Biodiv. Res. Conserv. 3-4: 291-293, 2006

DOI 10.14746/biorc.2006.3-4.20

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Dynamics of occurrence of aquatic plants in the south-western part of the Silesian Upland (south Poland)

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Abstract: The study presents a listing of aquatic plants in the south-western part of the Silesian Upland and an estimation of the degree of threat to individual species, taking into account their present frequency of occurrence and dynamic tendencies in the study area. Among 73 analysed species, 10 are considered to be probably extinct in the study area, 33 are listed as rare or endangered (with a small or decreasing number of localities), while 30 are not threatened. 23 plant species are under legal protection, while 12 of them are listed in the "Polish Red Data Book of Plants". The highest concentration of localities of aquatic plants was observed in the eastern part of the study area, in the vicinity of the town of Żory. Among the apparently extinct species, the majority are dicotyledonous plants, while monocotyledonous plants predominate in other two groups, which allows to draw the conclusion that they seem to be better adapted to anthropogenic transformations of the environment.

Key words: aquatic plants, endangered species, Rybnik Plateau, Katowice Upland, Silesian Upland

1. Introduction

The present study is devoted to aquatic vascular plants, a group which includes many extinct and endangered species because of the high level of water pollution in the study area. The goal of the study is to estimate the degree of threat to individual species on the basis of dynamics of their occurrence in the analysed area. Until 1945, data on aquatic plants in the study area could be found predominantly in works of German botanists. After World War II, the studies have been carried on by Polish florists, mainly from the botanical centres of Wrocław, Opole and Katowice. Recent years have brought the publication of monographic studies of the vascular flora of Rybnik Plateau (Urbisz 1996) and the south-western part of Katowice Upland (Urbisz 2001). Several other published studies also provide data on the occurrence of aquatic plants in this area (Domański 1997; Domański *et al*. 1997; Stebel *et al*. 1997; Urbisz & Urbisz 1998).

2. Material and methods

The study area encompasses the Rybnik Plateau and the south-western part of Katowice Upland and measures ca. 1250 km^2 (Kondracki 1988). Development of industry (Rybnik Coal Basin) and urban expansion have led here to significant transformation of the natural landscape, characterised by the occurrence of various anthropogenic terrain forms (e.g. industrial spoil heaps, sedimentation ponds, sewage overflow pools, sink holes), changes in water conditions and excessive pollution of the natural environment. The study area is located at a height of 250-300 m a.s.l. and lies on the main watershed of upper flows of the Oder and Vistula. Podzolic and brown soils occur there predominantly. The largest rivers in the area include: Bierawka, Lesznica, Kłodnica, Nacyna, Pszczynka, Ruda, Sumina and Szotkówka. A characteristic landscape feature are numerous ponds which occur mainly in the vicinity of Rybnik, Pawłowice and Żory. The largest water reservoir which is directly adjacent to the study area is the Rybnik Reservoir (5.43 km^2). The distinct climate of this area is characterised by the increased air temperature and frequency of precipitation and extension of the vegetation season (210-230 days).

The method applied for data collection included preparation of cartograms based on a square grid of 2 km x 2 km, according to the methodological convention of the *Distribution Atlas of Vascular Plants in Poland (ATPOL)* (Zając 1978). Names of plant species are taken from Mirek *et al*. (2002), the form of legal protection of species is

taken from the ordinance of the Minister of Environment of July 9th, 2004, the degree of threat is based on the *Polish Red Data Book of Plants* (Kaźmierczakowa & Zarzycki 2001), while the number of localities and dynamic tendencies in Poland are taken from Zarzycki *et al*. (2002).

3. Results

Among 73 analysed aquatic plant species (Tables 1-2), 10 species were considered to be probably extinct in the study area, 33 – rare and endangered (having currently not more than 10 localities), while 30 species were listed as not threatened. On the national scale, 19 of these species show a decrease in the number of localities, 10 remain in an equilibrium, while 6 are increasing their range (for the remaining species, data are lacking). As many as 23 species (31%) belong to legally protected plants – including 20 placed under strict protection and 3 under partial protection. From the 73 species which occur in the study area, 12 are listed in the *Polish Red Data Book of Plants*. The highest proportion of recorded species belonged to the categories: very rare (35%), rare (18%) and infrequent (16%). Only 2 species, *Lemna minor* and *Alisma plantago-aquatica*, occur in over 100 localities. On the national scale, most species (25) belong to category 4 (they have a large number of localities in many regions) and to category 2 (with a small

Table 1. Threatened aquatic species in the south-western part of the Silesian Upland

Species name	Pr.	C.t.	T.d.	L.P.	L.s.
probably extinct species					
Aldrovanda vesiculosa	++	CR	-2	1	7
Crassula aquatica		EX		1	3
Utricularia australis	++			3	3
Elatine alsinastrum	++	VU	-2	1	1
Hippuris vulgaris				3	1
Marsilia quadrifolia	++	EW		-	1
Montia fontana ssp. *chondrosperma*	++	VU		2	1
Nuphar pumila	++	VU	-1	2	1
Potamogeton ×angustifolius			-1	2	1
Potamogeton perfoliatus				4	1
endangered or rare species					
Batrachium peltatum	++			4	1
Butomus umbellatus				4	1
Callitriche autumnalis				2	1
Callitriche stagnalis				2	1
Nymphoides peltata	++	VU	-2	2	1
Potamogeton gramineus				3	1
Ruppia maritima		VU	-1	1	1
Stratiotes aloides			-/+	4	1
Batrachium circinatum				4	2
Batrachium fluitans	++		-1	2	2
Ceratophyllum submersum				3	2
Potamogeton alpinus				3	2
Potamogeton friesii				3	2
Sparganium neglectum				2	2
Eleocharis uniglumis				4	3
Hottonia palustris				4	3
Schoenoplectus tabernaemontani			-1	3	3
Trapa natans	++	CR	-2	2	3
Utricularia intermedia	++		-1	3	3
Utricularia minor	++		-1	3	3
Myriophyllum verticillatum			-/+	3	4
Najas minor	++		-1	2	4
Sparganium minimum				3	4
Elatine hexandra	++	VU	-2	2	5
Hydrocharis morsus-ranae			-/+	4	5
Zannichellia palustris				3	5
Callitriche hamulata				2	6
Elatine hydropiper	++	VU	-2	2	6
Najas marina			-/+	2	6
Potamogeton compressus				2	6
Batrachium trichophyllum	++			3	7
Potamogeton acutifolius				2	7
Eleocharis mamillata				2	8

Explanations: see Table 2

Table 2. Not threatened aquatic species in the south-western part of the Silesian Upland

Species name	Pr.	C.t.	T.d.	L.P.	L.s.
Myriophyllum spicatum			-/+	4	12
Nymphaea alba	+			4	13
Lemna trisulca			-/+	4	14
Callitriche verna				3	15
Potamogeton pectinatus			2	3	15
Potamogeton pusillus				3	15
Potamogeton lucens			-/+	4	16
Batrachium aquatile	++			4	17
Elatine triandra	++	VU	-2	2	18
Nuphar lutea	+			4	18
Salvinia natans	++		-1	2	18
Schoenoplectus lacustris				4	21
Potamogeton obtusifolius				2	22
Potamogeton crispus				4	23
Ceratophyllum demersum				4	25
Potamogeton trichoides			-1	2	27
Menyanthes trifoliata	+		-2	4	28
Sparganium erectum			-1	4	28
Sparganium emersum				3	32
Elodea canadensis			1	5	37
Oenanthe aquatica				4	39
Utricularia vulgaris	++			4	44
Callitriche cophocarpa			-/+	4	46
Potamogeton natans			2	4	51
Spirodela polyrhiza			-/+	4	55
Veronica beccabunga			1	5	64
Sagittaria sagittifolia			2	4	65
Eleocharis palustris				5	68
Alisma plantago-aquatica			1	5	125
Lemna minor			-/+	5	167

Explanations: Pr. (form of protection in Poland): + partial protection, ++ strict protection; C.t. (category of threat): EX – extinct species, EW – species extinct in natural conditions, CR – critically endangered, VU – vulnerable (after Kaźmierczakowa & Zarzycki 2001); T.d. (dynamic tendencies on the national scale): -2 – large decrease in the number of localities, -1 – decrease in the number of localities or individuals, -/+ – localities are disappearing and new ones are appearing, +1 – increase in the number of localities or individuals, +2 – large increase in the number of localities and emergence of new localities (after Zarzycki *et al*. 2002); L.P. (number of localities in Poland): 1 – very small number of localities (up to 20), 2 – small number of localities (up to 100), 3 – large number of localities concentrated in a single region, 4 – large number of localities in many regions, 5 – common species in the whole country (after Zarzycki *et al*. 2002); L.s. – number of localities (grid squares) in the study area; for extinct species the number of historical records is given

number of localities). Sites of occurrence of aquatic plants are concentrated mainly in the vicinity of Żory, Rybnik and Kuźnia Nieborowska, where most water reservoirs are located.

4. Conclusions

Localities of aquatic plants are concentrated mainly in the valley of the Ruda river in the eastern part of the study area (in the vicinity of the town of Żory), where multiple ponds occur often semi-natural in character. Most aquatic plants are rare species which occur in the study area in several or at most up to 20 localities. The species which have probably become extinct in the south-western part of the Silesian Upland include *Aldrovanda vesiculosa, Crassula aquatica*, *Elatine alsinastrum*, *Hippuris vulgaris*, *Marsilia quadrifolia*, *Montia fontana* ssp. *chondrosperma*, *Nuphar pumila*, *Potamogeton* x *angustifolius*, *P. perfoliatus* and *Utricularia australis*. They are mainly dicotyledonous plants (as many as 7 species), monocotyledons (2 species) and 1 species of aquatic fern.

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