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Plant resources in seven Jeonju City reservoirs: Osongjae, Gisijae, Sunggokjae, Gujujae, Seounjae, Hwanghakjae and Hacksojae

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ABSTRACT

The vascular plants of the seven reservoirs of Jeonju City were identified as consisting of 309 taxa; 87 families, 231 genera, 270 species, 35 varieties, and four forms. Eight taxa of endemic Korean plants were identified, including *Taxus cuspidata* var. *caepitosa* and *Aster koraiensis*. Ten taxa of rare and endangered species were identified, including *T. cuspidata* and *Penthorum chinense*. A total of 26 taxa of floristic special plants were recorded: class V species (5 taxa) included *Magnolia kobus* and *Prunus yedoensis*; class IV species (3 taxa) included *Prunus davidiana* and *Campanula takesimana*; class III species (5 taxa) included *Acer palmatum* and *Alisma orientale*. The hydrophytes of the seven reservoirs of Jeonju City were investigated and, of a total of 56 taxa, 46 taxa of emerged plants, two taxa of submerged plants, five taxa of floating-leaved plants, and three taxa of floating plants were identified. Thirty-two taxa of naturalized plants were identified. Among these, *Sicyos angulatus, Lactuca scariola, Paspalum distichum* var. *indutum* and *P. distichum* were identified, which are all wild plants that may disturb the ecosystem. The study suggests that these areas require management for the physical removal of these wild plants.

Introduction

A reservoir is a lake built in a river valley or wetland area to store water before it is supplied to rain-fed paddy fields. Most reservoirs do not exceed 10 m in depth and can therefore be considered as artificial wetlands. As reservoirs and rivers have usually been evaluated in civil engineering terms as tools for water conservation, flood control, or water supply, they are often dismissed as being ecologically poor. However, small-scale ponds and riverine wetlands are now being re-evaluated as biotopes capable of creating a biological community and having a role in maintaining urban ecology, rather than as biologically poor land.

The water quality of reservoirs in urban areas is influenced by non-point pollution sources. Urban reservoirs have positive roles, including natural water purification, the restriction of the effects of urban heat islands, flood control, groundwater recharge, the maintenance of biodiversity, and places for the human population to relax. Hydrophytes play a large part in these positive roles.

Hydrophytes are plants that grow in water or spend some of their growth period in water, even if they are also distributed away from water (Muenscher, 1944). In general, of the vascular plants, only herbaceous plants are referred to as hydrophytes (Sculthorpe, 1967); these hydrophytes are identified based on their life habits rather than on a taxonomic basis (Arber, 1920; Raunkiaer, 1934; Muenscher, 1944; Fassett, 1957; Sculthorpe, 1967). Sculthorpe (1967) classified aquatic vascular plants as emergent aquatics and free-floating aquatics by both life form and growth form. Emergent plants are divided into emerged plants that have their upper parts above the water surface; floating-leaved plants develop floating leaves on the water surface; and submerged plants have their vegetative parts in water. Plants that float in water or on the surface of the water are classified as floating plants.

Jeonju's seven reservoirs use artificial marshes in the form of eco-ponds to reduce non-point pollution sources from the urban area. A study of the ecosystems of the Jeonju reservoirs was conducted by Kim et al. (2004), who surveyed four sites (Osongjae, Ogongjae, Shinyongjae, and Eodujae), but it is still proving difficult to establish an efficient conservation plan. Of the areas studied in

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this work, apart from Osongjae, six reservoirs were studied for the first time. This study aims to show the importance of preserving urban reservoirs by reporting the rare and endangered plant species, hydrophytes, and floristic special plants present in these reservoirs. The flora and species composition of seven reservoirs in Jeonju were studied and basic data are provided to establish a conservation program for the sustainable use and maintenance of the reservoir biotope.

Materials and methods

This study was performed by targeting seven reservoirs in Jeonju. The basin area of each reservoir is relatively small (24–57 ha) and the depth of water is 5–8 m (Table 1). Each reservoir was surveyed three times from May 2012 to October 2012. Researchers surveyed the flora by walking along the banks of the reservoirs. The research range included parks located inside the trail and waterside regions of each reservoir.

The taxonomic group was identified using the illustrated plant books of Lee TB (1980, 2003), Lee WT (1996a, 1996b), and Lee YN (1996). The main resource plants, Korean endemic plants (National Institute of Biological Resources, 2011) and floristic special plants were classified according to the guidelines of the Third National Natural Environment Research (Kim, 2000; Ministry of Environment and National Institute of Environment Research, 2006). The naturalized plants were listed according to Lee YM et al. (2011).

Results

Vascular plants

A total of 309 taxa; 87 families, 231 genera, 270 species, 35 varieties, and four forms of vascular plants was identified (Appendix 1). The flora of each reservoir consisted of 159 taxa in Osongjae, 116 taxa in Gisijae, 85 taxa in Sunggokjae, 64 taxa in Gujujae, 91 taxa in Seounjae, 79 taxa in Hwanghakjae, and 63 taxa in Hacksojae. Osongjae, the largest of these reservoirs, had the most varied plant species. Of these 309 taxa, there are 95 taxa of woody plants (30.4% of total taxa) and 215 taxa of herbaceous plants (69.6% of the total taxa). Four taxa of Pteridophyta, 12 taxa of Gymnospermae, and 293 taxa of Angiospermae (94.8% of the total taxa) were identified (Table 2). A total of 285 vascular plant taxa have been identified in Osongjae, but as this included the area of Mt. Geonjisan, it was not cited in this study (Kim et al., 2004). Of the surveyed plants, the most dominant plants were Gramineae with 38 (12.3%) of the total 309 taxa; these were followed by Rosaceae with 23 (7.4%) taxa and Compositae with 17 (5.5%) taxa (Table 2).

Table 1
Areal characteristics of the seven reservoirs.

Reservior No.	Reservoir name	Address	Basin size (ha)	Water depth (m)
1	Osongjae	Dukjingu Songchondong 1 Street 9-4	57.0	8.0
2	Gisijae	Wansangu Pyonghwa-2-dong 889-2, 3	40.0	7.0
3	Sunggokjae	Dukjingu Ryongjongdong 565-1	24.0	6.0
4	Gujujae	Dukjingu Palbockdong 3 Street 31	36.0	6.0
5	Seounjae	Wansangu Hoojadong 3 Street 900-3, 4	56.0	6.0
6	Hwanghakjae	Wansangu Hoojadong 3 Street 1011	35.0	6.0
7	Hacksojae	Wansangu Pyonghwa-2-dong 11–17	26.0	5.0

Table 2
Number of vascular plants in the seven reservoirs of Jeonju City.

Division	Family	Genus	Taxa			
			Species	Variety	Form	Total
Pteriophyta	3	4	3	1	–	4
Gymnospermae	5	9	11	1	–	12
Angiospermae						
Dicotyledoneae	67	161	185	20	4	209
Monocotyledoneae	12	57	71	13	–	84
Total	87	231	270	35	4	309

Endangered plants and endemic Korean plants

In this study, two endangered plant species were identified: *Abeliopyllum distichum* Nakai and *Dysophylla yatabeana* Makino (planted). Of the 515 taxa of Korean endemic plants designated by the National Institute of Biological Resources (2011), eight taxa were identified (Table 3): *Taxus cuspidata* var. *caepitosa, Clematis trichotoma* Nakai, *Sasa quelpaertensis* Nakai, *Populus tomentiglandulosa* T. Lee, *Forsythia koreana* Nakai, *Paulownia coreana* Uyeki, *Aster koraiensis* Nakai, and *Campanula takesimana* Nakai.

Rare and endangered species

In this study, 10 taxa; eight families, nine genera, eight species, and two varieties of rare and endangered species as designated by the Korea Forest Service (2010) were identified (Table 4). Of these plants, only *Penthorum chinense* Pursh is considered to grow naturally, while nine taxa, including *Taxus cuspidata* S. and Z., *Magnolia kobus* A.P.DC., and *Abeliopyllum distichum* Nakai, were confirmed to have been planted.

Three thousand individuals of *Dysophylla yatabeana* Makino were supplied by the Ministry of Environment in May 2013 and were planted in Osongjae, flowering in September of that year. *Dysophylla yatabeana* Makino was discovered in Jeonju by a Japanese botanist in 1912 and Changbok Lee named it *Jeonju mulkkoripul*. *Acorus calamus* var. *angustatus* BESS was planted around the wetland and large-scale plantings of hydrophytes, including *Penthorum chinense* Pursh, *Dysophylla yatabeana* Makino and *Iris ensata* var. *spontanea* (Makino) Nakai, are forming colonies in Osongjae. Osongjae is therefore considered an important reservoir from a botanical perspective.

Table 3
List of endemic species in seven reservoirs of Jeonju City.

Scientific name	Korean name	Reservoirs
Taxus cuspidata var. *caepitosa* Nakai	눈주목 (P)	D
Clematis trichotoma Nakai	할미밀망	A
Sasa quelpaertensis Nakai	제주조릿대 (P)	B
Populus tomentiglandulosa T. Lee	은사시나무	A, E
Forsythia koreana Nakai	개나리 (P)	A, B
Paulownia coreana Uyeki	오동나무 (P)	A
Aster koraiensis Nakai	벌개미취 (P)	B, D E
Campanula takesimana Nakai	섬초롱꽃 (P)	B

A = Osongjae, B = Gisijae, C = Sunggokjae, D = Gujujae, E = Seounjae, F = Hwanghakjae, G = Hacksojae, P = planted.