Distribution of five rare plants in Korea

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ABSTRACT: The natural habitats and distribution of five rare plants were recently discovered in Korea. Salomonia oblongifolia DC., which grows in mountain wetlands, was found in Gijang-gun, Busan, Goseong-gun, Jeollaham-do, and Shinan-gun, Jeollanam-do. Glaux maritima var. obtusifolia Fernald, which grows along the coast, was found in Yangyang-gun, Gangwon-do, Pohang-si, Gyeongsangbuk-do and Buk-gu, Ulsan. Tiliae aquatica L. and Limosella aquatica L., which was previously not known to be present in Korea, were discovered in Gijang-gun, Busan for the first time. Apocynum lancefolium Russanov, which has a narrow distribution range in Korea, was also found in Samcheok-si, Gangwon-do, Ansan-si, Gyeonggi-do, Siheung-si, Gyeonggi-do, Jung-gu, Incheon, Yeongdeok-gun, Gyeongsangbuk-do and Shinan-gun, Jeollanam-do.

Keywords: Salomonia oblongifolia, Glaux maritima var. obtusifolia, Tiliae aquatica, Limosella aquatica, Apocynum lancefolium

Since the Protocol of ‘Access to Genetic Resources and Benefit-Sharing’ was adopted in the 10th Conference of the Parties of the Convention on Biology Diversity (CBD), native plants are considered significant resources for future access and benefit sharing. In addition, conservation strategies for rare and endangered plants must be developed at the national level.

To develop conservation strategies for rare and endangered plants, the taxon should be evaluated precisely. But in the past, the assessment of rare plants was conducted based on the personal experiences of some experts regarding related plants that were found by them frequently (Chang et al., 2001) and information on the taxon in terms of the ecology, distribution and population of the related plants could not be collected objectively. The International Union for Conservation of Nature (IUCN) claims that objective criteria should be established based on scientific data to assess endangered plants (IUCN, 2001a) and recommends the assessment of endangered plants at global scale (Chang et al., 2001). However, taxon that are currently in danger locally are only categorized on the regional scale and these data are used as supplement references for assessing the global scale conservative status of the taxon (IUCN, 2001b; Miller, 2007).

To establish a conservation strategy for rare plants, there should be research on the geographic distributions, population size, and ecological characteristics of plants. In addition, plants that are distributed in limited areas have low levels of genetic diversity when compared to species distributed nationally. Therefore, information on the geographic distribution range should be used as an important factor in estimating their genetic diversity (Chang et al., 1998). Based on this premise, there is a need to obtain information on the distribution of rare plants and endemic species, whose distributions are limited (Son et al., 2008). However, it is difficult to assess the status of certain plants because data on them cannot be found except in old literature and herbarium specimens.

Of the rare plants in Korea, the habitats of Salomonia oblongifolia DC., Glaux maritima var. obtusifolia Fernald, Tiliae aquatica L., Limosella aquatica L., and Apocynum lancefolium L. have not been accurately identified and the only information available on these plants are from illustrated plant books. In addition, there has been no ecological and taxonomic research on these plants.

Thus, this study was conducted to obtain information on the exact habitats and distribution of these five rare plants, whose domestic distributions are still largely unknown. In addition, this information will be used as basic data for assessing the conservative status of the taxon.

Materials and Methods

Natural habitat information was collected from previous literature, specimens and residents (NGO). The natural habitats survey was conducted from March 2010 to June 2011 based on the gathered information. The locations of the habitat were recorded using GPS and a distribution map was established using existing
information on the specimens. The specimen information was provided by Korea Biodiversity Information System (Nature) of the Korea Forest Service. The exact location of the habitats of these rare plants are not mentioned in this paper to protect these plants.

Results and Discussion

1. Salomonia oblongifolia DC. (Polygalaceae; Fabales)

Salomonia oblongifolia DC. is an annual herbaceous species that inhabits areas of sunny wetlands (Lee, 1996; Iwatsuki and Ohba, 1999). It is distributed in South Korea, Japan, Taiwan, Malaysia, India, the Philippines, Vietnam, the South China Sea, and Australia along with other subtropical regions (Iwatsuki and Ohba, 1999; Turner et al., 2000). It is classified as “Critically Endangered” in the Rare Plant Data Book of Korea (Korea National Arboretum, 2008). Although it has not been designated as a rare plant, it has extremely restricted distribution in limited areas of Japan (Iwatsuki and Ohba, 1999). In Korea, the only data on this specimen was from old studies (Mt. Baekun, Gwangyang-si, Jeollanam-do, Jimun-do, Shinan-gun, Jeollanam-do), and the exact habitat of this plant was not known until now. In this survey, S. oblongifolia was newly discovered in one region of Busan and two regions of Jeollanam-do, which is located on the southern coast (Fig. 1-a). Of the surveyed regions, the Busan and Shinan-gun, Jeollanam-do were stable and maintained healthy structures, whereas the population in Gokseong-gun, Jeollanam-do decreased (i.e., desiccation because of environmental changes) (Table 1). All the surveyed regions were forest wetlands, and

Fig. 1. Distribution maps of five rare plants. a. Salomonia oblongifolia; b. Gleux mariitima var. obtusifolia; c. Tiliae aquatica; d. Limosella aquatica; e. Apocynum lancifolium.
Table 1. Locality of population and general characteristics of investigated region.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Investigated area</th>
<th>Extent of habitat (m)</th>
<th>Estimated population size</th>
<th>Altitude (m)</th>
<th>Topography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salomonia oblongifolia</td>
<td>Gijang-gun, Busan</td>
<td>100 × 20</td>
<td>&lt;3,000</td>
<td>105</td>
<td>Forest wetlands</td>
</tr>
<tr>
<td></td>
<td>Goksong-gun, Jeollanam-do</td>
<td>10 × 10</td>
<td>~500</td>
<td>162</td>
<td>Forest wetlands</td>
</tr>
<tr>
<td></td>
<td>Shinan-gun, Jeollanam-do</td>
<td>200 × 100</td>
<td>&lt;5,000</td>
<td>28</td>
<td>Forest wetlands</td>
</tr>
<tr>
<td>Glaux maritima var. obtusifolia</td>
<td>Yangyang-gun, Gangwon-do</td>
<td>20 × 10</td>
<td>~500</td>
<td>4</td>
<td>Saline lake</td>
</tr>
<tr>
<td></td>
<td>Pohang-si, Gyeongsaangbuk-do</td>
<td>50 × 30</td>
<td>&lt;1,000</td>
<td>6</td>
<td>Saline lake</td>
</tr>
<tr>
<td></td>
<td>Bak-gu, Ulsan</td>
<td>70 × 30</td>
<td>&lt;1,000</td>
<td>29</td>
<td>Saline lake</td>
</tr>
<tr>
<td>Tillaea aquatica</td>
<td>Gijang-gun, Busan</td>
<td>70 × 50</td>
<td>~300</td>
<td>29</td>
<td>River bank</td>
</tr>
<tr>
<td>Limosella aquatica</td>
<td>Gijang-gun, Busan</td>
<td>70 × 10</td>
<td>~500</td>
<td>34</td>
<td>River side</td>
</tr>
<tr>
<td></td>
<td>Samecek-si, Gangwon-do</td>
<td>50 × 5</td>
<td>~500</td>
<td>43</td>
<td>River bank</td>
</tr>
<tr>
<td></td>
<td>Yeondeok-gun, Gyeongsaangbuk-do</td>
<td>100 × 3</td>
<td>&lt;1,000</td>
<td>79</td>
<td>River bank</td>
</tr>
<tr>
<td>Apocynum lanceolatum</td>
<td>Shinan-gun, Jeollanam-do</td>
<td>100 × 5</td>
<td>&lt;1,000</td>
<td>16</td>
<td>Road side</td>
</tr>
<tr>
<td></td>
<td>Ansan-si, Gyeonggi-do</td>
<td>70 × 4</td>
<td>&lt;500</td>
<td>6</td>
<td>Road side</td>
</tr>
<tr>
<td></td>
<td>Siheung-si, Gyeonggi-do</td>
<td>10 × 7</td>
<td>~500</td>
<td>5</td>
<td>Road side</td>
</tr>
<tr>
<td></td>
<td>Jung-gu, Incheon</td>
<td>7 × 4</td>
<td>~100</td>
<td>10</td>
<td>Road side</td>
</tr>
</tbody>
</table>

S. oblongifolia grew with Molinia japonica Hack., Urticaria racemosa Wall., and Urticaria bifida L. The natural domestic habitat of S. oblongifolia was geographically isolated among the populations and limited in distribution; thus, it is at great risk of regional extinction in Korea. To preserve S. oblongifolia, an active ex situ conservation strategy should be established, such as local seed collection and the formation of a conservation center. In addition, regions containing healthy populations should be designated as in situ conservation areas and be protected.

Morphological features
Stem 6–30 cm tall, slender, striate, simple or with ascending branches. Leaves alternate, nearly sessile, oblong to elliptic or lanceolate, 3–8 mm long, 1.5–3 mm wide. Flowers August to September, sessile, red-purple, ca. 2 mm long (Satake et al., 1982; Iwatsuki and Ohba, 1999). Fruits reniform, flat, with a few spines on margins, loculicidally dehiscent (Fig. 2-a).

Observed specimens

2. Glaux maritima var. obtusifolia Fernald (Primulaceae; Ericales)

Glaux maritima var. obtusifolia Fernald is a perennial species that usually grows on the coast of a saline lake (Yamazaki, 1993b). It is distributed in Korea, Japan, the Kuriles, Kamchatka, Alaska, and northwestern regions of North America (Oh, 1980; Yamazaki, 1993b). G. maritima var. maritima is distributed in central Asia (e.g., Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan), Russia, Europe, North America, and other temperate regions in the Northern Hemisphere (Hu and Kelso, 1996). According to previous studies, the plant restrictively grows along the northern coastal areas in Korea (Lee, 1996; Im et al., 1975). However, the exact location of its habitat was not known until now. In addition, it has been classified as “Data Deficient” in the Rare Plant Data Book of Korea (Korea National Arboretum, 2008). In this survey, we found new habitats in the Gangwon-do, Gyeongsangbuk-do, and Ulsan regions (Fig. 1-b). The new habitats usually included saline lakes and were in an area that was predominated by Triglochin maritimum L. The estimated population size at the Gyeongsangbuk-do and Ulsan regions was 1,000 individuals. In contrast, the estimated size in the Gangwon-do region was less than 500 individuals (Table 1). It is believed that the habitat damage was caused by human trampling and development because all the surveyed habitats were located along a roadside. Thus, it is necessary to inspire the preservation of these habitats through public communication and by establishing an ex situ conservation strategy, such as the collection of genetic resources.

Morphological features
Stems erect, 5–20 cm tall, terete, fleshy, glabrous. Leaves opposite, fleshy, with scattered minute glandular spots, 5–15 mm long, 1.5–6 mm wide, glabrous on both surfaces, upper surface shining, a raised midrib and 2–3 pairs of obscure lateral nerves on lower surface. Flowers June to July, solitary in leaf-axils.
Pedicel very short, glabrous. Calyx broadly campanulate, 5-cleft almost to base; lobes petal-like, white tinged with pink, narrowly oblong, ca. 5mm long. Capsule globose, acute at apex, ca. 3mm in diam, longitudinally dehiscing into 5-valves, with several seeds (Fig. 2-a). G. maritima var. maritima differs from var. obtusifolia by having linear or narrowly oblong leaves, obtuse at the apex and smaller capsules (Im et al., 1975; Yamazaki, 1993b; Lee, 1996).

3. **Tillaea aquatica** L. (Crassulaceae; Saxifragales)

*Tillaea aquatica* L. is an annual species found along river banks that usually grows in wet places within sandy soil. It is distributed in Eurasia, northern Africa, and North America (Ohba, 2001; Fu and Ohba, 2001). The genus *Tillaea* L. comprises about 16 species worldwide (Fu and Ohba, 2001). Adding to the taxonomic confusion within *Crassula* is the uncertain phylogenetic placement of the annual aquatic to semi-aquatic species that have been recognized as a separate genus, *Tillaea*, by some authors (Eggli et al., 1995; Gilbert et al., 2000). However, on the basis of recent molecular data, this genus is not valid and should not be recognized (More et al., 2009). Although, there are several records of the species in illustrated plant books and herbarium specimen data (Andong-si, Gyeongsangbuk-do; Jung-gu, Seoul) (Fig. 1-c), the exact location of its habitat and its distribution in Korea have not been reported until now. Furthermore, it has been classified as “Critically Endangered” in the *Rare Plant Data Book of Korea* (Korea National Arboretum, 2008) and as “Near Threatened” in the *Red Data Book of Japanese Vascular Plants* (Ministry of the Environment, Japan, 2007). The newly identified region in this survey was a river wash that was predominated with *Beckmannia syzigachne* (Steud.) Fernald and this region contained more than 500 individuals (Table 1). Also, this region was populated with *Limosella aquatica* L., which is a rare plant of Korea. Because *T. aquatica* is an annual species found on the river wash and grows in wet places within...
sandy soil and because it possesses inconspicuous features, it is difficult to determine the exact distribution pattern of this species and to monitor its population (Ministry of the Environment, Japan, 2007). Thus, it is necessary to discover new habitats and the exact distribution range in Korea based on similar growth environments and to enact an ex situ conservation strategy, such as seed collection and preservation of genetic resources.

Morphological features

Stems sparsely branched from base, 2–5 cm tall (Fig. 2c). Leaves opposite, base connate, linear-lanceolate, 5–8 mm long, ca. 1 mm wide, apex acute, spreading to ascending. Flower April to August, tetramerous, subsessile, solitary in axils of leaves on upper part of stem, without bracts. Calyx green, base connate; lobes ovate, ca. 0.5 mm long. Petals whitish, lanceolate-ovate, ca. 1.5 mm long, apex obtuse, erect at flowering persistent. Fruit a follicle, often reddish; seeds narrowly oblong, surface with numerous longitudinal obscure ribs (Satake et al., 1982; Lee, 1996; Ohba, 2001).

Observed specimens


4. Limosella aquatica L. (Scrophulariaceae; Lamiales)

Limosella aquatica L. is an annual species that grows along muddy lake and river margins, which undergoes extreme fluctuation in its population numbers annually (Curtis et al., 1995). It is distributed throughout temperate zones of the Northern and Southern Hemispheres (Lee, 1996; Hong et al., 1998). L. aquatica was first found in Yeongdeungpo, Seoul, therefore it was called ‘deunggopul’ in the Korean language (Lee, 1998). There is no data or habitat information on L. aquatica except for specimen data (Jung-gu, Seoul). The newly identified region in this survey was a river wash in the Busan region (Fig. 1d). The population size was estimated to be 70 × 10 m with about 50 individuals (Table 1). Also, this region contained the rare plant Tillaea aquatica L. The habitat of L. aquatica typically involves inundation regions, such as river margins (Curtis et al., 1985). Thus, its population numbers are very much in flux, and it is difficult to measure its distribution range and obtained habitat information. For this reason, it is also difficult to apply the exact IUCN Red List criteria for this taxon. However, it is classified as “Critically Endangered” in the Rare Plant Data Book of Korea (Korean National Arboretum, 2008). To establish conservation strategies for L. aquatica, new habitats and its exact distribution range must be surveyed first. In addition, an active ex situ conservation strategy should be established such as seed collection and genetic resource conservation.

Morphological features

Stolons slender, short, rooting from nodes (Fig. 2d). Leaves membranaceous; petiole slender, 1–4 cm long, glabrous. Flowers May to October, solitary in leaf axils. Pedicle 1–3 mm long at flowering, to 15 mm long at fruiting, glabrous. Capsule broadly ellipsoid, short acute, 2–3 mm long, slightly longer than persistent calyx. Seeds narrowly ellipsoidal, ca. 0.5 mm long, brown (Yamazaki, 1993c; Lee, 1996).

5. Apocynum lancifolium Rusanov (Apocynaceae; Gentianales)

Apocynum lancifolium Rusanov, which is a perennial in Apocynaceae family, grows in moderately moist bluffs on seashores and is distributed in China, India, Japan, Mongolia, Pakistan, Russia and the Southwest Asia, while some grows naturally around Europe (Yamazaki, 1993c; Li et al., 1995). In Korea, it is considered to be extinct since the only specimen data is from the past (Maepo-eup, Danyang-gun, Chungcheongbuk-do; Danyang-eup, Danyang-gun, Chungcheongbuk-do; Pyeongtaek-si, Gyeonggi-do) and no other specific information on where it grows is available. Therefore, it has been designated as “Critically Endangered” in the Rare Plant Data Book of Korea (Korean National Arboretum, 2008). However, there have been recent reports from various regions that wildflower societies and environmental groups discovered habitats of this species in the coastal areas of Gyeonggi bay. Other than the Gyeonggi-do area, which was shown to contain this species in this study, habitats of growth have also been reported in Gangwon-do, Incheon, Gyeongsangbuk-do, and Jeollanam-do. Thus, A. lancifolium, which was previously thought to be extinct, is actually distributed nationally (Fig. 1e). Most of the areas containing this species were nearby farm roads or waysides, and estimated population size at Ansan-si, Gyeonggi-do, Gyeongsangbuk-do and Jeollanam-do was greater than at Gangwon-do, Incheon, and Silkeung-si, Gyeonggi-do (Table 1). Also, it seemed that there has been serious damage to the habitat due to artificial disturbances such as weeding or road widening. Therefore, it is necessary to inspire the public to help maintain healthy population of these rare plant species through public communication and efforts to maintain ecological environments in situ are also required.
addition, efforts to preserve these species, not only in situ but also ex situ, will also be required, by securing gene resources.

**Morphological features**

Stems terete, glabrous, loosely branched, branches arching. Leaves opposite, membranaceous, more or less fleshy. Flowers June to July. Corolla tubular-campanulate, pale purple (Fig. 2-e). Follicles 1 or 2, linear, atropate-acuminate at apex. Seeds linear, ca. 3mm long, 0.5mm wide (Yamazaki, 1993a).

**Observed specimens**


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**Literature Cited**


