지기)	○		N				
<i>Artemisia japonica</i> Thunb. (제비쭉)		○	H				
<i>Artemisia princeps</i> Pamp. (쭉)	○ (6.0)	○ (35.9)	Ch				
<i>Artemisia stolonifera</i> (Maxim.) Kom. (넓은잎외잎쭉)	○		H				
<i>Aster koraiensis</i> Nakai (별개미취)	○		H				
<i>Aster meyerendorffii</i> (Regel & Maack) Voss (개쭉부쟁이)		○	H				
<i>Aster pilosus</i> Willd. (미국쭉부쟁이)	○		H	○	○		
<i>Aster subulatus</i> Michx. (비짜루국화)	○	○	H	○			
<i>Aster subulatus</i> var. <i>sandwicensis</i> A.G.Jones (큰비짜루국화)		○	Th	○			
<i>Aster yomena</i> (Kitam.) Honda (쭉부쟁이)	○	○	Ch				
<i>Bidens bipinnata</i> L. (도깨비바늘)	○	○ (1.1)	Th				
<i>Bidens biternata</i> (Lour.) Merr. & Sherff ex Sherff (털도깨비바늘)	○	○	Th				
<i>Bidens frondosa</i> L. (미국가막사리)	○	○ (1.4)	Th	○			
<i>Bidens pilosa</i> L. (울산도깨비바늘)	○	○	Th	○			
<i>Bidens tripartita</i> L. (가막사리)	○		Th				
<i>Cirsium japonicum</i> var. <i>maackii</i> (Maxim.) Matsum. (영경취)	○	○	H				
<i>Cirsium pendulum</i> Fisch. ex DC. (큰영경취)	○		H				I
<i>Conyza bonariensis</i> (L.) Cronquist (실망초)	○	○	Th	○			
<i>Conyza canadensis</i> (L.) Cronquist (망초)	○ (2.9)	○ (10.6)	Th	○			
<i>Coreopsis lanceolata</i> L. (큰금계국)	○	○	H	○			
<i>Cosmos bipinnatus</i> Cav. (코스모스)	○		Th	○			
<i>Crassocephalum crepidioides</i> (Benth.) S.Moore (주홍서나물)	○	○	Th	○			
<i>Crepidiastrum denticulatum</i> (Houtt.) Pak & Kawano (이고들빼기)	○	○	Th				
<i>Crepidiastrum sonchifolium</i> (Maxim.) Pak & Kawano (고들빼기)	○		Th				
<i>Dendranthema boreale</i> (Makino) Ling ex Kitam. (산국)	○	○	H				
<i>Dendranthema indicum</i> (L.) DesMoul. (감국)	○		H				
<i>Eclipta prostrata</i> (L.) L. (한련초)	○		Th				
<i>Erechtites hieracifolia</i> Raf. (붉은서나물)	○	○	Th	○			
<i>Erigeron annuus</i> (L.) Pers. (개망초)	○	○ (3.0)	Th	○			
<i>Erigeron philadelphicus</i> L. (봄망초)	○	○	H	○			
<i>Erigeron strigosus</i> Muhl. ex Willd. (주걱개망초)	○	○	Th	○			
<i>Eupatorium japonicum</i> Thunb. (등골나물)	○	○	G				
<i>Eupatorium rugosum</i> Houtt. (서양등골나물)	○	○	H	○	○		
<i>Filifolium sibiricum</i> (L.) Kitam. (실쭉)	○		H				
<i>Galinsoga ciliata</i> (Raf.) S.F.Blake (털별꽃아재비)	○	○	Th	○			
<i>Helianthus annuus</i> L. (해바라기)	○		Th				
<i>Helianthus tuberosus</i> L. (풍만지)	○	○	G	○			
<i>Hemistepta lyrata</i> Bunge (지칭개)		○	Th				
<i>Hypochaeris radicata</i> L. (서양금혼초)	○	○	H	○	○		
<i>Ixeris repens</i> (L.) A.Gray (갯쭉바귀)	○	○	G				I
<i>Ixeris strigosa</i> (H.Lév. & Vaniot) J.H.Pak & Kawano (선쭉바귀)	○		H				
<i>Lactuca indica</i> L. (왕고들빼기)	○	○ (1.7)	Th				
<i>Lactuca indica</i> f. <i>indivisa</i> (Makino) Hara (가는잎왕고들빼기)	○	○	Th				

Appendix 1. Continued 8

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	FR.D. ⁶⁾
	Present	Absent					
<i>Lactuca scariola</i> L. (가시상추)	○	○	Th	○	○		
<i>Lactuca triangulata</i> Maxim. (두메고들빼기)	○		Th				
<i>Petasites japonicus</i> (Siebold & Zucc.) Maxim. (머위)	○	○	H				
<i>Picris hieracioides</i> var. <i>koreana</i> Kitam. (쇠서나물)	○		Th				
<i>Senecio nemorensis</i> L. (금방망이)	○		H			VU	V
<i>Senecio vulgaris</i> L. (개쑥갓)		○	Th	○			
<i>Sigesbeckia pubescens</i> (Makino) Makino (털진득찰)	○	○	Th				
<i>Solidago altissima</i> L. (양미역취)		○	G	○	○		
<i>Sonchus asper</i> (L.) Hill (큰방가지똥)		○	Th	○			
<i>Sonchus brachyotus</i> DC. (사데풀)	○		H				
<i>Sonchus oleraceus</i> L. (방가지똥)	○	○	Th	○			
<i>Tagetes minuta</i> L. (만수국아재비)	○		Th	○			
<i>Taraxacum officinale</i> Weber (서양민들레)	○	○	H	○			
<i>Taraxacum platycarpum</i> Dahlst. (민들레)	○	○	H				
<i>Xanthium canadense</i> Mill. (큰도꼬마리)	○	○	Th	○			
<i>Xanthium strumarium</i> L. (도꼬마리)	○		Th	○			
Gramineae (벼과)							
<i>Agropyron ciliare</i> (Trin.) Franch. (속털개밀)		○	Th				
<i>Agropyron tsukushiense</i> var. <i>transiens</i> (Hack.) Ohwi (개밀)		○	H				
<i>Arthraxon hispidus</i> (Thunb.) Makino (조개풀)	○	○	Th				
<i>Bromus unioloides</i> Kunth (큰이삭풀)	○		H	○			
<i>Calamagrostis epigeios</i> (L.) Roth (산조플)	○	○	G				
<i>Calamagrostis langsdorffii</i> (Link) Trin. (산새풀)		○	G				
<i>Cymbopogon tortilis</i> var. <i>goeringii</i> (Steud.) Hand.-Mazz. (개솔새)		○	H				
<i>Dactylis glomerata</i> L. (오리새)	○	○	H	○			
<i>Digitaria ciliaris</i> (Retz.) Koel. (바랭이)	○	○ (2.9)	Th				
<i>Echinochloa crus-galli</i> (L.) P.Beauv. (돌피)	○	○	Th				
<i>Echinochloa crus-galli</i> var. <i>oryzicola</i> (Vasinger) Ohwi (물피)	○	○	Th				
<i>Eleusine indica</i> (L.) Gaertn. (왕바랭이)	○	○	Th				
<i>Elymus mollis</i> Trin. (갯그렁)		○	H				III
<i>Eragrostis curvula</i> Nees (능수참새그렁)		○	H	○			
<i>Eragrostis ferruginea</i> (Thunb.) P.Beauv. (그렁)	○	○	H				
<i>Eriochloa villosa</i> (Thunb.) Kunth (나도개피)	○	○	H				
<i>Festuca arundinacea</i> Schreb. (큰김의털)	○	○	H	○			
<i>Lolium perenne</i> L. (호밀풀)	○		H	○			
<i>Miscanthus sacchariflorus</i> (Maxim.) Benth. (물억새)		○	H				
<i>Miscanthus sinensis</i> var. <i>purpurascens</i> (Andersson) Rendle (억새)	○	○ (4.0)	H				
<i>Oplismenus undulatifolius</i> (Ard.) P.Beauv. (주름조개풀)	○	○ (1.6)	H				
<i>Panicum bisulcatum</i> Thunb. (개기장)	○	○	Th				
<i>Panicum dichotomiflorum</i> Michx. (미국개기장)	○	○	Th	○			
<i>Paspalum dilatatum</i> Poir. (큰참새피)	○		H	○			
<i>Paspalum thunbergii</i> Kunth ex Steud. (참새피)	○		H				
<i>Pennisetum alopecuroides</i> (L.) Spreng. (수크렁)	○	○	H				
<i>Phragmites communis</i> Trin. (갈대)	○	○	HH				
<i>Phyllostachys bambusoides</i> Siebold & Zucc. (왕대)	○	○	MM				
<i>Phyllostachys nigra</i> var. <i>henonis</i> (Bean) Stapf ex Rendle (숨대)	○		MM				
<i>Poa sphondylodes</i> Trin. (포아풀)	○		H				

Appendix 1. Continued 9

Scientific-Korean name	<i>P. americana</i> ¹⁾		L.F. ²⁾	A.S. ³⁾	E.D.S. ⁴⁾	R.L. ⁵⁾	FR.D. ⁶⁾
	Present	Absent					
<i>Setaria faberii</i> Herrm. (가을강아지풀)	○	○	Th				
<i>Setaria glauca</i> (L.) P.Beauv. (금강아지풀)	○	○	Th				
<i>Setaria viridis</i> (L.) P.Beauv. (강아지풀)	○ (3.7)	○ (12.3)	Th				
<i>Setaria</i> × <i>pyncnoma</i> (Steud.) Henrard ex Nakai (수강아지풀)	○	○	Th				
<i>Spodiopogon sibiricus</i> Trin. (큰기름새)	○	○	H				
<i>Sporobolus fertilis</i> (Steud.) Clayton (취꼬리새풀)		○	H				
<i>Themeda triandra</i> var. <i>japonica</i> (Willd.) Makino (솔새)	○	○	H				
<i>Zoysia japonica</i> Steud. (잔디)		○	Ch				
Cyperaceae (사초과)							
<i>Carex dimorpholepis</i> Steud. (이삭사초)	○		H				
<i>Carex humilis</i> var. <i>nana</i> (H.L.év. & Vaniot) Ohwi (가는잎그늘사초)	○	○	H				
<i>Carex kobomugi</i> Ohwi (통보리사초)	○	○	H				I
<i>Carex lanceolata</i> Boott (그늘사초)		○	H				
<i>Carex siderosticta</i> Hance (대사초)	○	○	H				
<i>Cyperus amuricus</i> Maxim. (방동사니)	○		Th				
<i>Cyperus iria</i> L. (참방동사니)	○	○	Th				
<i>Cyperus microiria</i> Steud. (금방동사니)	○	○	Th				
<i>Lipocarpa microcephala</i> (R.Br.) Kunth (세대가리)	○		Th				
Araceae (천남성과)							
<i>Arisaema heterophyllum</i> Blume (두루미천남성)	○		G			LC	I
Commelinaceae (닭의장풀과)							
<i>Commelina communis</i> L. (닭의장풀)	○ (2.9)	○ (7.8)	Th				
Liliaceae (백합과)							
<i>Hemerocallis fulva</i> (L.) L. (원추리)	○		G				
<i>Hosta capitata</i> (Koidz.) Nakai (일월비비추)		○	H				I
<i>Hosta longipes</i> (Franch. & Sav.) Matsum. (비비추)	○	○	H				
<i>Liriope platyphylla</i> F.T.Wang & T.Tang (맥문동)	○	○	G				
<i>Polygonatum odoratum</i> var. <i>pluriflorum</i> (Miq.) Ohwi (둥굴레)	○		G				
<i>Scilla scilloides</i> (Lindl.) Druce (무릇)	○	○	G				
<i>Smilax china</i> L. (청미래덩굴)	○	○	N				
<i>Smilax riparia</i> var. <i>ussuriensis</i> (Regel) Hara & T.Koyama (밀나물)		○	G				
<i>Smilax sieboldii</i> Miq. (청가시덩굴)	○	○	N				
Dioscoreaceae (마과)							
<i>Dioscorea batatas</i> Decne. (마)	○	○	G				
<i>Dioscorea bulbifera</i> L. (둥근마)		○	G				
<i>Dioscorea quinqueloba</i> Thunb. (참마)	○	○	G				
<i>Dioscorea quinqueloba</i> Thunb. (단풍마)	○	○	G				

¹⁾Numbers in parenthesis are rNCD ≥ 1 . ²⁾L.F., Raunkiaer's lifeform; ³⁾A.S., alien species; ⁴⁾E.D.S., ecosystem disturbing species designated by the act on the conservation and the use of biological diversity; ⁵⁾R.L., red list (CR, critically endangered; VU, vulnerable; LC, least concerned); ⁶⁾FR.D., floristic regional degree.