



CHARACTERIZATION OF SELECTED *OPHIOGLOSSUM VULGATUM* L. STATIONS IN NORTHERN-WESTERN POLAND

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SYNOPSIS

The principal aim of this work was to characterize phytosociological relations observed in 7 selected localities of *Ophioglossum vulgatum*, species recognised as a threatened by extinction in Western Pomerania and the whole area of Poland, and to determine the main threats resulting from anthropoppression. The study is based on 31 phytosociological relevees, made during the growing season in 2000-2001, 2005 and 2008, using the classic Braun-Blanquet method. Altogether 9 plant associations from 3 classes: *Molinio-Arrhenatheretea*, *Phragmitetea* and *Querco-Fagetea* were determined. In individual patches *Ophioglossum vulgatum* covered up to 25% of land.

All the presented stations of this rare fern are threatened by (1) too intensive meadow mowing; (2) a complete lack of any meadow management; (3) habitat drainage; and (4) non-rational forest management. In many cases, the species needs active protection due to the nature of sites it inhabits.

INTRODUCTION

Genus *Ophioglossum*, with 25-30 (50) species, is found nearly everywhere worldwide, mainly in tropical and subtropical regions (Heyný & Slavík, 1988). *Ophioglossum vulgatum* (southern adder's tongue) is a homosporous herbaceous perennial plant, growing from a rhizome base to 10-20 (rarely 30) cm high. It usually has single leaves (rarely in pairs = var. *polyphyllum*), not circinate in bud, consisting of a sterile lamina and a fertile spike. The sterile lamina is broadly ovate to ovate-acuminate with reticulate venation. The fertile spike has 12-40 sporangia on each side (Rothmaler, 1964).

Southern adder's tongue is a subatlantic-circumpolar species (Dostal, 1989), occurring almost everywhere throughout Europe (although rare in the Mediterranean region), North America (from Nova Scotia west to North Dakota, south to Virginia,

possibly North Carolina, Indiana and Nebraska; and in the Pacific Northwest), Asia (Syria, Iran, India, Caucasus, Kamchatka, Japan) and north-western Africa (Rothmaler, 1964; Meusel et al., 1965; Heyný & Slavík, 1988; Weakley, 1997). In Poland, it has been recorded in scattered sites in the lowlands and in piedmont locations (Zajac & Zajac, 2001) and is considered endangered (Zarzycki & Szeląg, 2006). According to Zarzycki et al. (2002) this rare fern has a small number of stations (up to 100) and in the last decade a marked decrease in its number of localities was stated. Recently, the species has been under legal protection in Poland (Directive of the Minister of the Environment, 9 July 2004, Dz. U. No. 168, Item 1764). In Western Pomerania (NW Poland), it is recognised as a taxon threatened by extinction (V category); its resources are clearly declining, mainly due to degradation of its habitat (Żukowski & Jackowiak, 1995).

Ophioglossum vulgatum prefers moist mineral-humic mesotrophic soils, neutral or alkaline. It occurs in moderate light and warm climatic conditions and has rather continental preferences. This fern, in addition, tolerates increased NaCl content (Zarzycki et al., 2002). It is a species characteristic of a *Molinion* alliance (Matuszkiewicz, 2002). In Poland the species attains a distinct developmental optimum in communities inhabiting moist *Molietum* meadows (Kącki, 1998).

During floristic and phytosociological studies carried out by the author since 1998 in the area of Western Pomerania, NW Poland, a dozen or so stations of *Ophioglossum vulgatum* have been noticed, including some in the area of Barlinek-Gorzów Landscape Park (BGLP), previously not detailed in literature. The principal aim of this work was to characterize phytosociological relations observed in 7 selected localities of *Ophioglossum vulgatum* and to determine the main threats resulting from anthropopression.

MATERIAL AND METHOD

This study is based on 31 phytosociological relevees, made during the growing season in 2000-2001, 2005 and 2008 on 7 selected stations of *Ophioglossum vulgatum*, using the classic Braun-Blanquet method. A brief characteristic of the examined stations is provided. The numerical force of each *Ophioglossum vulgatum* population was estimated, determining the number of individuals in a four-point scale: 1 – several, 2 – between ten and twenty, 3 – a few dozen, 4 – a few hundred; moreover the presence or lack of sporous specimens was reported. Patches containing the rare fern were assigned to 9 plant associations representing 3 classes: *Molinio-Arrhenatheretea*, *Phragmitetea* and *Querco-Fagetea* (Table 1-4).

Names of vascular plants follow Mirek et al. (2002), and mosses – Ochrya et al. (2003). Syntaxonomic classification was adopted from Matuszkiewicz (2002).

<i>Carex acutiformis</i>	r	.	.	r	+	.	.	+
* <i>Phragmites australis</i>	r	.	.	+	r	.	.	.
VIII. Other								
<i>Geum rivale</i>	+	1.2	.	+	+	+	+	2.2
<i>Cirsium arvense</i>	+	.	+	1.1	1.1	1.2	1.1	1.1
<i>Calamagrostis epigejos</i>	.	.	+	3.3	3.3	3.3	1.2	1.2
<i>Brachythecium rutabulum</i>	.	.	+	+	+	+	+	.
<i>Plagiomnium undulatum</i>	.	+	.	.	+	+	+	+
<i>Eurhynchium hians</i>	+	1.1	+	1.1	.	.	.	.
<i>Pseudoscleropodium purum</i>	.	.	.	.	+	+	+	+
<i>Galium aparine</i>	+	+	+	+	.	.	.	.
<i>Symphytum officinale</i>	2.2	.	+	1.2	.	.	.	.
<i>Lophocolea bidentata</i>	.	.	.	.	+	+	.	+
<i>Potentilla reptans</i>	+	+	r	.	.	.	.	.
<i>Carex nigra</i>	.	+	.	.	.	.	+	1.2
<i>Salix cinerea c</i>	.	.	.	.	.	+	1.2	1.2
<i>Urtica dioica</i>	r	.	r	.	.	r	.	r

Sporadic species: II. *Hypericum tetrapterum* 1(r), 4(r); *Lythrum salicaria* 1, 4; *Stachys palustris* 1, 3(1.1); *Valeriana officinalis* 1, 4; III. *Juncus effusus* 2(1.2), 3(1.2); *J. subnodulosus* 4(r); *Polygonum bistorta* 1; *Scirpus sylvaticus* 4; IV. *Climacium dendroides* 2(1.1); V. **Pimpinella major* 1(1.1); **Taraxacum officinale* 1; VI. *Avenula pubescens* 2; *Holcus lanatus* 2(1.1.), 3(r); VII. *Carex elata* 2; *C. paniculata* 4(1.2); *Galium palustre* 2; VIII. *Aegopodium podagraria* 8; *Anthoxanthum odoratum* 2(1.2); *Calliergonella cuspidata* 4, 7; *Calystegia sepium* 1; *Carex diandra* 5, 6; *C. flava* 2(1.2); *C. ovalis* 2; *C. panicea* 2(1.1); *Dactylorhiza incarnata* 4; *Epilobium hirsutum* 1, 3; *E. palustre* 1, 2; *Euonymus europaeus c* 8; *Glechoma hederacea* 3, 4; *Listera ovata* 6; *Lycopus europaeus* 4; *Mentha aquatica* 2(1.1); *Origanum vulgare* 7, 8; *Polygonum amphibium f. terrestre* 3, 4; *Populus tremula* 7, 8; *Potentilla erecta* 1; *Ranunculus repens* 2; *Rubus caesius c* 1(1.1), 3; *Salix aurita c* 4; *Salix rosmarinifolia c* 1, 8; *Scrophularia nodosa* 5, 6; *S. umbrosa* 4; *Thuidium tamariscinum* 8; *Valeriana dioica* 7(1.2); *Veronica chamaedrys* 2, 4(r).

RESULTS WITH DISCUSSION

Below is a brief description of the 7 examined stations of *Ophioglossum vulgatum* in NW Poland. An asterisk (*) denotes a station not previously described in literature.

Station I (*) – It is a 200ha area of moist meadows between the villages of Niepołtcko and Żydowo in the Płonia River Valley (BGLP, Barlinek Commune, Zachodniopomorskie Province); only a small part of the area is mowed regularly; *Ophioglossum vulgatum* was found in 3 small fragments of the examined area:

Table 2. *Ophioglossum vulgatum* in associations from *Calthion* alliance (*Molinio-Arrhenatheretea* class)

No. of relevee	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Day.Month	02.06	09.06	21.06	21.06	10.06	02.06	02.06	09.06	02.06	21.06	21.06	21.06	02.06	12.06	12.06	21.06	21.06
Year	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2005	2005	2001	2001
Station	1.2	1.1	V	III	1.2	1.2	1.2	1.1	1.2	V	III	III	1.2	VI	VI	V	IV
Density of shrub layer [%]	0	0	0	0	0	0	0	0	0	0	0	0	0	5	15	0	0
Cover of herb layer [%]	100	100	100	95	95	100	100	100	100	95	100	100	95	95	95	100	100
Cover of moss layer [%]	10	5	5	10	zn	10	15	5	5	zn	10	10	zn	40	35	zn	5
Area of relevee [m ²]	25	25	25	25	25	20	20	25	20	25	25	25	25	50	50	25	25
Number of species	63	43	38	36	31	44	47	45	42	39	36	27	35	32	19	36	33
	<i>Angelico-Cirsietum</i>		<i>Scirpetum sylvatici</i>				<i>Juncetum subnodulosi</i>			<i>Deschampsia caespitosa</i> association						<i>Holcus lanatus</i> association	
I. Ch. et D.* Ass.																	
<i>Cirsium oleraceum</i>	3.2	3.2	+	.	2.2	2.2	1.2	+	+	+	.	.	r	.	.	+2	+
<i>Polygonum bistorta</i>	2.1	1.1	.	.	+	+	1.1	+	+	.	.	.	.	.	.	.	.
<i>Scirpus sylvaticus</i>	1.2	r	4.5	4.4	4.4	4.3	1.1	r	.	r	.	.	.	.	.	.	r
<i>Juncus subnodulosus</i>	+	r	.	.	.	.	4.4	4.3	3.3	.	.	.	r	.	.	.	.
* <i>Deschampsia caespitosa</i>	.	+2	+2	1.2	+2	.	.	1.2	+2	4.4	3.3	3.3	4.3	3.4	4.4	+2	.
* <i>Holcus lanatus</i>	2.1	2.1	1.1	1.1	1.1	1.1	1.1	+	.	+	1.1	+	.	.	.	3.4	4.5
II. Ch. Calthion																	
<i>Crepis paludosa</i>	+	r	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.
<i>Myosotis palustris</i>	.	.	r	r	r	+	+	r	r	.	.	.	.	.	.	.	.
<i>Juncus effusus</i>	r	.	1.2	+	.	.	.	.	.	.	1.2	.	.	.	.	.	+2
III. Ch. Filipendulion et Molinion*																	
* <i>Ophioglossum vulgatum</i>	+	2.2	1.2	2.2	+	+	+	+	2.2	2.2	2.2	1.2	2.2	2.2	1.2	2.2	+
<i>Lysimachia vulgaris</i>	r	.	.	.	.	+	+	+	+	r	.	1.1	+	+	.	.	.
<i>Filipendula ulmaria</i>	+	.	.	.	+	+	1.1	+	1.1	.	1.1	.	+	.	.	.	.
<i>Valeriana officinalis</i>	+	.	.	.	.	r	r	+	+	.	.	.	+	1.2	+	.	.
* <i>Molinia caerulea</i>	.	+	.	1.2	.	.	.	.	+	.	+	.	+	.	.	.	.
<i>Hypericum tetrapterum</i>	+	.	.	.	.	+	+	.	r	.	.	.	.	.	.	.	.
<i>Lythrum salicaria</i>	.	.	.	.	+	.	.	.	+	r	.	.	+	.	.	.	.
IV. Ch. Molinietalia																	
<i>Lotus uliginosus</i>	.	r	+	+	.	.	+	+	1.1	+	+	1.1	+	.	.	+	+
<i>Lychnis flos-cuculi</i>	+	r	.	+	.	1.1	+	r	.	r	+	+	r
<i>Equisetum palustre</i>	1.1	.	.	+	+	1.1	1.1	+	+	.	.	.	+

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<i>Cirsium palustre</i>	.	.	+	+	.	.	.	+	.	+	.	+	+
<i>Galium uliginosum</i>	r	r	r	+	.	.	.
V. Ch. Arrhenatherion et Arrhenatheretalia*																	
<i>Galium mollugo</i>	+	1.1	+	+	1.1	+	+	r	+	+	.	+	.	+	1.2	+	.
* <i>Achillea millefolium</i>	+	+	.	+	+	+	+	+	+	r	+	+	+	.	.	+	+
* <i>Pimpinella major</i>	+	1.1	+	1.1	1.1	+	+	+	+	.	.	.	.	.	.	+	+
<i>Arrhenatherum elatius</i>	2.1	.	.	+	1.1	1.1	+	.	.	.	.	.	.	.	.	1.1	r
* <i>Dactylis glomerata</i>	+	+	.	.	+	.	r	.	.	.	.	.	.	.	.	r	+
* <i>Taraxacum officinale</i>	+	.	.	.	+	.	.	.	r	.	.	.	.	.	.	.	r
VI. Ch. Molinio-Arrhenatheretea																	
<i>Ranunculus acer</i>	2.1	1.1	+	+	+	1.1	1.1	+	1.1	+	+	+	+	.	.	+	.
<i>Lathyrus pratensis</i>	.	+	+	+	.	+	+	+	+	+	+	+	+	.	.	+	+
<i>Rumex acetosa</i>	+	r	.	+	+	+	+	r	+	+	+	+	+	.	.	+	1.2
<i>Festuca rubra</i>	+	+	+2	.	1.2	+	.	.	+	+	+	+	+	.	.	1.2	.
<i>Plantago lanceolata</i>	1.1	+	.	.	+	.	.	+	.	+	+	+	.	.	.	+	.
<i>Avenula pubescens</i>	+	+	r	.	.	.	+	+	.	r	r	+	.	.	.	2.1	.
<i>Poa trivialis</i>	+	r	r	r	.	+	+	.	+	.	.	.	+	+	.	.	.
<i>Poa pratensis</i>	r	1.2	r	.	+	.	.	+	+	.	.	.	+	+	+	+	.
<i>Festuca pratensis</i>	+	2.2	.	.	.	.	.	r	.	+	+	.	.	.	.	+	.
<i>Cerastium holosteoides</i>	+	+	.	.	r	r	r	+	.	.	.	.	.	.	.	.	r
<i>Vicia cracca</i>	+	+	.	+	.	+	+	.	r	.	.	.	r	.	.	.	.
<i>Alopecurus pratensis</i>	r	r	+	.	.	.	.	.	.	.	.	.	.	.	.	+	r
VII. Ch. Magnocaricion et Phragmitetea*																	
<i>Carex acutiformis</i>	1.1	1.1	1.1	.	+	1.1	1.1	1.1	2.1	+	.	1.1	2.1	.	.	.	r
* <i>Phragmites australis</i>	+	.	.	.	.	1.1	r	2.2	+	+	r	1.1	+	.	.	.	r
<i>Carex paniculata</i>	.	.	.	.	.	.	+2	1.2	+2	.	.	.	+2	.	.	.	.
<i>Galium palustre</i>	.	.	+	+	.	.	.	.	.	r	+	.	+	.	.	.	.
VIII. Other																	
<i>Geum rivale</i>	+	+	+	2.2	r	+	+	1.2	+	1.2	2.2	3.3	+	.	.	+	+
<i>Eurhynchium hians</i>	2.2	+	.	+	.	+	1.1	+	+	.	+	+	.	.	.	.	+
<i>Cirsium arvense</i>	+	+	+	+	+	.	.	+	1.1	.	.	.	.	1.2	1.2	+	+

<i>Galium aparine</i>	.	.	.	+	.	.	.	+	+	r	+	+	+	+	.	.	r
<i>Carex panicea</i>	+	+	.	1.1	.	+	+	2.2	+	.	1.1	+	.	.	.	.	.
<i>Anthoxanthum odoratum</i>	+	r	+	+	.	.	.	.	.	+	1.1	+	.	.	.	1.1	.
<i>Potentilla reptans</i>	+	+	.	+2	.	.	.	+	+	.	+	.	.	.	.	.	+
<i>Veronica chamaedrys</i>	+	.	+	.	.	r	+	.	.	+	r	.	.	.	.	1.1	+
<i>Ranunculus repens</i>	+	.	.	.	+	.	.	.	.	+	+	.	+	.	.	+	r
<i>Urtica dioica</i>	.	.	2.3	.	.	r	.	.	r	.	.	.	.	1.2	+	r	1.1
<i>Mentha aquatica</i>	.	+	.	+	.	.	.	+	.	.	1.1	+	.	.	.	.	1.1
<i>Calliergonella cuspidata</i>	+	.	.	+	.	1.1	1.1	+	+	.	.	.	.	.	.	.	.
<i>Alchemilla plicata</i>	+	+2	.	.	.	1.2	+	+	.	.	.	.	.	.	.	.	.
<i>Symphytum officinale</i>	+	.	.	.	.	+	+	.	1.2	.	.	.	+	.	.	.	.
<i>Luzula campestris</i>	r	.	.	r	.	.	+	.	.	+	.	.	.	.	.	+	.
<i>Carex nigra</i>	+	.	.	.	.	+	1.1	.	.	.	+2	.	+	.	.	.	.
<i>Brachythecium rutabulum</i>	.	.	.	.	.	.	.	+	.	.	+	.	.	3.3	3.2	.	.
<i>Carex pairae</i>	.	.	+	.	.	.	.	.	.	1.2	.	.	.	1.2	1.2	+	.
<i>Rubus caesius c</i>	.	.	.	.	.	.	.	.	1.1	.	.	.	+	+	+	.	.
<i>Eupatorium cannabinum</i>	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.
<i>Valeriana dioica</i>	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	1.1
<i>Plagiomnium affine</i>	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.
<i>Calystegia sepium</i>	.	.	.	.	+	+	.	.	r	.	.	.	+	.	.	.	.

Sporadic species: **III.** *Geranium palustre* 8(r), 13(r); *Selinum carvifolia* 1, 6(1.1), 7; *Stachys palustris* 9, 13; **IV.** *Angelica sylvestris* 1, 6, 7; *Climacium dendroides* 1, 6; *Trollius europaeus* 1(1.2), 6, 7(1.2); **V.** **Bromus hordeaceus* 1; **Heracleum sibiricum* 1, 2, 6; **Leucanthemum vulgare* 1; **VI.** *Centaurea jacea* 2; *Trifolium pratense* 1, 16; **VII.** *Carex elata* 11, 12(1.2), 13; *Carex vesicaria* 3; **Equisetum fluviatile* 10, 11, 12; *Iris pseudacorus* 3, 10; *Scutellaria galericulata* 10; **VIII.** *Acer pseudoplatanus* 14; *Agrostis stolonifera* 10, 16; *Ajuga reptans* 14; *Anemone nemorosa* 16; *Bellis perennis* 1; *Calamagrostis canescens* 3(1.2), 16, 17(1.1); *C. epigejos* 16; *Calliergon cordifolium* 1, 7; *Carex flacca* 2, 8(1.2); *C. flava* 4, 11(1.2); *C. hirta* 6, 10, 16; *C. ovalis* 11; *C. pallescens* 1, 4; *Cornus sanguinea b* 14, 15(1.2);

Dactylorhiza incarnata 2; *Epilobium palustre* 11(r), 12(r), 13(r); *Euonymus europaea b* 14, 15; c 14, 15; *Festuca arundinacea* 14(1.2); *Ficaria verna* 14; *Frangula alnus c* 3; *Fraxinus excelsior c* 3, 14; *Galeopsis tetrahit* 14(r); *Glechoma hederacea* 16; *Hedera helix* 15; *Humulus lupulus* 14; *Kindbergia praelonga* 14(1.2), 15(1.2); *Linaria vulgaris* 3, 16; *Lycopus europaeus* 17; *Lysimachia nummularia* 1, 5; *Moehringia trinervia* 14, 15; *Plagiomnium cuspidatum* 3; *P. undulatum* 4, 11, 12; *Plantago major* 1; *Potentilla anserina* 2; *P. erecta* 2, 4(1.1), 10; *Prunus spinosa b* 14(1.2), 15; *Ranunculus auricomus* 3, 10, 14(r); *Rhamnus cathartica b* 14(1.2), 15(2.2); c 14, 15; *Rubus idaeus c* 3(1.1), 10(1.1), 17(1.1); *Scrophularia nodosa* 14(1.2), 15(1.2); *S. umbrosa* 14(1.2); *Stellaria graminea* 3, 17; *S. media* 14; *S. palustris* 10, 13; *Trifolium repens* 1, 16; *Ulmus laevis c* 14; *Viola palustris* 3, 10(1.2).

Table 3. *Caricetum acutiformis* (*Phragmitetea*) with *Ophioglossum vulgatum*

No. of relevee	1	2	3
Day.Month	21.06	02.06	09.06
Year	2001	2001	2001
Station	IV	1.2	1.3
Cover of herb layer [%]	100	95	95
Cover of moss layer [%]	zn	5	zn
Area of relevee [m ²]	20	20	20
Number of species	36	26	23
I. Ch. Ass.			
<i>Carex acutiformis</i>	4.5	4.5	5.5
II. Ch. Magnocaricion			
<i>Peucedanum palustre</i>	r	.	r
<i>Scutellaria galericulata</i>	+	.	r
<i>Galium palustre</i>	.	+	r
<i>Phalaris arundinacea</i>	r	r	.
III. Ch. Phragmitetea			
<i>Phragmites australis</i>	+	2.1	+
IV. Ch. Molinion, Calthion* et Filipendulion**			
<i>Ophioglossum vulgatum</i>	1.2	+	+
** <i>Hypericum tetrapterum</i>	+	+	.
* <i>Scirpus sylvaticus</i>	+	1.1	.
* <i>Cirsium oleraceum</i>	r	+	.
** <i>Filipendula ulmaria</i>	r	+	.
V. Ch. Molinietalia et Molinio-Arrhenatheretea*			
* <i>Lathyrus pratensis</i>	+	r	+
* <i>Poa trivialis</i>	1.1	+	.
* <i>Holcus lanatus</i>	+	+	.
* <i>Rumex acetosa</i>	+	+	.
<i>Lotus uliginosus</i>	+	r	.
<i>Lychnis flos-cuculi</i>	r	r	.
<i>Equisetum palustre</i>	.	+	+
VI. Other			
<i>Urtica dioica</i>	1.1	r	2.1
<i>Cirsium arvense</i>	1.1	+	+
	+	1.2	+
<i>Calliargon cordifolium</i>	+	+	+
<i>Eurhynchium hians</i>	+	+	+
<i>Glechoma hederacea</i>	1.1	.	+
<i>Calamagrostis epigejos</i>	+	.	+
<i>Carex panicea</i>	+	+	.
<i>Calystegia sepium</i>	.	+	+
<i>Symphytum officinale</i>	.	+	+
<i>Geum rivale</i>	+	r	.

Sporadic species: **II.** *Carex paniculata* 3(+.2); *Iris pseudacorus* 1(1.2); **IV.** **Juncus effusus* 1; **V.** *Cirsium palustre* 1; *Deschampsia caespitosa* 1(1.2); **Ranunculus acer* 2;

VI. *Calamagrostis canescens* 1; *Epilobium hirsutum* 3(1.2); *E. palustre* 1; *Eupatorium cannabinum* 3; *Galium aparine* 3; *Lycopus europaeus* 1; *Mentha aquatica* 1; *Pimpinella major* 2; *Polygonum amphibium* f. *terrestre* 3; *Rubus caesius* c 3; *R. idaeus* c 1(2.1); *Stachys sylvatica* 3; *Stellaria graminea* 1; *Valeriana dioica* 1; *Veronica chamaedrys* 1.

Table 4. *Fraxino-Alnetum* (*Quercu-Fagetea*) with *Ophioglossum vulgatum*

No. of relevee	1	2	3
Day.Month	10.05	11.05	21.05
Year	2000	2000	2000
Station	II	II	II
Density of tree layer [%]	75	85	85
Density of shrub layer [%]	2	2	2
Cover of herb layer [%]	70	90	80
Cover of moss layer [%]	zn	zn	zn
Area of relevee [m ²]	100	100	100
Number of species	41	35	32
I. D. Ass. et Alnenion*			
<i>*Alnus glutinosa</i> a	3.2	5.5	5.5
<i>Lysimachia vulgaris</i>	+	+	r
<i>Solanum dulcamara</i>	+	+	+
<i>Galium palustre</i>	r	+	r
<i>Frangula alnus</i> c	.	r	+
II. Ch. Alno-Ulmion			
<i>Plagiomnium undulatum</i>	+	+	+
III. Ch. Fagion et Fagetalia*			
<i>*Anemone ranunculoides</i>	.	1.1	r
IV. Ch. Quercu-Fagetea			
<i>Fraxinus excelsior</i> b	+	+	+
<i>Anemone nemorosa</i>	+	1.2	r
<i>Brachypodium sylvaticum</i>	+	+	+
<i>Acer platanoides</i> c	+	+	.
<i>Aegopodium podagraria</i>	1.1	.	r
<i>Ranunculus auricomus</i>	+	.	+
V. Ch. Molinion et Calthion*			
<i>Ophioglossum vulgatum</i>	+	+	+
<i>*Crepis paludosa</i>	+	1.1	+
<i>*Polygonum bistorta</i>	+	+	+
VI. Ch. Molinietalia et Molinio-Arrhenatheretea*			
<i>Deschampsia caespitosa</i>	1.2	+2	+2
<i>*Lathyrus pratensis</i>	+	+	+
<i>*Poa trivialis</i>	+	.	+
<i>Equisetum palustre</i>	+	+	.
VII. Other			
<i>Carex elata</i>	2.2	4.5	4.5
<i>Geum rivale</i>	1.2	1.1	1.2
<i>Carex acutiformis</i>	1.1	1.1	1.1
<i>Equisetum fluviatile</i>	+	+	+
<i>Rubus idaeus</i> b	+	+	+
<i>Potentilla erecta</i>	+	+	+
<i>Dryopteris carthusiana</i>	+	+	+
<i>Calliergonella cuspidata</i>	+	+	+
<i>Rhamnus cathartica</i> c	+	.	+

<i>Eupatorium cannabinum</i>	+	+	.
<i>Urtica dioica</i>	+	.	+
<i>Galium aparine</i>	+	+	.
<i>Viola palustris</i>	.	+	+

Sporadic species: **III.** **Dryopteris filix-mas* 1; *Fagus sylvatica* c 2; **Paris quadrifolia* 2(+.2); **IV.** *Fraxinus excelsior* a 1(3.2), c 1; *Hepatica nobilis* 1; **V.** *Molinia caerulea* 1(1.2); **VI.** *Cirsium palustre* 1; **Vicia cracca* 2; **VII.** *Ajuga reptans* 1(1.2); *Calamagrostis canescens* 3(+.2); *Cardaminopsis arenosa* 1; *Carduus crispus* 1; *Carex flava* 2; *C. pallescens* 1; *Carpinus betulus* c 3; *Deschampsia flexuosa* 2; *Moehringia trinervia* 1; *Pinus sylvestris* c 2; *Ranunculus repens* 1; *Sorbus aucuparia* c 3; *Stellaria palustris* 1; *Valeriana dioica* 2; *Veronica chamaedrys* 1.

I.1. A wasteland situated 1.3 km NW of Żydowo, with species that are rare in Western Pomerania, e.g. *Juncus subnodulosus*, *Dactylorhiza incarnata*, *Valeriana dioica* and a slight presence of *Molinia caerulea*; the subpopulation of *Ophioglossum vulgatum* had a few dozens specimens, out of which 30% had fertile spikes; two communities, belonging to the *Calthion* alliance, with a presence of studied species were observed: *Cirsio-Polygonetum* (Table 2, relevee no. 2) and a rare West-European community *Juncetum subnodulosi* (Table 2, relevee no. 8);

I.2. A wasteland on the right bank of the Płonia River, about 1.3 km west of Żydowo, with a presence of *Trollius europaeus* and *Juncus subnodulosus*, planned to be a reserve or ecological ground named 'Pełnikowe Sitowisko' (Baciewicz, 1996; Myśliwy, 2003b); subpopulation of *Ophioglossum vulgatum* was not numerous – more than 20 specimens without fertile spikes; the examined species was observed in a mosaic of meadow communities belonging to two alliances: *Calthion* (Table 2: *Scirpetum sylvatici* – relevees no. 5-6; *Juncetum subnodulosi* – relevees no. 7 and 9; *Cirsio-Polygonetum* – relevee no. 1; *Deschampsia caespitosa* association – relevee no. 13) and *Filipendulion* (Table 1: *Filipendulo-Geraniatum* – relevee no. 1) and in the sedge rush *Caricetum acutiformis* from the *Magnocaricion* alliance, at the very bank of the Płonia River (Table 3, relevee no. 2);

I.3. Floristically poor *Molinia* meadow, adjacent to a fish pond, about 0.9 km NW of Żydowo, with a large participation of *Calamagrostis epigejos* and nitrophilous plants, such as *Urtica dioica*; from the Western side it borders a fragment of sedge rushes; the subpopulation of *Ophioglossum vulgatum* was about 40 specimens, including individual and splendid specimens with fertile spikes; the patches with a presence of the examined species have been ascribed to the *Molinia caerulea* association (Table 1, relevees no. 3-4) and *Caricetum acutiformis* (Table 3, relevee no. 3).

Station II – It is a designed nature reserve 'Lilie Wodne' ('Water Lillies'), about 4 km N of Rybakowo (BGLP, Barlinek Commune, Zachodniopomorskie Province), including an overgrowing little lake in a deep depression, with surrounding marsh and peat-bog plants (Radziszewicz & Stępień, 2001); the population of *Ophioglossum vulgatum* was a few dozen of specimens without fertile spikes, living in considerable dispersion; the species was observed in the dried and degraded ash-alder wood *Fraxino-Alnetum* from the *Alno-Ulmion* alliance (Table 4, relevees no. 1-3);

in some areas there are visible signs of human activity: partial forest clearing, plowed soil and planting furrows.

Station III (*) – It is a meadow covered with planted and relatively young alders, next to a water flow connecting Chłop and Chłopek lakes, situated about 3 km NW of Rybakowo (BGLP, Kłodawa Commune, Lubuskie Province); the population of *Ophioglossum vulgatum* had a few dozen specimens, including several ones with fertile spikes; the species was observed in moist and floristically poor patches with the presence of *Molinia caerulea*, forming a mosaic of three different associations from the *Molinion* alliance (Table 1: *Molinia caerulea* association – relevee no. 2) and *Calthion* alliance (Table 2: *Scirpetum sylvatici* – relevee no. 4 and *Deschampsia caespitosa* association – relevees no. 11-12).

Station IV (*) – It is a forest clearing, about 1 km W of Grabino Lake (BGLP, Kłodawa Commune, Lubuskie Province); the population of *Ophioglossum vulgatum* was a few dozen specimens, occurring in dispersion and without fertile spikes; the patches with a presence of the examined species were ascribed to the *Caricetum acutiformis* community, with a distinct presence of nitrophilous species, mainly *Urtica dioica* and *Cirsium arvense* (Table 3, relevee no. 1) and a meadow association with a domination of *Holcus lanatus*, and the appearing reed (Table 2, relevee no. 17).

Station V (*) – It is an intensely mowed and ditched forest meadow near Grabino Lake (BGLP, Kłodawa Commune, Lubuskie Province); the population of *Ophioglossum vulgatum* was quite large, with almost 100 specimens, out of which almost half had fertile spikes; the species was observed in a mosaic of three floristically poor associations from the *Calthion* alliance (Table 2: *Scirpetum sylvatici* – relevee no. 3; *Deschampsia caespitosa* association – relevee no. 10 and *Holcus lanatus* association – relevee no. 16).

Station VI – The nature reserve ‘Czapli Ostrów’ (‘Heron Island’), on a 12 ha island on Ostrowieckie Lake (Dębno Lubuskie Commune, Zachodniopomorskie Province), established to protect colonies of many water bird species (Bosiacka & Myśliwy, 2007); the population of *Ophioglossum vulgatum* was about 300 individuals, out of which only 5 had fertile spikes; this rare fern occurred in a forest clearing in the south part of the island, in patches of an association with *Deschampsia caespitosa* (Table 2, relevee no. 14-15).

Station VII (*) – A designed nature reserve ‘Wyspa Sidły’ (‘Sidły Island’), with an area of 6 ha on an island on Wdzydze Lake, within the Wdzydzki Landscape Park (Karsin Commune, Pomorskie Province); the population of *Ophioglossum vulgatum* was very numerous (a few hundred individuals), but only a small part of them had fertile spikes; the examined species occurred in the central part of the island, where it was a component of a meadow association with *Molinia caerulea*, with a considerable presence of *Calamagrostis epigejos* in some patches (Table 1, relevees no. 5-8), and also, although less numerous, a component of the thickets with *Frangula alnus*, *Salix cinerea*, *Rhamnus cathartica* and *Cornus sanguinea*.

All the presented stations of *Ophioglossum vulgatum* are threatened by (1) too intensive meadow mowing – station V; (2) a complete lack of any meadow

management – stations I.1-2, III, IV, VI and VII; (3) habitat drainage – stations IV, V, VII; and (4) non-rational forest management – station II. A negative effect of drainage on species richness is unquestionable and was proved by e.g. Grootjans et al. (2005). Mowing several times a year resulted in most grasslands being transformed into commercially more profitable, but floristically poorer, multi-mown fresh meadows of the *Arrhenatheretalia* order. The consequence involved the disappearance of numerous species typical of *Molinion* meadows, including Southern adder's tongue, which was observed in the study area (Myśliwy, 2003a). Cessation of human economic activities and the associated absence of meadow tending is equally bad for the meadow flora, and triggers succession processes (Myśliwy & Bosiacka, in press). The accumulation of litter is one of the most important mechanisms changing species composition after abandonment. As a result of abandonment, specialist species are often replaced by generalist species, a decrease of species diversity is observed, as well as the establishment of woody or invasive species (Peintinger & Bargamini, 2006). In the study area the appearance of nitrophilous species, reducing the floristic richness, was observed (stations I, III and IV), as well as an increase of the proportion of forest species (stations III, VI, VII).

CONCLUSIONS

On the 7 examined habitats of *Ophioglossum vulgatum* in NW Poland, altogether 31 phytosociological relevees were performed, representing 9 plant associations from 3 classes: *Molinio-Arrhenatheretea*, *Phragmitetea* and *Querco-Fagetea*. The most numerous is *Calthion* alliance (communities: *Cirsio-Polygonetum*, *Scirpetum sylvatici*, *Juncetum subnodulosi* and associations with *Deschampsia caespitosa* and *Holcus lanatus*). In *Filipendulion* and *Molinion* alliances, as well as in the two last classes mentioned above, one association with a presence of the examined species was recognized. In individual patches Southern adder's tongue covered up to 25% of land.

In all the examined phytocenoses one may observe a small presence of bryophytes, probably caused by drying of habitats. Some actions to save at least the most floristically rich stations of this rare fern should be undertaken. One of the studied sites is already protected as a nature reserve (station VI), which does not mean that the applied form of protection allows for the needs of Southern adder's tongue; three other sites are located within areas of proposed nature reserves or ecological grounds (stations I.2, II, VII). In many cases, the species needs active protection due to the nature of the sites it inhabits.

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