The Red List of Selected VASCULAR PLANTS in Korea

Chin-Sung Chang, Hui Kim, Sungwon Son, and Yong-Shik Kim

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Cover photos
Front cover: *Hanabusaya asiatica*
Back cover: *Thuja koraiensis*
Abies Koreana
Deutzia paniculata
Prunus choreiana

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The work of establishing a consolidated list of threatened plants in Korea was first initiated by the KPSG (Korean Plant Specialist Group) who developed the original database on which this report is based. The exacting task of compiling data from national Red Lists was carried out by the KPSG. Drs. Hui Kim and Chin Sung Chang coordinated the compilation of data and the assessments of the target species. Dr. Sungwon Son provided guidance, encouragement, and good advice throughout the project. Dr. Yong-Shik Kim organized the evaluation workshop.

Nomenclature and taxonomy follows the Provisional Checklist of Vascular Plants for the Korean Peninsula Flora (KPF) (Chang *et al.,* 2014).

The fourth author, Dr. Y.S. Kim, who is a chairperson of the KPSG, would like to express his appreciation as follows.

The Red List assessment for threatened plants in Korea in the context of the present environmental situation has been one of the forthcoming tasks for the KPSG. The KPSG is proud of this first comprehensive and valuable output using the updated IUCN Red List category and criteria to identify and target endemic species in the Korean peninsula. The Vascular Plants Red Data List was prepared by the KPSG in the last couple of years with the kind and generous support of the Korea National Arboretum (KNA) and with authors who focused on integrated approaches to the conservation of threatened Korean plant taxa.

This publication is closely followed by the KPF-Database that can be applied jointly with the IUCN Red List category and criteria. The former includes selected taxa and implements a 'Waiting List for Threatened Korean Plant Taxa', which identifies those taxa for which analyses based on the IUCN Red List Assessment is beyond current application because of the lack of relevant information. An updated change in threatened status for certain taxa will substitute or amend the status categories mentioned here. The annual updates to the Red Data List will be open to the public via electronic formats; they will be based on either new or additional data, or refined methods of analyzing the data already available.

Through the dedicated efforts of the KPSG, this publication could be a landmark for maximizing the conservation of threatened plants and for developing supporting policy and action to conserve plant species, as well as for communicating the importance of plant conservation in the Republic of Korea.

We are grateful to all the members of the Korea National Arboretum and other colleagues from Korea who provided essential advice, invaluable guidance, and supplementary information on the plant species included in the database.

Any opinions, findings, conclusions, or recommendations expressed in this document are strictly those of the authors: they do not necessarily reflect the views of the KPSG or of the International Union for Conservation of Nature (IUCN).

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Foreword

The Korea National Arboretum undertakes various research activities along with *in-situ* and *ex-situ* conservation activities for biodiversity conservation on the Korea Peninsula, which also coincide with the national target of the Global Strategy for Plant Conservation (GSPC) 2020. For example, we are implementing Target 7 of GSPC 2020 through the activities of habitat monitoring, installation and protection activities of conservation facilities, and designation of protection areas for *in-situ* conservation of rare and endangered plants. In addition, we are implementing Target 8 of GSPC 2020 through various ex-situ conservation activities and studies based on the Seed Bank and Propagation Center.

Meanwhile, the Korea National Arboretum also conducts various research projects and activities for conservation of rare and endangered plants on the Korean Peninsula through a partnership with the International Union for Conservation of Nature (IUCN) Korean Plant Specialist Group (KPSG). Notably, in 2011, and IUCN Red List assessment training workshop was held to emphasize the importance of the results of this research.

The IUCN Red List assessment of Korean endemic plants with the KPSG was a meaningful activity that was the first ever conducted in Korea, and this corresponds with the implementation of Target 2 of GSPC 2020. With the opportunity of this operation, we are willing to continue the assessment of endemic plants on the Red List in East Asia at the regional level, while simultaneously continuing to assess Korean endemic plants on the Red List.

Lastly, I would like to express my gratitude to the researchers and the KPSG for their unstinting effort toward the Red List assessment of the Korean peninsular endemic plants.

You Mi Lee, Ph.D.
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Cypripedium japonicum

Introduction

Cirsium rhinoceros

Adenophora taquetii

The Korean landscape has been drastically changed by the Korean War and human activities of the last 100 years, so that now the peninsula is covered in a mosaic of natural and semi-natural habitats. This staggering modification has obviously placed great pressure on our natural areas. Consequently, biodiversity loss is an enormous challenge facing Korea in the 21st century.

This report is the first comprehensive analysis of decline using the updated IUCN Red List category and criteria for some selected species in the Korean peninsula. It emphasizes a group of species more threatened in the Republic of Korea than in the rest of the Democratic People's Republic of Korea.

The IUCN SSC's Korean Plant Specialist Group (KPSG) was established in the spring of 1997; this group was started with 10 members from the botanical gardens and arboreta, government officials, and academics.

We held several plant conservation workshops at the Korea National Arboretum. Moreover, the conservation research funds raised by the Korea National Arboretum (KNA) regularly accelerated the group's activity. The augmented KPSG has acted as the key messenger to pursue activities such as the Red List compilation, thus increasing its responsibility in Korea for the next 20 years.

The KPSG has adopted an ambitious new strategy to halt the loss of biodiversity in Korea by 2020. There are three main priorities: 1) The IUCN Red List of Korean Plants both at the global and national level, 2) The plant conservation action plan for endangered species, and 3) The conservation strategy for Korean Plants. The KNA has supported the KPSG to work on the red listing for Korean plants since 2010.

Regional Korean Red Lists are an important tool to scientifically assess and communicate the status of species among scientists in Korea. They can complement the reporting from temporary surveys of a specific taxonomic group, and they can give limited information about the situation of biodiversity in Korea. The data at hand are simply insufficient to reach any definitive assessment. It is disturbing that the lack of data is still a limiting factor in achieving conservation goals.

This report aims to address one of the most serious gaps in our knowledge by providing a starting baseline that is critical for developing reliable evaluations. Here, we have taken an integrated approach to rare plant conservation through this work. The list itself shows clearly how much further work needs to be done to complete the detailed conservation assessment of all Korean species.

FORESTS AND BIODIVERSITY IN KOREA

The flora of Korea is not well known because of its geographic position (situated between China and Japan), which encompasses a diversity of terrestrial formations and wide ranges in altitude (0–2,000 m above sea level), precipitation levels (600–1,800 mm), and average yearly temperatures (-2.5–25 C°). These variations in temperature and rainfall within relatively small areas are reflected in three distinct temperate forest zones (cold, cool, and warm).

Forest alone covers 12,930,000 ha, or 58% of the Korea's land area, mainly in form of broad-leaf and conifer trees. Moreover, 70% of its land surface is steep and mountainous. A range of forest types are found, including evergreen and warm temperate forest on the southern coast, cool and cold temperate forest in the east, montane conifer forest, and cold temperate forest in the north, and

Hanabusaya asiatica

mixed forest (conifer and broad-leaf) in the west. Korea has more than 3,500 higher plant species, including 650 woody species in 1,000 genera and 200 families.

There are two institutions in Korea responsible for the management of forest resources. The Ministry of Environment is in charge of the National Parks, while the Korea Forest Service (KFS) is in charge of the management of national forests. The KFS is responsible for the conservation of threatened species and the preparation of the official Red List of Korea.

Although a floristic province is a geographic area with a relatively uniform composition of plant species, adjacent floristic provinces usually do not have sharp boundaries. A transitional area, often called a 'vegetation tension zone', is one in which many species from both regions overlap; an example is the west side of the Korean peninsula. In addition, the Ulleung and Jeju Islands are characterized by an exceptional amount of endemic species, which constitute a subset of the Korean peninsula flora, rather than an altogether unique flora.

The flora of the Eastern Asiatic region is generally characterized by a large number of endemics. The major subdivision of the Eastern flora is composed of 13 provinces. The determination of the extent of these provinces is based upon their diversity of endemic genera, phylogenetic divergence, and geographic origins (including geologic, climatic, and geographic factors). Among 13 provinces of the Eastern Asiatic Region (Takhtajan, 1986), the Manchurian, Korean-Japanese, and North Chinese provinces are three that can be recognized in the Korean peninsula now. The separation of the Korean-Japanese and North Chinese provinces is newly proposed here, with the former including the Manchurian province. This province includes only eastern China east of a line that passes from northwest to southwest Korea.

The distribution patterns are variously associated into diversified ecosystems from Northeast China (Fig. 1, mixed deciduous forest with *Pinus koraiensis* as one of the dominants). Mixed deciduous forests marked by *Pinus koraiensis* cover vast mountainous regions and contain a number of old floristic

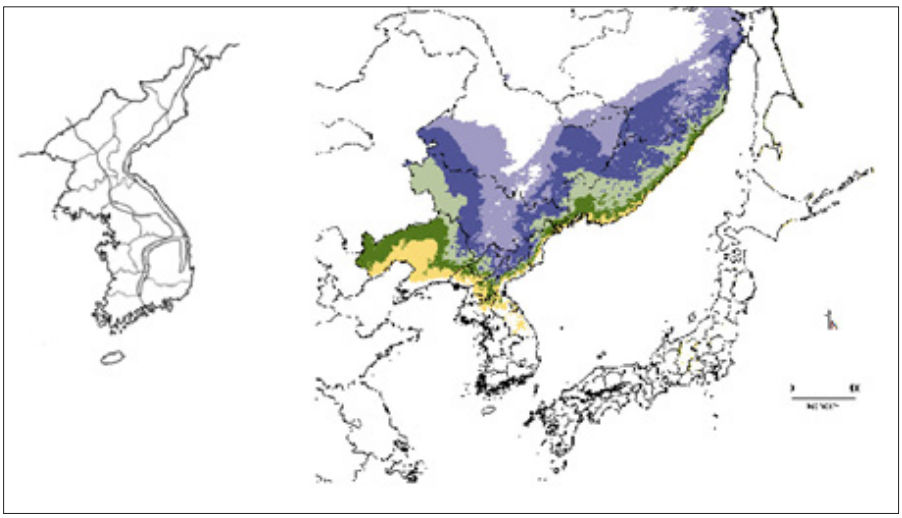


Fig. 1. Amur flora (Manchurian flora)

Glochidion chodoense

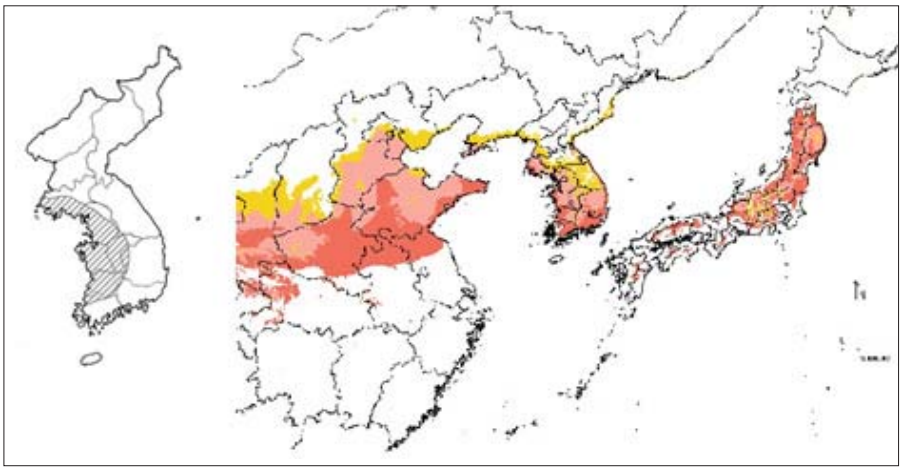


Fig. 2. North China flora

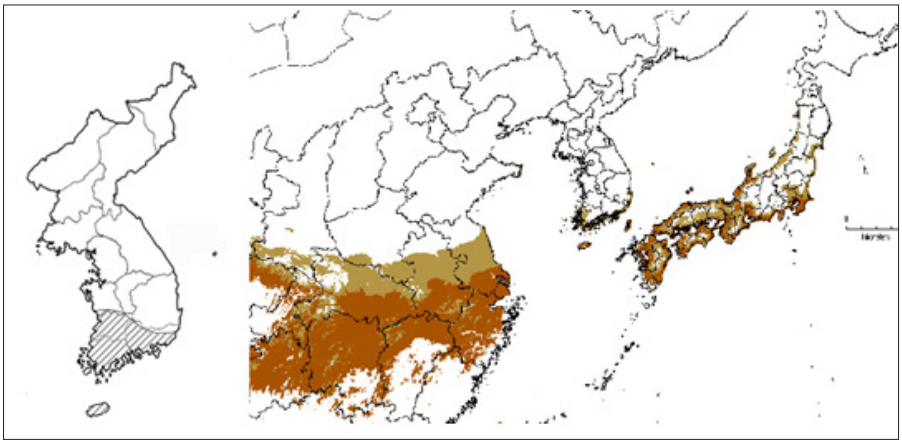


Fig. 3. China-Japan-Korea flora (CJK)

elements, but endemic genera are very scarce here and no endemic families occur within this province. The representative species are as follows; *Schisandra chinensis* (Turcz.) Baillon, *Ulmus laciniata* (Trautv.) Mayr, *Juglans mandshurica* Maxim., *Quercus mongolica* Fisch. ex Ledeb., *Tilia mandshurica* Rupr. & Maxim., *Phellodendron amurense* Rupr., *Eleutherococcus sessiliflorus* (Rupr. et Maxim.) S. Y. Hu, *Vitis amurensis* Rupr., *Picea jezoensis* (Siebold & Zucc.) Carrière, *Platycladus orientalis* (L.) Franco, *Abies holophylla* Maxim., *Betula costata* Trautv., *Salix kangensis* Nakai, *Rhododendron schlippenbachii* Maxim., *Pyrus ussuriensis* Maxim., *Acer mandshuricum* Maxim., *Acer komarovii* Pojarkova, *Acer barbinerve* Maxim., *Acer caudatum* var. *ukurunduense* (Trutv. & C. A. Mey.) Rehder, *Acer pictum* var. *mono* (Maxim.) Maxim. ex Franch., *Acer tataricum* subsp. *ginnala* (Maxim) Wesm., *Deutzia glabrata* Kom.,*Oplopanax elatus* (Nakai) Nakai, *Syringa wolfii* C. K. Schneid., *Syringa reticulata* (Blume) H. Hara, *Abies nephrolepis* (Trautv.) Maxim., *Betula davurica* Pall., and *Euonymus verrucosus* Scop. var. *pauciflorus* (Maxim.) Regel.

The characteristic vegetation of North China is a drier, mixed deciduous oak forest marked by *Pinus tabuliformis* or *P. densiflora* (Fig. 2, from maritime areas to the Liaotung and Shandong peninsulas). North China has a rather ancient flora that dates from the Tertiary. The following species are representative examples of the North China province: *Philadelphus pekinensis* Rupr., *Rhus chinensis* Mill., *Celtis sinensis* Persoon, *Clerodendrum trichotomum* Thunb., *Euonymus hamiltonianus* Wall., *Grewia biloba* G. Don, *Cocculus orbiculatus* (L.) DC,. *Akebia quinata* (Houtt.) Decne., *Rhodotypos scandens* (Thunb.) Makino, *Betula chinensis* Maxim,. *Platycarya strobilacea* Siebold & Zucc., and *Hovenia dulcis* Thunb.

Furthermore, it is reasonable to keep the original Japan-Korean Province separate and distinct in a floristic sense. The degree of diversification has been more pronounced and rapid in this province. Many evergreen species are found here, which belong to the Lauraceae, Fagaceae, Hamamelidaceae, and Aquifoliaceae families. Representative examples of these deciduous woody plants are: *Tsuga diversifolia* (Maxim.) Mast., *Pinus parviflora* Siebold & Zucc., *Pinus densiflora* Siebold & Zucc., *Celtis sinensis* Persoon, *Larix gmelinii* (Rupr.) Kuzen., *Pinus thunbergii* Parl., *Chamaecyparis obtusa* (Siebold & Zucc.) Endl., *Magnolia kobus* A. DC., *Carpinus tschonoskii* (Siebold & Zucc.) Maxim., *Stewartia pseudocamellia* Maxim., *Rhododendron tschonoskii* Maxim., and *Acer palmatum* Thunb.

The Korean peninsula supports approximately 3,500 species of vascular plants (Park, 2007), of which approximately 2.5% are thought to be endemic. The mountains of the Korean peninsula are a recognized local biodiversity hotspot, supporting approximately 45% of all species. Floristic diversity in the Korean peninsula is highest in Gangwon province and nearly as high as in southern Korea and the islands. Endemism is highest regionally in the Gangwon province and Taebaek Mountains, although local centers of endemism are widely scattered throughout the Korean peninsula.

Information collected for conservation assessments

The geographical scope is the Korean peninsula, extending from North to South Korea (see Fig. 1). In studying the Korea peninsula, we tried to concentrate on the North Korea region because it is significantly important in terms of much-needed Red List evaluations, but the available data for this region were inaccessible and not well informed. The potential for improved knowledge in the form of well documented biodiversity information is now recognized as essential for a better understanding and more effective conservation of Korean plants. The KPF database builds on earlier work that used data aggregated from heterogeneous sources before the end of Second World War, such as herbarium collections from TI, KYO, TUS, E, A, and other diverse literatures. Importantly, the data derived from herbarium specimens were sufficient to define plant geographic distributions in detail. Although range descriptions are certainly not the only consideration in status assessments, they are a critical starting point. That is, this information may be sufficiently available for many species to avoid a designation of Data Deficient.

Detailed population monitoring of selected species at a national scale from 2010 to 2015 began with the launch of the Korean Plant monitoring scheme, organized by Korea National Arboretum. The scheme's methodology was taken up independently by many local officers and amateur naturalists, and has so far collated data from over 80 sites. The methodology and development of monitoring protocols have been reviewed in detail, and these will be used to supplement standard data in the assessment of certain rare species from 2017 onward. Because this methodology will provide a standardized annual measure of populations at the studied sites, it can be used to generate long- and short-term population trends. The database will be updated continuously and made freely and widely available.

Implementation of this Red List Data

Although our aim in this report is to assess the level of threat facing vascular plant species in the Korean peninsula, Korea is a political, not a biogeographical, entity. Now that Red List Data exist for vascular plants in both ROK (South Korea) and DPRK (North Korea) some guidance on how these lists should be used is needed, especially given the fact that many taxa have different levels of threat in each area.

Any taxon deemed threatened (*i.e.,* Critically Endangered, Endangered, Vulnerable or Near Threatened) should be regarded as a priority for conservation in Korea, regardless of its threat status in Korea.

A candidate list of rare and endangered plant species was first drawn up from the published DPRK Red Data Book (2005), the List of Endangered and Threatened Wildlife and Plants (Ministry of Environment, 2005), and the Rare Plants Data Book of Korea (proposed by Korea National Arboretum, 2008). A current assessment was made for each species against the IUCN Red List Categories and Criteria version 3.1: a Red List status, when criteria were met, was assigned to each species for its population(s) on the Korean peninsula. If necessary, geographic information and quantitative elements were added to the original IUCN scheme, as a numerical criterion is now widely used to distinguish globally threatened plants.

Finally, an exhaustive search for synonyms of each species and their distributions in East Asia, particularly on the Korean peninsula, was then conducted. This was principally done using the Provisional Checklist of Vascular Plants for the Korea Peninsula Flora (KPF) (Chang *et al.,* 2014).

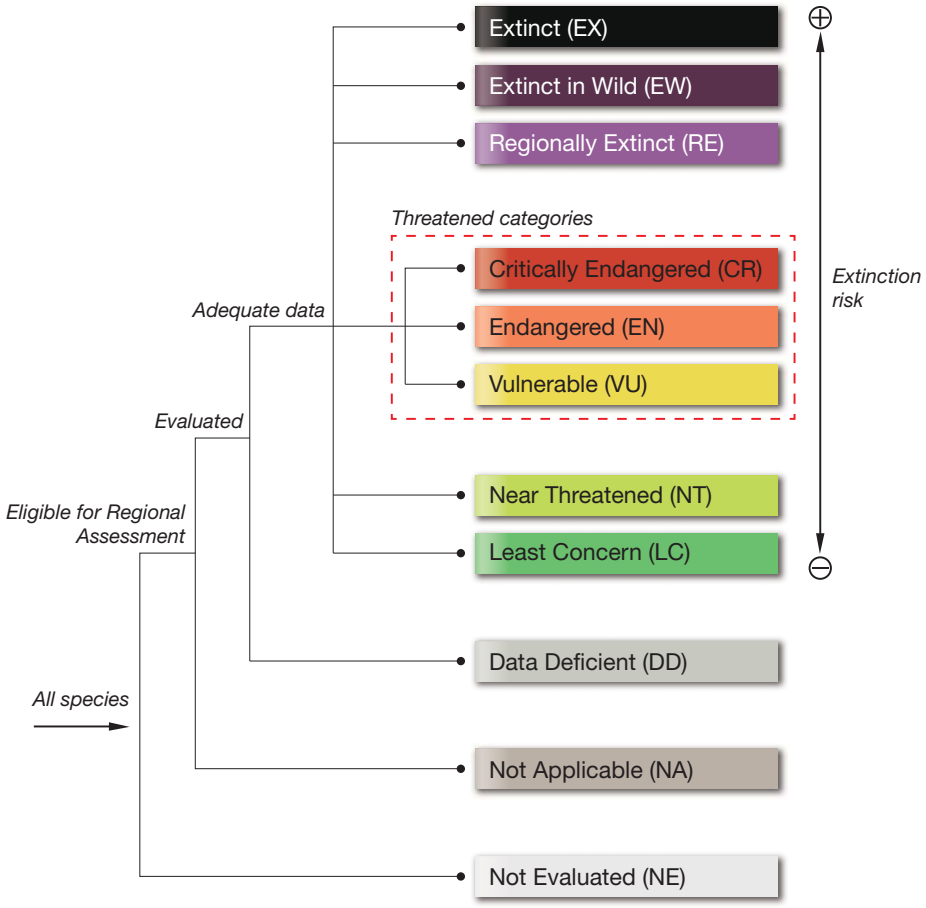
Deutzia paniculata

IUCN Red List Categories and Criteria

Kirengeshoma palmata

At the global scale, the best source of information on the conservation status of plants is the *IUCN Red List of Threatened Species* (see www.iucnredlist.org; IUCN 2011). The Red List provides taxonomic, conservation status, and distribution information on taxa that have been evaluated using the *IUCN Red List Categories and Criteria*: *Version 3.1* (IUCN 2001). There are nine Categories, ranging from Least Concern to the Extinct category. The IUCN Red List Categories are based on a set of quantitative criteria linked to population trends, population size and structure, and geographic range. Species classified as Vulnerable, Endangered, and Critically Endangered are considered as 'threatened'.

Fig. 4. IUCN Red List Categories at the global level (IUCN 2015)



Coverage and Data Sources

Iris koreana

1. Taxonomic coverage

Although various lists of 'at risk' plant species in Korea have been developed, an up-to-date IUCN Red List of Korean plants is not presently available. Two national institutes, the Ministry of Environment and the Korea National Arboretum, have published National Red Lists of threatened species, mostly, but not always, based on the IUCN Red List Categories and Criteria. In line with the national strategy for plant conservation, in 2005, the Ministry of Environment, Republic of Korea, declared legislation to develop and recognize a List of Endangered and Threatened Wildlife and Plants. It also proposed, in 2011, amending a list by de-listing or re-classifying endangered species with idiosyncratic qualitative criteria for two levels (I and II) followed by status reviews.

Since the IUCN Red List provides reliable tools to evaluate the extinction risk of species, the threatened status of 98 plants proposed by the Ministry of Environment (ROK) was assessed using the IUCN Red List Criteria (version 3.1) at a global level. Most species proposed by the Ministry of Environment (ROK) did not qualify as threatened. Indeed, one of the major difficulties found in applying the IUCN Red List criteria at the global scale was a lack of knowledge on the status of species at broader geographic scales, and the perceived difficulty this causes. Also, many endangered species, such as *Abeliophyllum distichum*, *Leontice microrhyncha*, *Sophora koreensis*, *Leontopodium coreanum*, *Iris odaesanensis*, and *Corylopsis coreana*, at global level were excluded here. Knowledge gaps and uncertainties mean that the number of taxa at high risk of extinction may be substantially greater than is currently known. A lack of taxonomic information for the status of the species *Physocarpus insularis*, as well as an invalidly published name, *Caragana koreana*, excluded them. These results suggest that the highest priorities for the Red List should be given to endemic species in Korean peninsula at global scale.

Similarly, an IUCN Red List of Threatened Species in the Democratic People's Republic of Korea (DPRK) has been published by the DPRK Man and the Biosphere (MAB) National Committee (MAB National Committee of DPR Korea, 2005). This book supplied categories and associated detailed documentation for all DPRK plants on the IUCN Red List. The DPRK MAB National Committee adopted two cases to list 153 rare and endangered species: 1) 55 rare taxa native and endemic to the DPRK, with four categories; and 2) 98 rare and endangered taxa native to the DPRK, but widely distributed in neighboring countries, also with four categories.

However, the regional IUCN Red List developed by the DPRK MAB National Committee posed several problems. As the DPRK national list designation had proceeded without quantitative information on the status of the species in the neighboring countries of China, Japan, and far-eastern Russia, it may lead to wide-scale inaccuracies.

Another problem that arose was taxonomic inflation and the instability of the species lists. Many species in the DPRK on the IUCN Red List were extremely vulnerable to changes in species definitions. As a result of new knowledge and taxonomic revisions, all available evidence suggests that the current species concept about vascular plants in the DPRK is confounded by limited knowledge within the country and great taxonomic uncertainty. In reality, therefore, this threatened species list might have many limitations in dealing effectively with the problems they aim to solve because of an uneven taxonomic treatment.

The ambiguous qualitative criteria used to measure the likelihood of extinction were only applied to the rare and endangered taxa according to regional boundaries either

in South or in North Korea (Chang *et al.,* 2005). Thus, more than half of the plant taxa proposed by the Ministry of Environment (ROK) do not qualify as threatened species according to the IUCN Red List Criteria because these taxa were widely distributed in neighboring countries (Chang *et al.,* 2005; Kim *et al.,* 2012).

The absence of a Korean plant species Red List, and the lack of consistency between other lists of priority plant species, seriously constrains the prioritization of species-based conservation work at the national level. Monitoring of progress towards these targets in Korea is not possible without such a fundamentally important baseline list. It is suggested here that the highest priority for the Red List should first be given to species endemic to the Korean peninsula. There have been attempts to define the conservation status of Korea species, but only for restricted geographical areas (e.g., North vs. South Korea) and taxonomic groups, or for setting priorities among a large number of endemic species.

A total of 523 vascular plant taxa were included in the latest national checklist by the Ministry of Environment (ROK) in 2005. Meanwhile, the 'Creation and Furtherance of Arboretums Act', which included a national endemic list as an appendix, was established by the Korea Forest Service (KFS) and legislated into law in late 2011. Examining the data for both lists proposed by ROK and KFS, of the total of 360 legislated taxa around 286 taxa are in the list of Ministry of Environment (ROK), of which about 80% have been found as common taxa. Among them, only 59 taxa (16.5%) are identified as nationally endemic species. The status of the remainder is either of unresolved candidates (73 taxa, 20.4%) or of synonyms (196 taxa, 54.7%).

The KPSG has developed a consolidated list of threatened plant species based on an available endemic list. Forms and invalidly published intraspecific or species names are excluded from the Red List (left out as a 'parking list'). Also, 50 taxa are categorized in the List as on a 'waiting list' (WL) due to taxonomic conflicts. In such instances, these taxa are included on the WL pending further study, which might resolve the taxonomic issues.

The Red List of the Endemic Plants of the Korean peninsula provides floristic and conservation analyses of the selected plants in the region, making assessments for approximately 5% of endemic taxa.

The first challenge facing the national institutes after agreeing upon a new red list of the Korean flora was the choice of species to be first assessed. Target species selection was based on taxa listed in Provisional Checklist of Vascular Plants For The Korea Peninsula Flora (KPF) (Chang *et al.,* 2014), whereas on the other hand a screening process was conducted to add further taxa of conservation concern. Target species proposed by the Korean National Arboretum were chosen among taxa that were first endemic and sub-endemic to Korea. A short list of vascular taxa was thus identified and a further selection was made to obtain a final list. In total, 33 endemic or subendemic species of vascular plants were selected here for the current evaluation. We attached the list of previously published taxa which is native in Korean peninsula. These taxa were assessed by by other specialist groups under ver. 3.1 (Table 4). The final Red List highlights the most present and pressing issues in conservation, showing which plant taxa are closest to extinction.

2. Geographic coverage

This Red List Data covers the country of the Korean peninsula, including ROK and DPRK. The boundaries of Korean peninsula as defined for the purpose of this assessment are shown in Fig. 1. Because some areas in Northeast China do not neatly fall along political boundaries, the area covered sometimes extends beyond the geographically defined boundary. Red List assessments were made only at the global level.

3. Data Sources

The Korea Peninsula Flora Database (KPF) was used as a basis for the analysis of species distributions used in the IUCN threat criterion B, which for the purpose of this study looks exclusively at the area of occupancy (AOO). The IUCN criteria (B, C, and D) examine the current number of sites, populations, or individuals in the area being considered. Criteria B and C also require evidence of ongoing decline.

The most recent record was sought for each site, along with population information and a judgment of whether any population decline is underway based on recent observations. IUCN threat categories for criteria B, C, and D in this study are therefore based on the most up-to-date and detailed information available. The judgment of site-level population decline is perhaps the most difficult to assess given the paucity of monitoring data for many taxa, hence there is much room for an improved monitoring of many taxa. Most taxa may have been allocated a lower category of threat (based on population size alone) because monitoring data is simply not available. While we do lack precise data on many distributions, population numbers, and trends for other taxa, the IUCN Red List at a global scale may be the best way forward to refine the process, and to improve uniformity in both the DPRK and ROK (Fitzpatrick *et al.,* 2007).

4. Application of IUCN Criteria and IUCN categories in Korea

In order to carry out an assessment, the following information was compiled for each species:

- Species' taxonomic delimitation
- Geographic range (including a distribution map)
- Red List Category and Criteria
- Habitat preferences
- Major threats
- Conservation measures
- Other general information
- Key literature references

As part of these assessments, the population trend status for each species was also considered. Due to a lack of centralized monitoring data for most species, this status is largely qualitatively, and not quantitatively, determined, and so it carries a high level of uncertainty. This is reflected in the high number of species with an unknown population trend. The resulting final IUCN Red List assessments are a product of our research on species status, and are backed by relevant literature and data sources. The data will be edited every five years, and possible questions will be resolved through communications with experts and members of relevant local specialist groups.

5. Explanation of the Red List data

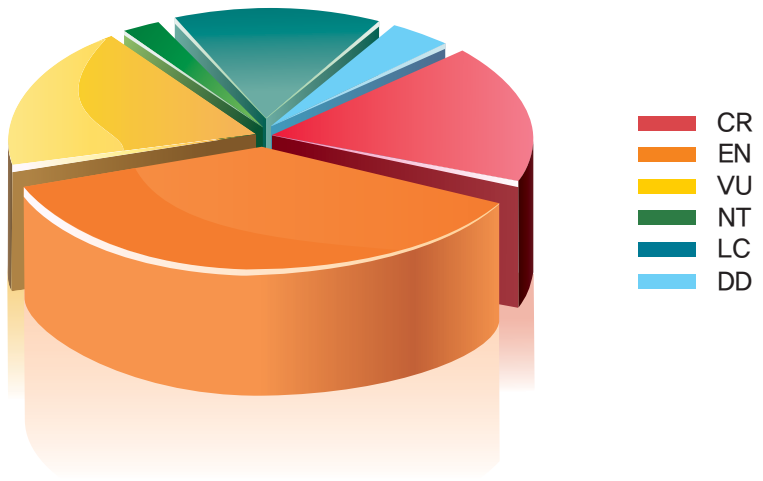
This global evaluation of their conservation status has been one of the few attempts to evaluate plants in Korea. In total there are about 33 taxa listed. The IUCN Red List categories (2001a) and criteria have been applied to 33 of these.

The summary of results is given in the Table 1 below. It indicates that 25 taxa are threatened with extinction in the wild according to the IUCN Red List categories and criteria (Critically Endangered, Endangered, and Vulnerable). This represents more than 60% of the evaluated taxa in Korea. One species is categorized as Near Threatened and further five taxa are considered as Least Concerned and two taxa are recorded as Data Deficient. This latter category (DD) arises when there is no direct information on which to base a sound assessment of extinction risk or of any trends in subpopulations in the Korean Peninsula. Nevertheless, the guidelines state that it is "important to make positive use of whatever data are available" (IUCN, 2001b).

A list of 10 Korean endemic plant taxa (Table 3) is compiled and will be assessed for their status according to the IUCN Red list categories and criteria in the near future. Also, Those Korean taxa of IUCN Red List categories status have been assessed by other special groups and listed in Table 4.

Table 1. Summary of IUCN Red List assesing results by KPSG.

Conservation status	Number of taxa
CR	5
EN	15
VU	5
NT	1
LC	5
DD	2
Total	33



6. Threats

Many of the threats to Korea's forests are related to increasing human population and a drastic increase in economic land uses, with conversion of forest into road networks and human settlements. However, the reliability of the data provided for the assessment is still uncertain, owing to the region's incapacity to properly monitor and conduct forest inventories. There is also very little official information on the actual status of forests, their associated species, and their levels of degradation.

Table 2. Newly assessed vascular plants species by KPSG under IUCN Red List ver. 3.1.

Family	Scientific Name	Criteria	Category
Ophioglossaceae	*Mankyua chejuense* B.Y.Sun & M.H.Kim & C.H.Kim	B1ab(iii)+2ab(iii)	CR
Apiaceae	*Bupleurum euphorbioides* Nakai	B2ab(iii)	EN
Apiaceae	*Bupleurum latissimum* Nakai	B1ab(iii)	CR
Asteraceae	*Cirsium rhinoceros* (H.Lév. & Vaniot) Nakai		LC
Asteraceae	*Koyamacalia pseudotaimingasa* (Nakai) H.Rob. & Brettell	B1ab(i,ii)+2ab(i,ii)	VU
Asteraceae	*Leontopodium coreanum* Nakai		DD
Berberidaceae	*Gymnospermium microrrhynchum* (S.Moore) Takht.	B2ab(iii,v)	EN
Campanulaceae	*Adenophora taquetii* H.Lév.	D2	VU
Campanulaceae	*Hanabusaya asiatica* (Nakai) Nakai	B2ab(iii,v); C2a(i)	EN
Euphorbiaceae	*Glochidion chodoense* J.S.Lee & Im	B1ab(iii,v)+2ab(iii,v)	CR
Fabaceae	*Sophora koreensis* Nakai	B1ab(iii)+2ab(iii)	EN
Hamamelidaceae	*Corylopsis coreana* Uyeki	B2ab(iii)	EN
Hydrangeaceae	*Deutzia paniculata* Nakai	B2ab(i,iii,iv)	EN
Hydrangeaceae	*Kirengeshoma palmata* Yatabe	B2ab(ii,iii,v)	EN
Iridaceae	*Iris koreana* Nakai	B2ab(iii,v)	EN
Iridaceae	*Iris odaesanensis* Y.N.Lee	B2ab(iii,v)	EN
Lamiaceae	*Salvia maximowicziana* Hemsl.		LC
Lamiaceae	*Scutellaria insignis* Nakai		DD
Oleaceae	*Abeliophyllum distichum* Nakai	B2ab(iii)	EN
Oleaceae	*Forsythia ovata* Nakai	B1ab(iii)+2ab(iii)	EN
Oleaceae	*Fraxinus chiisanensis* Nakai	B2ab(ii,iii)	EN
Oleaceae	*Syringa reticulata* (Blume) H.Hara		LC
Papaveraceae	*Corydalis filistipes* Nakai	D2	VU
Polygonaceae	*Fallopia koreana* B.U.Oh & J.G.Kim	B1ab(iii)+2ab(iii)	VU
Ranunculaceae	*Aconitum austrokoreense* Koidz.		NT
Ranunculaceae	*Aconitum coreanum* (H.Lév.) Rapaics		LC
Ranunculaceae	*Anemone koraiensis* Nakai		LC
Ranunculaceae	*Anemone maxima* Nakai	B1ab(iii)	CR
Ranunculaceae	*Megaleranthis saniculifolia* Ohwi	B2ab(iii)	EN

Rosaceae	*Malus komarovii* (Sarg.) Rehder	B2ab(iii,iv,v)	EN
Rosaceae	*Pentactina rupicola* Nakai	B1ab(iii)	CR
Rosaceae	*Prunus choreiana* Nakai ex Im	B2ab(iii)	EN
Salicaceae	*Salix blinii* H.Lév.	D2	VU

* Some species have been excluded from the current Red List because of inadequate distributional data and/or taxonomic uncertainties. Once the taxonomic status of this 'waiting list' taxa in Table 3 is clarified, those that qualify can be included in the IUCN threat analysis. We intend to proceed with this list over the next few years.

Table 3. Endemic species list which is on the pipeline of assessment by KPSG.

Family	Species	Endemism
Caprifoliaceae	*Lonicera harae* Makino	Endemic
Caprifoliaceae	*Viburnum carlesii* Hemsl.	Subendemic
Caprifoliaceae	*Weigela subsessilis* (Nakai) L.H.Bailey	Endemic
Ranunculaceae	*Clematis brachyura* Maxim.	Endemic
Ranunculaceae	*Clematis trichotoma* Nakai	Endemic
Rhamnaceae	*Rhamnus taquetii* (H.Lév. & Vaniot) H.Lév.	Endemic
Rosaceae	*Neillia uekii* Nakai	Endemic
Valerianaceae	*Patrinia saniculifolia* Hemsl.	Endemic
Cyperaceae	*Carex okamotoi* Ohwi	Endemic
Liliaceae	*Heloniopsis koreana* Fuse, N.S.Lee & M.N.Tamura	Endemic

Table 4. Taxa assessed in Korean peninsula for which other specialist groups previously published under version 3.1.

ID	Family	Scientific Name	Red List status	Red List criteria	Taxonomic remarks
1	Pinaceae	*Abies holophylla* Maxim.	NT		
2	Pinaceae	*Abies koreana* E.H.Wilson	EN	B2ab(ii,iii,v)	
3	Pinaceae	*Abies nephrolepis* (Trautv. ex Maxim.) Maxim.	LC		
4	Acoraceae	*Acorus calamus* L.	LC		
5	Acoraceae	*Acorus gramineus* Sol.	LC		
6	Poaceae	*Agrostis canina* L.	LC		
7	Poaceae	*Agrostis stolonifera* L.	LC		
8	Droseraceae	*Aldrovanda vesiculosa* L.	EN	B2ab(iii,v)	
9	Alismataceae	*Alisma plantago-aquatica* L.	LC		
10	Betulaceae	*Alnus hirsuta* (Spach) Rupr.	LC		synonym of *A. incana* ssp. *hirsuta*
11	Betulaceae	*Alnus japonica* (Thunb.) Steud.	LC		
12	Betulaceae	*Alnus mandshurica* (Callier) Hand.-Mazz.	LC		synonym of *A. viridis* ssp. *fruticosa*
13	Betulaceae	*Alnus maximowiczii* Callier	DD		synonym of *A. viridis* ssp. *fruticosa*
14	Betulaceae	*Alnus pendula* Matsum.	LC		
15	Araceae	*Arisaema heterophyllum* Blume	LC		
16	Poaceae	*Arundo donax* L.	LC		
17	Betulaceae	*Betula chinensis* Maxim.	LC		
18	Betulaceae	*Betula costata* Trautv.	LC		
19	Betulaceae	*Betula dahurica* Pall.	LC		
20	Betulaceae	*Betula ermanii* Cham.	LC		
21	Betulaceae	*Betula fruticosa* Pall.	LC		
22	Asteraceae	*Bidens tripartita* L.	LC		
23	Hydrocharitaceae	*Blyxa aubertii* Rich.	LC		
24	Hydrocharitaceae	*Blyxa japonica* (Miq.) Maxim. ex Asch. & Gürke	LC		
25	Poaceae	*Calamagrostis lapponica* (Wahlenb.) Hartm.	LC		
26	Poaceae	*Calamagrostis pseudophragmites* (Hall.f.) Koel	LC		
27	Araceae	*Calla palustris* L.	LC		
28	Theaceae	*Camellia japonica* L.	LC		
29	Cyperaceae	*Carex canescens* L.	LC		
30	Cyperaceae	*Carex japonica* Thunb.	LC		
31	Cyperaceae	*Carex lachenalii* Schkuhr	LC		
32	Cyperaceae	*Carex lasiocarpa* Ehrh.	LC		
33	Cyperaceae	*Carex limosa* L.	LC		
34	Cyperaceae	*Carex vesicaria* L.	LC		
35	Betulaceae	*Carpinus cordata* Blume	LC		
36	Betulaceae	*Carpinus eximia* Nakai	DD		synonym of *Carpinus tschonoskii*
37	Betulaceae	*Carpinus laxiflora* (Siebold & Zucc.) Blume	DD		
38	Betulaceae	*Carpinus tschonoskii* Maxim.	LC		
39	Betulaceae	*Carpinus turczaninowii* Hance	LC		
40	Apiaceae	*Centella asiatica* (L.) Urb.	LC		
41	Cephalotaxaceae	*Cephalotaxus harringtonii* (Knight ex J.Forbes) K.Koch	LC		
42	Pteridaceae	*Ceratopteris thalictroides* (L.) Brogn.	LC		
43	Apiaceae	*Cicuta virosa* L.	LC		
44	Cyperaceae	*Cladium mariscus* (L.) Pohl	LC		synonym of *C. chinense*
45	Commelinaceae	*Commelina diffusa* Burm.f.	LC		
46	Cyperaceae	*Cyperus difformis* L.	LC		
47	Cyperaceae	*Cyperus iria* L.	LC		
48	Cyperaceae	*Cyperus nipponicus* Franch. & Sav.	LC		
49	Cyperaceae	*Cyperus rotundus* L.	LC		
50	Cyperaceae	*Cyperus tenuispica* Steud.	LC		
51	Orchidaceae	*Cypripedium calceolus* L.	LC		
52	Orchidaceae	*Cypripedium guttatum* Sw.	LC		
53	Orchidaceae	*Cypripedium japonicum* Thunb. in J.A.Murray	EN	B2ab(ii,iii,iv,v); C2a(i)	

54	Orchidaceae	*Cypripedium macranthos* Sw.	LC	
55	Droseraceae	*Drosera peltata* Thunb.	LC	
56	Cyperaceae	*Eleocharis acicularis* (L.) Roem. & Schult.	LC	
57	Onagraceae	*Epilobium hirsutum* L.	LC	
58	Onagraceae	*Epilobium palustre* L.	LC	
59	Equisetaceae	*Equisetum fluviatile* L.	LC	
60	Equisetaceae	*Equisetum hyemale* L.	LC	
61	Nymphaeaceae	*Euryale ferox* Salisb.	LC	
62	Poaceae	*Festuca parvigluma* Steud.	LC	
63	Cyperaceae	*Fimbristylis complanata* (Retz.) Link	LC	
64	Cyperaceae	*Fimbristylis dichotoma* (L.) Vahl	LC	
65	Cyperaceae	*Fimbristylis dipsacea* (Rottb.) C.B.Clarke	LC	
66	Cyperaceae	*Fimbristylis littoralis* Gaudich.	LC	
67	Cyperaceae	*Fimbristylis ovata* (Burm.f.) J.Kern	LC	
68	Cyperaceae	*Fimbristylis schoenoides* (Retz.) Vahl	LC	
69	Cyperaceae	*Fuirena ciliaris* (L.) Roxb.	LC	
70	Hydrocharitaceae	*Halophila nipponica* J.Kuo	NT	
71	Asteraceae	*Hemisteptia lyrata* (Bunge) Fisch. & C.A.Mey.	LC	
72	Hydrocharitaceae	*Hydrilla verticillata* (L.f.) Royle	LC	
73	Hydrocharitaceae	*Hydrocharis dubia* (Blume) Backer	LC	
74	Apiaceae	*Hydrocotyle javanica* Thunb.	LC	
75	Juncaeae	*Juncus bufonius* L.	LC	
76	Juncaeae	*Juncus decipiens* (Buchenau) Nakai	LC	
77	Juncaeae	*Juncus prismatocarpus* R.Br.	LC	
78	Juncaeae	*Juncus wallichianus* J.Gay ex Laharpe	LC	
79	Cupressaceae	*Juniperus chinensis* L.	LC	
80	Cupressaceae	*Juniperus communis* L.	LC	ssp. *alpina* in Korea
81	Cupressaceae	*Juniperus rigida Siebold* & Zucc.	LC	
82	Cyperaceae	*Kyllinga brevifolia* Rottb.	LC	
83	Pinaceae	*Larix gmelinii* (Rupr.) Kuzen.	LC	
84	Fabaceae	*Lespedeza cuneata* (Dum.Cours.) G.Don	LC	
85	Scrophulariaceae	*Limnophila aromatica* (Lam.) Merr.	LC	
86	Scrophulariaceae	*Limnophila sessiliflora* (Vahl) Blume	LC	
87	Scrophulariaceae	*Lindernia crustacea* (L.) F.Muell.	LC	
88	Scrophulariaceae	*Lindernia micrantha* D.Don	LC	
89	Liliaceae	*Lloydia triflora* (Ledeb.) Baker	LC	
90	Lythraceae	*Lythrum salicaria* L.	LC	
91	Magnoliaceae	*Magnolia sieboldii* K.Koch	LC	
92	Menyanthaceae	*Menyanthes trifoliata* L.	LC	
93	Scrophulariaceae	*Microcarpaea minima* (Retz.) Merr.	LC	
94	Pontederiaceae	*Monochoria korsakowii* Regel & Maack	LC	
95	Pontederiaceae	*Monochoria vaginalis* (Burm.f.) C.Presl	LC	
96	Haloragaceae	*Myriophyllum spicatum* L.	LC	
97	Hydrocharitaceae	*Najas graminea* Delile	LC	
98	Hydrocharitaceae	*Najas marina* L.	LC	
99	Hydrocharitaceae	*Najas minor* All.	LC	
100	Nymphaeaceae	*Nymphaea tetragona* Georgi	LC	
101	Menyanthaceae	*Nymphoides peltata* (S.G.Gmel.) Kuntze	LC	
102	Apiaceae	*Oenanthe javanica* (Blume) DC.	LC	
103	Betulaceae	*Ostrya japonica* Sarg.	LC	
104	Hydrocharitaceae	*Ottelia alismoides* (L.) Pers.	LC	
105	Parnassiaceae	*Parnassia palustris* L.	LC	
106	Polygonaceae	*Persicaria amphibia* (L.) Delarbre	LC	
107	Polygonaceae	*Persicaria hydropiper* (L.) Spach	LC	
108	Polygonaceae	*Persicaria lapathifolia* (L.) Delarbre	LC	
109	Poaceae	*Phalaris arundinacea* L.	LC	

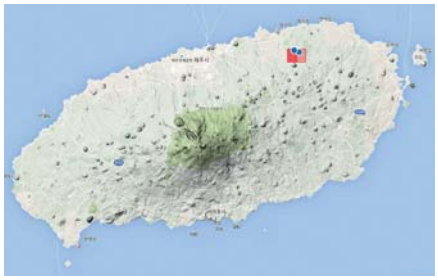
110	Poaceae	*Phleum alpinum* L.	LC		
111	Poaceae	*Phragmites australis* (Cav.) Steud.	LC		
112	Zosteraceae	*Phyllospadix iwatensis* Makino	VU	B1ab(ii,iii)	
113	Zosteraceae	*Phyllospadix japonicus* Makino	EN	B2ab(i,ii,iii)	
114	Pinaceae	*Picea jezoensis* (Siebold & Zucc.) Carrière	LC		
115	Pinaceae	*Picea koraiensis* Nakai	LC		
116	Pinaceae	*Pinus densiflora Siebold* & Zucc.	LC		
117	Pinaceae	*Pinus koraiensis Siebold* & Zucc.	LC		
118	Pinaceae	*Pinus parviflora Siebold* & Zucc.	LC		
119	Pinaceae	*Pinus pumila* (Pall.) Regel	LC		
120	Pinaceae	*Pinus tabuliformis* Carrière	LC		
121	Pinaceae	*Pinus thunbergii* Parl.	LC		
122	Poaceae	*Poa annua* L.	LC		
123	Polygonaceae	*Polygonum pubescens* Blume	LC		synonym of *Persicaria pubescens*
124	Poaceae	*Polypogon monspeliensis* (L.) Desf.	LC		
125	Potamogetonaceae	*Potamogeton crispus* L.	LC		
126	Potamogetonaceae	*Potamogeton distinctus* A.Benn.	LC		
127	Potamogetonaceae	*Potamogeton gramineus* L.	LC		
128	Potamogetonaceae	*Potamogeton maackianus* A.Benn.	LC		
129	Potamogetonaceae	*Potamogeton natans* L.	LC		
130	Potamogetonaceae	*Potamogeton octandrus* Poir.	LC		
131	Potamogetonaceae	*Potamogeton perfoliatus* L.	LC		
132	Rosaceae	*Potentilla palustris* (L.) Scop.	LC		synonym of *Comarum palustre* L.
133	Rosaceae	*Potentilla supina* L.	LC		
134	Gramineae	*Pseudoraphis sordida* (Thwaites) S.M.Phillips & S.L.Chen	LC		
135	Cyperaceae	*Pycreus flavidus* (Retz.) Koyama	LC		
136	Cyperaceae	*Pycreus polystachyos* (Rottb.) P.Beauv.	LC		
137	Cyperaceae	*Rhynchospora alba* (L.) Vahl	LC		
138	Alismataceae	*Sagittaria pygmaea* Miq.	LC		
139	Poaceae	*Schizachyrium brevifolium* (Sw.) Buse	LC		
140	Cyperaceae	*Schoenoplectus mucronatus* (L.) Palla	LC		
141	Cyperaceae	*Schoenoplectus triqueter* (L.) Palla	LC		
142	Fabaceae	*Sophora flavescens* Aiton	LC		
143	Typhaceae	*Sparganium erectum* L.	LC		
144	Caryophyllaceae	*Spergularia marina* (L.) Griseb.	LC		
145	Orchidaceae	*Spiranthes sinensis* (Pers.) Ames	LC		
146	Potamogetonaceae	*Stuckenia pectinata* (L.) Börner	LC		
147	Taxaceae	*Taxus cuspidata* Siebold & Zucc.	LC		
148	Thelypteridaceae	*Thelypteris palustris* Schott	LC		
149	Cupressaceae	*Thuja koraiensis* Nakai	VU	B2ab(ii,iii,iv,v); C2a(i); D1	
150	Taxaceae	*Torreya nucifera* (L.) Siebold & Zucc.	LC		
151	Trapaceae	*Trapa incisa* Siebold & Zucc.	LC		
152	Poaceae	*Trisetum bifidum* (Thunb.) Ohwi	LC		
153	Typhaceae	*Typha latifolia* L.	LC		
154	Typhaceae	*Typha orientalis* C.Presl.	LC		
155	Lentibulariaceae	*Utricularia bifida* L.	LC		
156	Hydrocharitaceae	*Vallisneria natans* (Lour.) H.Hara	LC		
157	Scrophulariaceae	*Veronica anagallis-aquatica* L.	LC		
158	Fabaceae	*Vicia amoena* Fisch. ex Ser.	LC		
159	Zosteraceae	*Zostera asiatica* Miki	NT		
160	Zosteraceae	*Zostera caespitosa* Miki	VU	B2ab(ii,iii)	
161	Zosteraceae	*Zostera caulescens* Miki	NT		
162	Zosteraceae	*Zostera geojeensis* Shin	EN	B2ab(ii,iii)	
163	Zosteraceae	*Zostera japonica* Asch. & Graebn.	LC		
164	Zosteraceae	*Zostera marina* L.	LC		

Globally Threatened Taxa

1. Fern and fern allies

Ophioglossaceae

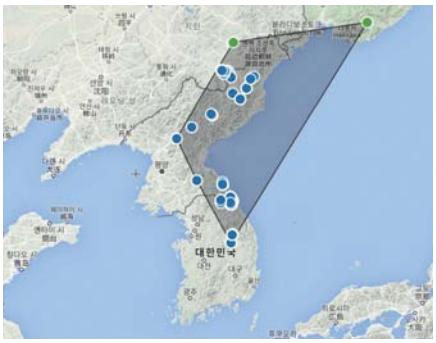
Mankyua chejuense B.Y. Sun, M.H. Kim & C.H. Kim
CR B1ab(iii)+2ab(iii)
Mankyua chejuense has an estimated area of extent of approximately 8 km^2, but the estimated area of occupancy (AOO) of the species is just 0.055 km^2. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, which include the effects of deforestation (Bae, 2009; Chang and Seok, 1997). For these reasons, *M. chejuense* has been assessed as Critically Endangered.



2. Angiosperms

Apiaceae

Bupleurum euphorbioides Nakai
EN B2ab(iii)
Bupleurum euphorbioides has an estimated AOO of about 184 km^2. It occurs in 15 locations. The distances between locations range from 30–900 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *B. euphorbioides* has been assessed as Endangered.

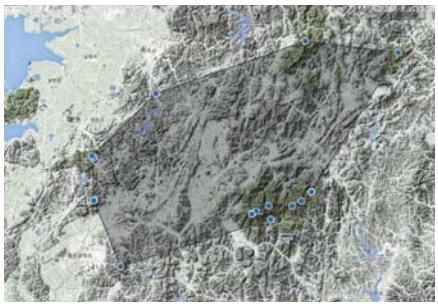


Bupleurum latissimum Nakai
CR B1ab(iii)
Bupleurum latissimum has an estimated AOO of about 20 km^2. It occurs in six fragmented sites within one location. The distances between each site range from 1–12 km and they are severely fragmented and very restricted, so likely too great to allow for effective gene flow. There is a clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *B. latissimum* has been assessed as Critically Endangered.

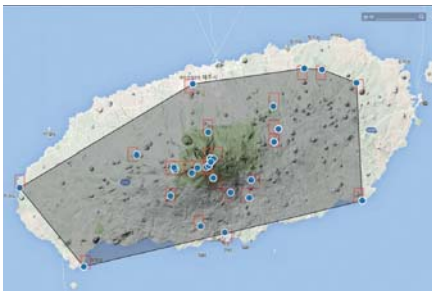
Asteraceae

Koyamacalia pseudotaimingasa (Nakai) H. Rob. & Brettell
VU B1ab(i,ii)+2ab(i,ii)

Koyamacalia pseudotaimingasa is an endemic species in South Korea. There is no information available on its quantified population sizes or population trends. The estimated extent of occurrence and the estimated AOO of this species are 4,867 km^2 and 56 km^2, respectively. Because of its narrow range the risk of extinction is high, since the existing threats to the species and its habitats are likely to cause the population to decline quickly in the near future. Since 1940, neither reports nor collections were recorded, so the AOO was reduced from 5,600 to 4,867, amounting to an 13% decline. For these reasons, *K. pseudotaimingasa* has been assessed as Vulnerable.



Cirsium rhinoceros (H. Lév. & Vaniot) Nakai
LC
The species has a reasonably large population compared to other endemics on Jeju island, and is widespread, growing in a number of localities across the island. There is no current evidence of decline, and although there is a potential future threat from invasive species and habitat loss, it is unclear whether these would have a sufficient impact to justify to categorize this species as threatened. For these reasons, *C. rhinoceros* has been assessed as Least Concern.



Leontopodium coreanum Nakai
DD
This species is endemic to North Korea, where it is reported from a small area in the Keumkang mountain area (extent of occurrence is 74 km^2 and area of occupancy is 16 km^2). There is very little additional information available for this species at present. Therefore, it is currently assessed as Data Deficient.

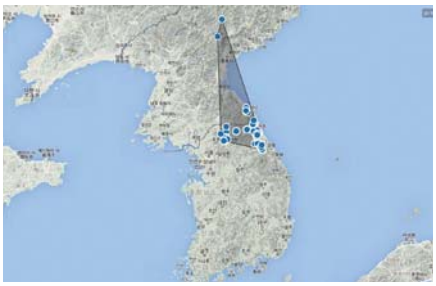
Berberidaceae

Gymnospermium microrrhynchum
(S. Moore) Takht.
EN B2ab(iii,v)
Gymnospermium microrrhychum has an estimated AOO of about 148 km^2. It occurs in 15 fragmented locations. The distances between locations range from 60–600 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *G. microrrhychum* has been assessed as Endangered.

Campanulaceae

Adenophora taquetii H. Lév.
VU D2
This species is endemic to Jeju Island, where it has a narrow distribution, growing in only one location. Currently there is no evidence of population decline, but there is a future potential threat from invasive species and habitat loss, both of which are occurring on Jeju but it currently is unclear what effects these threats may be having on *A. taquetii*. The species is assessed as Vulnerable (VU D2) based on its restricted range and plausible threats that potentially could push this species into CR or EX within a short time period.

Hanabusaya asiatica (Nakai) Nakai
EN B2ab(iii,v); C2a(i)
Hanabusaya asiatica has an estimated area of occupancy (AOO) of about 72 km^2. It occurs in 20 locations, but the distances between each subpopulation range from 20–200 km; the population is considered to be severely fragmented (*i.e.,* distances between subpopulations are likely to be too great to allow for effective gene flow). There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors which include the effects of deforestation. For these reasons, *H. asiatica* has been assessed as Endangered.

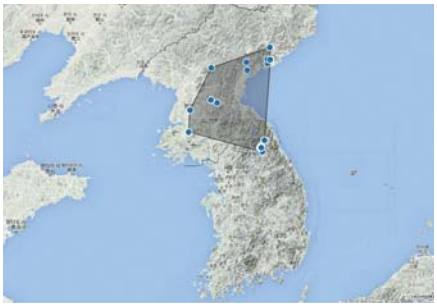


Euphorbiaceae

Glochidion chodoense J.S. Lee & Im
CR B1ab(iii,v)+2ab(iii,v)
Glochidon chodoense has an estimated AOO of about 8 km^2, and the estimated area of occupancy of the species is 8 km^2. It occurs in three fragmented locations. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation (Bae, 2009; Chang and Seok, 1997). For these reasons, *G. chodoense* has been assessed as Critically Endangered.

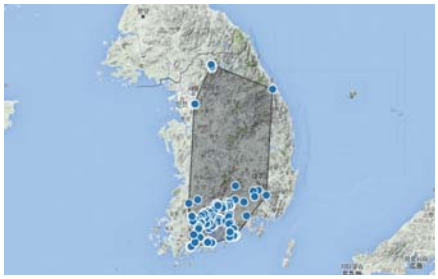
Fabaceae

Sophora koreensis Nakai
EN B1ab(iii)+2ab(iii)
Sophora koreensis has an estimated AOO of about 72 km^2. It occurs in nine locations. The distances between location range from 50–320 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *S. koreensis* has been assessed as Endangered.



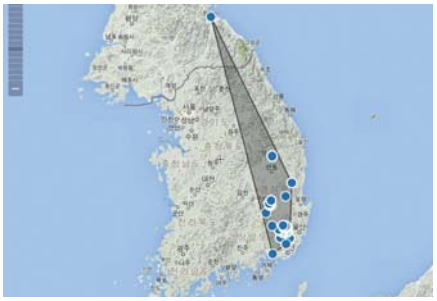
Hamamelidaceae

Corylopsis coreana Uyeki
EN B2ab(iii)
Corylopsis coreana has an estimated AOO of about 56,781 km^2. It occurs in 37 locations. The distances between locations range from 50–200 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *C. coreana* has been assessed as Endangered.

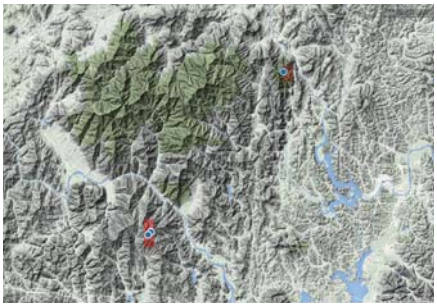


Hydrangeaceae

Deutzia paniculata Nakai
EN B2ab(i,iii,iv)
This species is an endemic shrub in Korea. *Deutzia paniculata* has an estimated extent of about 1,196 km^2 and estimated AOO of about 116 km^2. It occurs in six locations. The distances between locations range from 10–100 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *D. paniculata* has been assessed as Endangered.



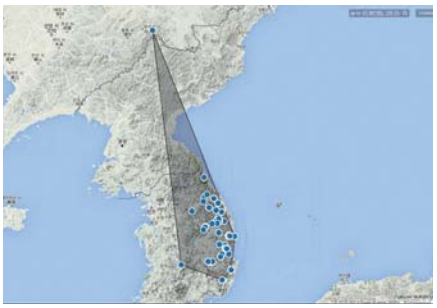
Kirengeshoma palmata Yatabe
EN B2ab(ii,iii,v)
This species occurs in forest habitats in China, Japan and South Korea. These habitats are declining due to human disturbance, herbivore damage, and soil erosion. The species has a large extent of occurrence (EOO); far larger than the criterion B1 thresholds. However its area of occupancy (AOO) is around 64 km^2. Given its small AOO, continuing decline in extent and quality of habitat, a severely fragmented population, and the very small population size, this species is listed as Endangered.



Iridaceae

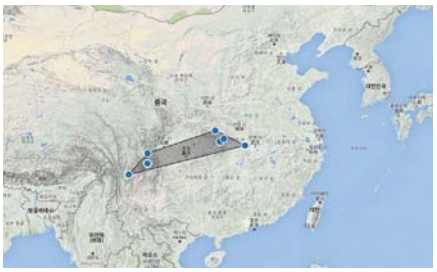
Iris koreana Nakai
EN B2ab(iii,v)
Iris koreana has an estimated AOO of about 92 km^2. It occurs in 14 locations. The distances between locations range from 30–200 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of habitat degradation. For these reasons, *I. koreana* has been assessed as Endangered.

Iris odaesanensis Y.N. Lee
EN B2ab(iii,v)
Iris odaesanensis has an estimated AOO of about 180 km^2. It occurs in 20 locations. The distances between locations range from 30–200 km and are severely fragmented, likely to be too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat owing to a number of factors that include the effects of deforestation. For these reasons, *I. odaesanensis* has been assessed as Endangered.

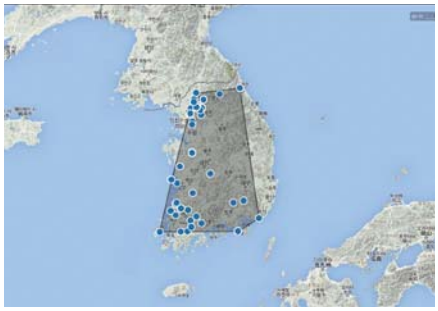


Lamiaceae

Salvia maximowicziana Hemsl.
LC
This species has a relatively wide distribution in South Korea and China. There sis no information available on threats to this species, however it has a wide distribution and the population size is assumed to be very large. The species is currently assessed as Least Concern.



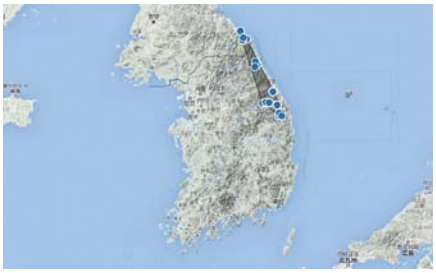
Scutellaria insignis Nakai
DD
There is no current evidence of decline, and although there are foreseeable threats from invasive species and habitat loss, it is unclear whether these factors would have a sufficient impact to justify categorizing this species. For these reasons, *S. insignis* has been assessed as Data Deficient.



Oleaceae

Abeliophyllum distichum Nakai
EN B2ab(iii)
Abeliophyllum distichum is an endemic shrub in Korea. This species has an estimated AOO of about 72 km^2. It occurs in nine locations. The distances between locations range from 20–220 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *A. distichum* has been assessed as Endangered.

Forsythia ovata Nakai
EN B1ab(iii)+2ab(iii)
Forsythia ovata has an estimated AOO of about 80 km^2. It occurs in five locations. The distances between locations range from 30–200 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *F. ovata* has been assessed as Endangered.



Fraxinus chiisanensis Nakai
EN B2ab(ii,iii)
Fraxinus chiisanensis is an endemic tree in Korea. This species has an estimated AOO of about 84 km^2. It occurs in nine locations. The distances between locations range from 5–100 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *F. chiisanensis* has been assessed as Endangered.

Papaveraceae

Corydalis filistipes Nakai
VU D2
The species is endemic to Ulleung island, where it is narrowly distributed, growing in a single locality across the entire island. There is no current evidence of decline, and while there are foreseeable threats from invasive species and habitat loss, it is unclear whether these factors would have a sufficient impact to justify categorizing this species. Nevertheless, *C. filistipes* has an estimated AOO of approximately 16 km^2. With only one population in a very restricted area of occupancy in a single location, it is prone to the effects of human activities or stochastic events within a very short time period. For these reasons, *C. filistipes* has been assessed as Vulnerable.

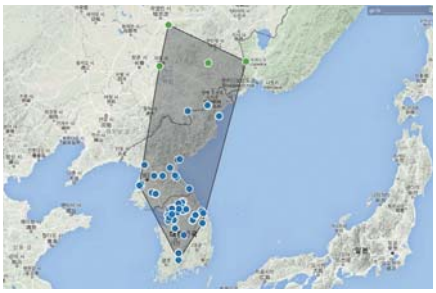
Polygonaceae

Fallopia koreana B.U.Oh & J.G.Kim
VU B1ab(iii)+2ab(iii)
Fallopia korana has an estimated AOO of about 60 km^2. It occurs in nine locations. The distances between locations range from 20–100 km and are severely fragmented, and likely too great to allow for effective gene flow. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *F. korana* has been assessed as Vulnerable.

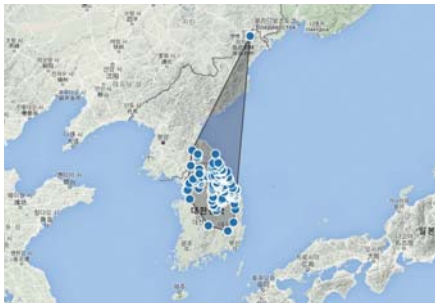
Ranunculaceae

Aconitum austrokoreense Koidz.
NT
Aconitum austrokoreense is endemic to South Korea, where it has an estimated area of occupancy (AOO) of 148 km^2. The species occurs in well over 10 locations. The population is fragmented, but currently it is unclear whether it fully meets the IUCN conditions for being 'severely fragmented'. There are various threats across its range (e.g., there is continuing decline in habitat in many areas). Currently this species doesn't quite meet all of the conditions to qualify for a threatened category under criterion B. It is therefore assessed as Near Threatened (NT) as it nearly meets criterion B2.

Aconitum coreanum (H. Lév.) Rapaics
LC
Aconitum coreanum is distributed in China, Korea, and Russian Primosky, growing in 21 localities across these countries. There is no current evidence of decline, and while there are foreseeable threat from invasive species and habitat loss, it is unclear whether these factors would have a sufficient impact to justify categorizing this species. For these reasons, *A. coreanum* has been assessed as Least Concern.



Anemone koraiensis Nakai
LC
The species is subendemic to the Korean peninsula. Currently there is no evidence of decline, and although there are threats in place in various parts of its range, it is unclear whether these would have a sufficient impact to justify to categorize this species as threatened at present. Therefore, *A. koraiensis* is assessed as Least Concern.



Anemone maxima Nakai
CR B1ab(iii)
Anemone maxima is endemic to Ulleung island, where it is narrowly distributed, growing in a single locality across the entire island. There is no current evidence of decline, and while there are foreseeable threats from invasive species and habitat loss, it is unclear whether these factors would have a sufficient impact to justify categorizing this species. *Anemone maxima* has an estimated AOO of approximately 48 km^2. With only one population in a very restricted area of occupancy in a single location, it is prone to the effects of human activities or stochastic events within a very short time period. For these reasons, *A. maxima* has been assessed as Critically Endangered.

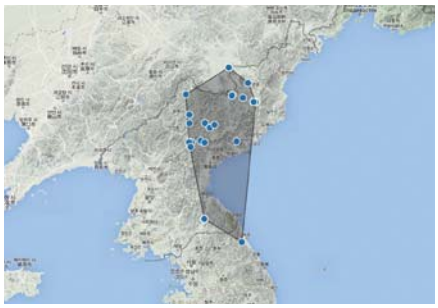
Megaleranthis saniculifolia Ohwi
EN B2ab(iii)
Megaleranthis saniculifolia has an estimated area of occupancy (AOO) of about 272 km^2. It occurs in >10 locations, but the distances between each subpopulation range from 60–600 km, making the population severely fragmented (*i.e.*, distances between subpopualtions are likely to be too great to allow for effective gene flow). There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors which include the effects of deforestation. For these reasons, *M. saniculifolia* has been assessed as Endangered.

Rosaceae

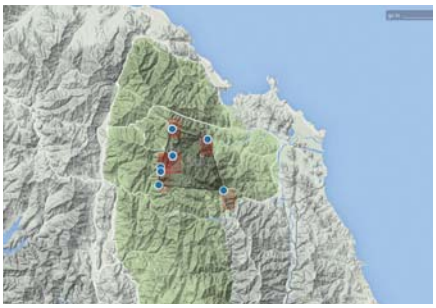
Malus komarovii (Sarg.) Rehder
EN B2ab(iii,iv,v)
Malus komarovii has a small distribution in Korea and a very limited range in northern China. This species has been previously assessed as Vulnerable (World Conservation Monitoring Centre, 2013). There is no evidence that the threats documented in previous assessments have ceased, and fragmentation and habitat degradation are documented both in the Korean DMZ and the Changbai Shan Nature Reserve.

Furthermore, minimal ex situ conservation is in place for this species and no evidence for active in situ conservation was discovered (e.g., management and monitoring). Taking this into account, this species has been globally assessed as Endangered because it has an estimated AOO of 84 km^2 and an estimated extent of occurrence of 52,000 km^2; its populations are severely fragmented; and it is suffering continuing decline in quality of habitat. Recommendations for this species include management and monitoring of its subpopulations wherever applicable, and the collection of germplasm material for ex situ conservation.

※ This species was assessed by Rhodes, L., Maxted, N., Kim, H., Son, S.-W. and Kim, Y.-S.



Pentactina rupicola Nakai
CR B1ab(iii)
Pentactina rupicola is an endemic on Mt. Geumgang in North Korea, where it is narrowly distribute narrowly, growing in a single locality across the mountain range. This species has an estimated AOO of approximately 24 km^2 with an extent of occurrence of approximately 57.5 km^2. There is clear and documented evidence of a continuing decline in quality and quantity of habitat due to a number of factors, namely the effects of deforestation. For these reasons, *P. rupicola* has been assessed as Critically Endangered.

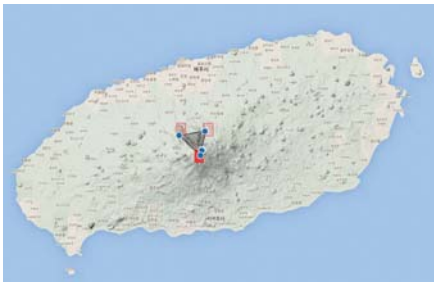


Prunus choreiana Nakai ex Im
VU B2ab(iii)
Prunus choreiana is an endemic species in Korea. This species is naturally fragmented due to a lack of suitable habitat. Major threats to this species are local development and agricultural activities. This species has an estimated AOO of approximately 72 km^2. It occurs in 10 locations. The distances between locations range from 20–500 km and are severely fragmented, and likely too great to allow for effective gene flow. This species meets the threshold for criterion B2, with a continuing decline in area and quality of habitat, and 10 or less known locations and a fragmented population. For these reasons, this species has been listed as Vulnerable.

Salicaceae

Salix blinii H. Lév.
VU D2
The species is endemic to Jeju Island, South Korea, where it has a restricted distribution on Mt. Halla. It is known from just one location, with an estimated extent of occurrence (EOO) and area of occupancy (AOO) around 12 km^2. Currently there is no current evidence of decline, and but there is a future

potential threat from invasive species and habitat loss, both of which are occurring on Jeju but it currently is unclear what effects these threats may be having on this species. The species is assessed as Vulnerable (VU D2) based on its restricted range and plausible threats that potentially could push this species into CR or EX within a short time period.



Information Collection for Conservation Assessment

A major component of this evaluation was analyses of the distributions of each species using information compiled from a variety of sources. These included regional and monographic floras, the national Endangered List from the Ministry of Environment, the Red List of Korea National Arboretum online herbarium specimen databases, and the taxonomic and ecological scientific literature. The information available for different species varied in terms of both accuracy and precision, and reflected a variety of different time scales, as both recent and historical distribution data were included in the analyses.

All attempts were made to locate information on all of the species considered by the authors and for the subsequent taxa described. The taxonomy and nomenclature of the Korean Plants has been thoroughly reviewed by us.

It is important, however, to consider a number of limitations when interpreting the results obtained and presented here. Many species tend to be sparsely distributed in the forests within which they occur. For these reasons, the distribution maps obtained are likely to overestimate the potential area in which each species is likely to actually occur. Because the current distributions of many species are poorly known, it is possible that populations of some species exist outside the currently known limits of their distribution. The maps were used as a basis for assessing the risk of extinction, according to the IUCN Red List categories and criteria (IUCN, 2001). Application of the criteria was undertaken by the KPSG.

Where and when available, categories were followed for endemic species considered in such regional assessments. Since the current distribution and status of most of the species is poorly known, this approach was considered to provide the most accurate assessment possible with the information available at hand. The IUCN criteria were applied conservatively, however; in other words, estimates of potential area of occupancy were applied to criteria related to extent of occurrence. The guidelines for using the Red List criteria produced by IUCN refer to 'continuing decline' as 'a recent, current, or projected future decline, which is liable to continue unless remedial measures are taken'. We considered that the criterion of 'continuing decline' was met if the area of forest cover was considered to be declining according to the latest data from Korea National Arboretum, as well as those data from previous assessments (as far back as 1990). After setting up the list of species endemic to the Korean peninsula, quantitative data on population size and structure, distributional range, rates of decline, and habitat fragmentation should be collected as part of a long-term project for the Red List categories. Transparency and accountability are the most important factors to succeed in this endeavor.

Priority Needs for Further Action

Although incomplete, the information here does provide a useful baseline for planning urgent conservation action in Korea. Further efforts will be made by the Korea National Arboretum and us to collect new information on the taxa currently listed as Not Evaluated. We will collect more information on populations of any of these taxa, whether or not they are considered threatened, so that a more complete evaluation of Korean plants can be produced in the future. Such information should be based on field assessments of the conservation status of the taxa, and an analysis of the threats which are leading to decline of populations in the wild. Based on the information already available, urgent attention is required for these taxa.

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ANNEX
IUCN Red List Categories and Criteria

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care

should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

THE CRITERIA FOR CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥ 90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥ 80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

3. A population size reduction of ≥ 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of the following:
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥ 80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:
1. Extent of occurrence estimated to be less than 100 km2, and estimates indicating at least two of a-c:
   a. Severely fragmented or known to exist at only a single location.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km2, and estimates indicating at least two of a-c:
   a. Severely fragmented or known to exist at only a single location.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:
1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
   (a) Population structure in the form of one of the following:
      (i) no subpopulation estimated to contain more than 50 mature individuals, OR
      (ii) at least 90% of mature individuals in one subpopulation.
   (b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥ 70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥ 50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

3. A population size reduction of ≥ 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of the following:
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥ 50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:
1. Extent of occurrence estimated to be less than 5,000 km2, and estimates indicating at least two of a-c:
   a. Severely fragmented or known to exist at no more than five locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km2, and estimates indicating at least two of a-c:
   a. Severely fragmented or known to exist at no more than five locations.
   b. Continuing decline, observed, inferred or projected, in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.
   c. Extreme fluctuations in any of the following:
      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 2,500 mature individuals and either:
1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
   (a) Population structure in the form of one of the following:
      (i) no subpopulation estimated to contain more than 250 mature individuals, OR
      (ii) at least 95% of mature individuals in one subpopulation.
   (b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:
1. An observed, estimated, inferred or suspected population size reduction of ≥ 50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥ 30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

3. A population size reduction of ≥ 30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of the following:
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or

parasites.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥ 30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:
   1. Extent of occurrence estimated to be less than 20,000 km2, and estimates indicating at least two of a-c:
      a. Severely fragmented or known to exist at no more than 10 locations.
      b. Continuing decline, observed, inferred or projected, in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) area, extent and/or quality of habitat
         (iv) number of locations or subpopulations
         (v) number of mature individuals.
      c. Extreme fluctuations in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) number of locations or subpopulations
         (iv) number of mature individuals.

   2. Area of occupancy estimated to be less than 2,000 km2, and estimates indicating at least two of a-c:
      a. Severely fragmented or known to exist at no more than 10 locations.
      b. Continuing decline, observed, inferred or projected, in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) area, extent and/or quality of habitat
         (iv) number of locations or subpopulations
         (v) number of mature individuals.
      c. Extreme fluctuations in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) number of locations or subpopulations
         (iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:
   1. An estimated continuing decline of at least 10% within 10 years or three generations,

whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
   (a) Population structure in the form of one of the following:
      (i) no subpopulation estimated to contain more than 1,000 mature individuals, OR
      (ii) all mature individuals are in one subpopulation.
   (b) Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:
   1. Population size estimated to number fewer than 1,000 mature individuals.
   2. Population with a very restricted area of occupancy (typically less than 20 km2) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

The Red List of Selected

VASCULAR PLANTS in Korea

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