



## Status of wetland vascular plant species in Korea

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### Abstract

We report the status of wetland vascular plant species in Korea including the whole peninsula and its adjacent islands. This analysis was based on database from our previous categorized list. In all, 4,050 taxa have been reported, including 3,769 native and 281 naturalized. Of these, 479 taxa (12%) are considered as wetland vascular indicator species: 240 obligate wetland plants (OBW) and 239 facultative upland plants (FACW). Approximately 31% of those 479 taxa, i.e., 149 taxa, are labelled as aquatic macrophytes. Wetland plants, mostly herbaceous but some woody, inhabit aquatic bodies and wet meadows. Except for two OBW and six FACW taxa, the rest of the plants are summer-green only. The information provided here is valuable for making assessments of wetland ecosystem health, as well as for developing management plans to preserve and restore wetlands and their resident plant species while also creating artificial wetland environments.

**Key words:** facultative wetland plant, Korea, obligate wetland plant

### FINDINGS

The question of how many vascular plant species occur in whole Korean peninsula and its adjacent islands might be answered based on prominent literature resources, such as 'Lineamenta Florae Koreae' (Lee 1996), which lists 4,071 taxa, whereas 'A Synonymic List of Vascular Plants in Korea' (Korea National Arboretum and the Plant Taxonomic Society of Korea 2007) reports 4,881 taxa that include both naturalized and cultivated plants. However, it is more difficult to determine how many wetland vascular plant species inhabit or to decide which of them are wetland species truly.

The range of wetland species covers a wide spectrum of

habitats associated with water. Obligate wetland species, which live continuously in the water, are one extreme while obligate upland species, found in forests or dry meadows, are at the other end of the spectrum. Because numerous species have become established between those two extremes, the practice of categorizing plants according to water conditions is artificial and may not always be precise. However, categorized information is necessary if we are to preserve, restore, and use those species as part of our wetland management schemes.

We previously assigned all 4,050 wetland taxa on the Korean Peninsula and its adjacent islands to several

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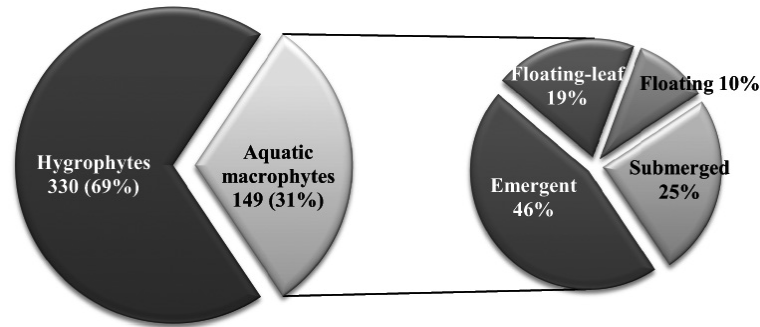
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**Fig. 1.** Wetland plants subdivided into hygrophytes and aquatic macrophytes by degree of wetness (left), and four types of aquatic macrophytes assigned according to morphology (right). A hygrophyte is defined as a plant in saturated soil conditions such as watersides and marshes, which are temporarily inundated or saturated by surface or groundwater at a frequency and duration sufficient to support but does not live in an aquatic environment, while an aquatic macrophyte is defined as a plant either rooted or floating in water most of time. Refer to Choung et al. (2012) in detail.

groups (Choung et al. 2012). Our most important exercise was to classify those vascular plants into five categories based on their frequency of occurrence in wetlands. To do so, we applied criteria slightly modified from those of the US Fish and Wildlife Service (1997). The following definitions were used:

- Obligate wetland plant (OBW), almost always occurs in wetlands under natural conditions (estimated > 98% probability in wetlands)
- Facultative wetland plant (FACW), usually occurs in wetlands but is occasionally found on non-wetland sites (estimated 71–98% probability in wetlands)
- Facultative plant (FAC), equally likely to occur in wetlands as in non-wetland areas (estimated 31–70% probability)
- Facultative upland plant (FACU), occasionally occurs in wetlands but is usually found in non-wetland areas (estimated 3–30% probability in wetlands)
- Obligate upland plant (OBU), rarely occurs in wetlands under natural conditions (estimated < 3% probability in wetlands)

For our list, we defined ‘wetland’ broadly, according to the Ramsar Convention (1971), i.e., “wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters”. Such sites would necessarily include most rivers, streams, lakes, reservoirs, tidal flats, beaches, rice paddies, and fish farms.

The categories of obligate and facultative wetland plants were further divided, based on degree of wetness,

into hygrophytes and aquatic macrophytes. The latter were then subdivided into four types according to morphology. In addition, major habitat, growth form, longevity, leaf form, and seasonality were recorded for each species. Decisions pertaining to the categorization of each species were made in our group discussions, which also referenced the literature and field experience. Here, we report the status of wetland plant species in Korea as a follow-up analysis of our earlier listings.

Based on our categorized species list of 4,050 taxa, including 3,769 native and 281 naturalized taxa (Choung et al. 2012), we have now summarized the distribution of wetland plants on the Korean Peninsula and its adjacent islands. The definitions and descriptions of all terms used here are referenced in that earlier list in detail.

Among the 4,050 plant taxa, 240 (6%) and 239 (6%) are considered as OBWs and FACWs, respectively (Table 1). These 479 wetland taxa account for 12% of the total. In contrast, upland species, such as OBUs and FACUs, comprise 84% of all taxa considered here. This indicates that terrestrial ecosystems are well developed when compared with wetlands. Topographically, the inland wetlands are less developed because, historically, they have not been

**Table 1.** Categorization of vascular plant species on the Korean Peninsula by frequency of occurrence in wetlands

Category	No. of taxa	Percentage (%)
Obligate wetland plant (OBW)	240	6
Facultative wetland plant (FACW)	239	6
Facultative plant (FAC)	178	4
Facultative upland plant (FACU)	211	5
Obligate upland plant (OBU)	3,182	79
Total	4,050	100

as strongly influenced by glaciers or activity by earthquake, volcanos, faults, and folds in that region (Wikipedia, Korea 2015). However, the coastal wetlands cover long stretches of beaches and mudflats. Therefore, to prevent flooding and secure those water resources, numerous artificial dams and reservoirs have been constructed in areas that support habitats for wetland plants.

Within our subdivisions of aquatic macrophytes and hygrophytes, the former includes 69% of all OBWs and FACWs while the latter accounts for 31% of the total (Fig. 1). Whereas all FACWs are hygrophytes, the OBW category consists of both aquatic macrophytes and hygrophytes. Among those macrophytes, approximately half (46%) are of the emergent type while the smallest portion (10%) contains species that are of the floating type.

As expected, most of the OBWs (62%) inhabit aquatic environments while the rest live in wet meadows, e.g., riparian and littoral zones that are saturated with water throughout much of the year (Table 2). However, no

standing water is present except for brief to moderate periods during the growing season. Compared with OBWs, 90% of FACW plants grow in wet meadows while 10% exist in damp forests. Members of the genus *Salix* are representative of that forest category.

Overall, 77% of the Korean taxa are herbaceous while the rest are woody plants (Table 3). All members of OBWs are herbaceous but most woody plants belong to either the OBU or FACU category. Because of prolonged, harsh winter conditions, 92% of all taxa are green only in the summer (Table 4) and just two OBW taxa, *Potamogeton oxyphyllus* and *Lycopodium cernuum*, are evergreen.

We believe that the information gleaned from our study will be useful for developing strategies aimed at preserving and restoring wetlands and their resident plant species. Moreover, our data will provide a foundation when devising plans to assess the health of Korean wetland ecosystems as well as to create artificial wetlands there.

**Table 2.** Habitat distribution of plant species among five categories

Habitat	OBW	FACW	FAC	FACU	OBU	Total
Forest		24 (10)	24 (13)	72 (34)	1,554 (49)	1,674 (41)
Meadow and shrubland			52 (29)	139 (66)	1,628 (51)	1,819 (45)
Wet meadow	91 (38)	215 (90)	102 (57)			408 (10)
Aquatic environment	149 (62)					149 (4)
Total	240 (100)	239 (100)	178 (100)	211 (100)	3,182 (100)	4,050 (100)

Numbers of taxa are shown as well as the percentage (in parentheses) found within each category.

OBW, obligate wetland plant; FACW, facultative wetland plant; FAC, facultative plant; FACU, facultative upland plant; OBU, obligate upland plant.

**Table 3.** Growth forms of plant species belonging to five categories

Growth form	OBW	FACW	FAC	FACU	OBU	Total
Tree	0 (0)	13 (5)	6 (3)	2 (1)	240 (8)	261 (6)
Subtree	0 (0)	4 (2)	4 (2)	3 (1)	117 (4)	128 (3)
Shrub	0 (0)	13 (5)	12 (7)	1 (0)	515 (16)	541 (13)
Herb	240 (100)	209 (87)	156 (88)	205 (97)	2,310 (73)	3,120 (77)
Total	240 (100)	239 (100)	178 (100)	211 (100)	3,182 (100)	4,050 (100)

Numbers of taxa are shown as well as the percentage (in parentheses) found within each category.

OBW, obligate wetland plant; FACW, facultative wetland plant; FAC, facultative plant; FACU, facultative upland plant; OBU, obligate upland plant.

**Table 4.** Seasonality of plant species belonging to five categories

Seasonality	OBW	FACW	FAC	FACU	OBU	Total
Evergreen	2 (1)	6 (3)	12 (7)	19 (10)	283 (9)	322 (8)
Half-evergreen			1 (1)		12 (0)	13 (0)
Summer-green	200 (99)	233 (97)	160 (92)	172 (90)	2,931 (91)	3,696 (92)
Total	202 (100)	239 (100)	173 (100)	191 (100)	3,226 (100)	4,031 (100)

Numbers of taxa are shown as well as the percentage (in parentheses) found within each category.

OBW, obligate wetland plant; FACW, facultative wetland plant; FAC, facultative plant; FACU, facultative upland plant; OBU, obligate upland plant.

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