Biodiv. Res. Conserv. 13: 3-8, 2009

10.2478/v10119-009-0001-7

BRC
www.brc.amu.edu.pl

Orobanche bartlingii Griseb. (Orobanchaceae) in Poland: taxonomical position, distribution and habitat requirements

Renata Piwowarczyk[1], Marcin Nobis[2] & Alojzy Przemyski[3]

[1, 3]Department of Botany, Institute of Biology, Jan Kochanowski University in Kielce, Świętokrzyska 15, 25-406 Kielce, Poland, e-mail: [1]renka76@wp.pl, [3]przemal@ujk.kielce.pl
[2]Department of Plant Taxonomy and Phytogeography, Institute of Botany, Jagiellonian University, Kopernika 27, 31-501 Kraków, Poland, e-mail: m.nobis@uj.edu.pl

Abstract: The paper presents current distribution of *Orobanche bartlingii* Griseb. in Poland, including the new localities which were found in Podzamcze (Kraków-Częstochowa Upland) and Cząstków Stary (Kielce Upland). Taxonomical position as well as some diagnostic features that differ *O. bartlingii* from *O. alsatica* are presented. Habitat requirements and plant communities in which the species was recorded are discussed.

Key words: *Orobanche bartlingii,* diagnostic features, distribution, habitat requirements, Poland

1. Introduction

Orobanche bartlingii Griseb. [syn. *O. libanotidis* Rupr., *O. alsatica* var. *libanotidis* (Rupr.) Beck.] (Bartling's broomrape) is one of the rarest representatives of the parasitic family Orobanchaceae L., recorded in only three localities in Poland (Szelag 2001a; Rakowski 2004; Nowak-Dańda & Dańda 2006). The species is included in the Polish red data book of plants as a vulnerable (Szeląg 2001b) and is red-listed as a rare (Zarzycki & Szeląg 2006). All species of the genus *Orobanche* are strictly protected in Poland (Regulation 2004).

The aim of this work is to report on new localities and habitat requirements of *O. bartlingii* in Poland.

2. Methods

Field studies were carried out during the flowering period of *Orobanche bartlingii*, i.e. from mid June until the end of July in 2006 and 2007. The distribution of its localities was mapped using the ATPOL grid based on cartogram units 10 x 10 km (Zając 1978).

The nomenclature of the vascular plant species listed in the phytosociological table follows Mirek *et al*. (2002) and the nomenclature of syntaxa is used after Matuszkiewicz (2006).

Herbarium specimens are deposited in the Herbarium of the Department of Botany, Jan Kochanowski University, Kielce (KTC).

3. Results

3.1. Taxonomy

Orobanche bartlingii belongs to the Osproleon section Wallr. (= *Orobanche* L.) subsection *Curvatae* Beck. It is most closely related to *Orobanche alsatica* Kirschl. whose morphology is similar to that of *O. bartlingii*. The two species are treated by some researchers as varieties of *O. alsatica*, i.e. *O. alsatica* Beck var. *typica* and *O. alsatica* var. *libanotidis* (Rupr.) Beck, subspecies within it, i.e. *O. alsatica* subsp. *alsatica* and *O. alsatica* subsp. *libanotidis* (Rupr.) Tzvelev (e.g. Beck 1890, 1930; Gilli 1966; Buia 1985; Rothmaler *et al*. 2002; Tzvelev 1981) or are combined within the *O. alsatica* complex (e.g. Zázvorka 2000).

Orobanche bartlingii (= *O. libanotidis*) is distinguished as a separate species in, for instance, German (Nieschalk & Nieschalk 1968, 1974; Uhlich *et al*. 1995; Kreutz

Table 1. A comparison of the most important features of *Orobanche bartlingii* Griseb. and *O. alsatica* Kirschl.

Features	*Orobanche bartlingii*	*Orobanche alsatica*
Corolla	Shorter than 20 mm (usually 12-17 mm), almost horizontal	Longer than 20 mm (usually 20-25 mm) almost perpendicular
Dorsal line of the corolla	Evenly curved at the base	Regularly and strongly curved
Style	Glabrous or rarely sparsely glandular-pubescent	Glandular-pubescent
Stamens	Inserted 1-3 mm above the base of the corolla tube	Inserted 4-7 mm
Host	*Libanotis pyrenaica*	*Peucedanum cervaria*

1995), French (Royer *et al*. 1992), Austrian (Melzer & Barta 1995), Estonian (Lilleleht 1998), Ukrainian (Prokudin 1999; Mosyakin & Fedoronchuk 1999) and Central Asian floras (Mayevsky 2006).

Libanotis pyrenaica is the most frequently reported host plant of *Orobanche bartlingii* (Beck 1930; Pusch & Barthel 1992; Kreutz 1995; Uhlich *et al*. 1995; Zázvorka 2000), while *Peucedanum cervaria* (Zázvorka 1997) and the species of the genera *Pimpinella* and *Angelica* (Tzvelev 1981; Uhlich *et al*. 1995) are occasionally reported as its hosts. The species parasitizes only *Libanotis pyrenaica* in its localities in Poland (Szeląg 2001a, 2001b; Rakowski 2004; Nowak-Dańda & Dańda 2006).

A set of the most important features that distinguish *O. bartlingii* and *O. alsatica* was compiled using available keys, e.g. Beck (1930), Pusch and Barthel (1992), Kreutz (1995), Uhlich *et al*. (1995), Pujadas and Gómez (2000), Rothmaler *et al*. (2002), and the authors' own observations conducted on the specimens from their Polish populations to facilitate the distinction between the two species (Table 1).

3.2. General distribution

Orobanche bartlingii occurs in the area ranging from central and eastern Europe to China. The centre of its distribution range is located in the Baltic Region, Russia and Siberia (Kreutz 1995).

O. bartlingii in the rank of a species or a lower unit, possibly as a complex, is given from the Central Asia, Siberia, Caucasus (Mayevsky 2006; Tzvelev 1981), Ukraine (Prokudin 1999), Estonia (Kukk 1999), the Czech Republic (Zázvorka 2000), Slovakia (Zázvorka 1997), Hungary (Soó 1968), Romania (Buia 1985), Germany (Rothmaler *et al*. 2002; Uhlich *et al*. 1995), Austria (Adler *et al*. 1994; Melzer & Barta 1995), Switzerland (Binz & Heitz 1990) and France (Royer *et al*. 1992). Its exact distribution range cannot be specified at present as *O. bartlingii* has been erroneously determined as *O. alsatica* or the two species are included in *O. alsatica* agg. Therefore its potential distribution range may considerably overlap with the distribution range of *O. alsatica*. However, a more in-depth analysis of the problem and research into the two taxa have revealed some differences in their distribution. The potential range of *O. bartlingii* in Europe was presented in the studies by Kreutz (1995) and Uhlich *et al*. (1995), based on relevant data available to date.

O. bartlingii usually grows in xerothermic grasslands and shrubs, woodland glades, on outcrops and calcareous slopes, preferring alkaline soils, clay or loess soils (e.g. Tzvelev 1981; Kreutz 1995). It has also been reported from colder submontane regions where considerable temperature fluctuations are recorded (Nieschalk & Nieschalk 1974).

3.3. Distribution and habitat conditions in Poland

The species was recorded in Poland for the first time on the Grodzisko Hill in the Ojców National Park in 1992 (Szeląg 2001a). Further localities were found in 1995-1996, near Rzędkowice between the Lechwora and Kursantów Ridges as well as near the Okiennik Rock (Rakowski 2004). The most recent localities were found in the Kobylańska Valley on the slopes of the Postrzępiona Ridge in 2005 (Nowak-Dańda & Dańda 2006) (Fig. 1). They are situated in the Kraków-Częstochowa Upland (central Poland).

Fig. 1. Distribution of *Orobanche bartlingii* Griseb. in Poland (in the ATPOL grid square system 10x10 km)
Explanations: ▲ – new localities, ● – localities cited in literature

Orobanche bartlingii prefers open and sunny spaces. It prefers sites with a S, SW and SE exposure as well as moderately shady sites with a W exposure and sporadically with a N exposure.

The majority of specimens in the Kobylańska Valley occurs in saxicolous grasslands (*Festucetum pallentis* association) on a W-facing slope (Nowak-Dańda & Dańda 2006). The species was also observed in the patches of the forest edge *Geranio-Peucedanetum cervariae* association, and also in similar habitat, but in the shadow tree in the locality in Rzędkowice. Moreover, single specimens were observed in grassland phytocoenosis where vegetation succession is very slow (Rakowski 2004). It grows in a xerothermic grassland (*Festucetalia valesiacae* order) in the locality in Grodzisk; only single specimens were recorded on a rocky slope (*Festucetum pallentis* association) (Szeląg 2001a).

3.4. New localities in Poland

Two new localities of *Orobanche bartlingii* were recorded during the studies in the villages of Cząstków Stary near Nowa Słupia (Kielce Upland) and Podzamcze near Ogrodzieniec, in the vicinity of the Ogrodzieniec Castle (Kraków-Częstochowa Upland) (Fig. 1). In Cząstków Stary, the species grows on the right, steep rocky slope of the Pokrzywianka Valley with a SW exposure. It occurs in the ecotone communities of the *Trifolio-Geranietea sanguinei* class, developed on the border of xerothermic shrubs. Specimens of the species were also found in the patches of xerothermic grasslands (characterized by a different species composition and preservation degree) in the summit part of the slope. The grassland borders the steep edge of the slope to the W, a birch grove to the SE, E and the initial form of the oak-hornbeam forest and xerothermic shrubs to the NE. The populations in Podzamcze are situated in the S, SE, E, W and also N parts of the hill. Numerous populations of *Orobanche bartlingii* were recorded also near chalky outcrops of monadnocks and in the ruins of the Ogrodzieniec Castle – in xerothermic grasslands of the *Festuco-Brometea* class, often with a large participation of common meadow species of the *Molinio-Arrhenatheretea* class. It occurs quite frequently in moderately shady ecotone sites, e.g. at the edge of shrubs with *Corylus avellana*, on the border of oak-hornbeam forest communities representing the *Querco-Fagetea* class or directly near paths. A detailed list of species recorded in the communities with *Orobanche bartlingii* is given in the Table 2. In the new localities, *Orobanche bartlingii* parasitizes only *Libanotis pyrenaica*.

Table 2. Plant communities with *Orobanche bartlingii* Griseb.

No. of relevé	1	2	3	4
Date	20.06.07	30.06.07	30.06.07	25.06.07
Area of relevé [m^2]	100	200	200	100
Exposure	SW/W	S	SW	W
Inclination [^{o}]	5	3	3	20
Altitude a.s.l. [m]	265	490	450	318
Cover of trees A [%]	-	10	30	10
Cover of shrubs B [%]	2	20	30	15
Cover of herbaceus plants C [%]	60	90	90	70
Cover of D layer [%]	<1	<1	<1	<1
Number of species	37	54	44	36
Orobanche bartlingii	**1**	**+**	**+**	**1**
Ch. Cl. Trifolio-Geranietea sanguinei				
Galium mollugo	1	2	1	+
Libanotis pyrenaica	5	2	2	3
Agrimonia eupatoria	+	+	+	.
Coronilla varia	.	2	1	+
Medicago falcata	+	+	.	.
Origanum vulgare	2	.	.	+
Verbascum lychnitis	1	.	+	.
Ch. Cl. Festuco-Brometea				
Euphorbia cyparissias	.	1	+	+
Avenula pratensis	.	+	1	.
Helianthemum nummularium	.	+	.	+
Plantago media	.	+	+	.
Scabiosa ochroleuca	1	.	.	+
Stachys recta	.	.	+	+
Ch.Cl. Molinio-Arrhenatheretea				
Achillea millefolium s.l.	+	+	1	.
Arrhenatherum elatius	+	+	3	.
Dactylis glomerata	1	1	2	.
Festuca pratensis	1	3	2	.
Anthyllis vulneraria	+	.	.	+
Festuca rubra	1	.	1	.

Knautia arvensis	.	+	+	.
Leucanthemum vulgare	.	.	+	+
Lotus corniculatus	.	+	+	.
Plantago lanceolata	.	+	.	+
Poa pratensis	+	+	.	.
Tragopogon pratensis	.	+	+	.
Trifolium pratense	+	+	.	.
Ch. Cl. Querco-Fagetea				
Acer platanoides	+	+	.	.
Fraxinus excelsior	.	+	2	.
Others	.	.	.	.
Briza media	.	3	1	+
Convolvulus arvensis	+	+	+	.
Hypericum perforatum	+	+	.	+
Medicago lupulina	+	+	+	.
Polygala vulgaris	.	+	+	+
Silene vulgaris	.	+	+	+
Thymus pulegioides	.	2	+	+
Linum catharticum	.	+	.	+
Sanguisorba minor	.	+	.	1
Solidago virgaurea	+	.	.	+
Tusillago farfara	.	+	+	.
Urtica dioica	+	.	+	.
Veronica chamaedrys	.	+	1	.
Vincetoxicum hirundinaria	.	+	+	.

Sporadic species: *Pinus sylvestris* A 2(1), 4, C 4; *Betula pendula* B 3; *Frangula alnus* B 4; *Juniperus communis* B 2(2); *Quercus robur* C 2; **Ch. Cl. Querco-Fagetea:** *Acer platanoides* B 1; *A. pseudoplatanus* C 3; *Carex digitata* 4; *Carpinus betulus* C 2; *Corylus avellana* B 3(1), C 3; *Padus avium* B 1; *Tilia cordata* A 3(2), B 3, C 2; *Fraxinus excelsior* A 3(1); B 3; *Poa nemoralis* 3; *Ulmus minor* B 4; *U. laevis* B 1; **Ch. Cl. Rhamno-Prunetea:** *Cornus sanguinea* B 4, *Crataegus monogyna* B 2; *Prunus spinosa* 3; *Rosa canina* 2; *R.* sp. 1; **Ch. Cl. Trifolio-Geranietea sanguinei:** *Clinopodium vulgare* 3(1); *Fragaria viridis* 4; *Galium verum* 4; *Polygonatum odoratum* 4; *Silene nutans* 2; **Ch. Cl. Festuco-Brometea:** *Arabis hirsuta* 1; *Asperula cynanchica* 4; *Brachypodium pinnatum* 4(2); *Campanula sibirica* 1; *Centaurea scabiosa* 2; *Dianthus carthusianorum* 1; *Festuca pallens* 4(2); *Phleum phleoides* 2; *Poa compressa* 4; *Salvia verticillata* 2; *Seseli annuum* 2; *Viola rupestris* 4; **Ch.Cl. Molinio-Arrhenatheretea:** *Leontodon hispidus* 1; *Phleum pratense* 1; *Prunella vulgaris* 2; *Deschampsia caespitosa* 2; *Taraxacum officinale* s.l. 1; *Alchemilla* sp. 3; **Others:** *Agrostis capillaris* 2; *Artemisia vulgaris* 1; *Botrychium lunaria* 4; *Calamagrostis epigejos* 3(1); *Carex spicata* 3; *C. flacca* 2; *Carlina acaulis* 4; *Chaerophyllum aromaticum* 3(1); *Cruciata glabra* 4(1); *Elymus repens* 2; *Erigeron acris* 1; *Fragaria vesca* 1; *Medicago sativa* 1(1); *M.* ×*varia* 2; *Melilotus alba* 3; *Potentilla heptaphylla* 2; *Primula veris* 3; *Reseda lutea* 2; *Sedum maximum* 1; *Trifolium repens* 3; *Vicia hirsuta* 1(1); *Viola collina* 4

Explanations: Localities of records – 1. Xerothermic grassland on the former wasteland or cultivated field, on the steep, right slope of the Pokrzywianka Valley near the Cząstków Stary resort. 50°53'42.3''N, 21°06'05.1''E, ATPOL cartogram grid of 10x10 km: EE77; 2. Podzamcze, overgrown xerothermic grassland, in the neighbourhood of the Ogrodzieniec Castle, 50°27'02''N, 19°33'12''E, ATPOL cartogram grid DF26; 3. Podzamcze, borderland of oak-hornbeam woods and xerothermic grassland, in the neighbourhood of the Ogrodzieniec Castle, 50°27'02''N, 19°33'12''E, ATPOL cartogram grid DF26; 4. The Kobylańska Valley, between the villages of Będkowice and Kobylany, saxicolous grassland on the slope of the Postrzępiona Ridge. 50°27'02''N, 19°33'12''E, ATPOL cartogram grid DF58

4. Conclusions

There is a significant diversification in the population abundance of *Orobanche bartlingii* between various localities in Poland . The population in Grodzisko ranges from 30 to 45 specimens (Szeląg 2001a), over 100 specimens were recorded in the Kobylańska Valley (Nowak-Dańda & Dańda 2006) and in Cząstków Stary, respectively, and ca. 800 specimens were observed in Podzamcze. The most numerous population estimated at ca. a few thousand specimens was recorded in Rzędkowice.

Habitats occupied by the species are often characterized by a specific ecotone system of individual phytocoenoses, i.e. a mosaic of fringe oak-hornbeam communities representing the *Querco-Fagetea* class, shrubs with *Corylus avellana*, communities of the *Geranion sanguinei* alliance and xerotermic grasslands of the *Festucetalia valesiacae* order. This species also grows in saxicolous grasslands *Festucetum pallentis*, in the places where there is a high rate of organic matter accumulation in the top soil layer or, more often, in zones bordering tall herb-grassland communities *Cirsio-Brachypodion pinnati* and shrub communities of the *Prunetalia spinosae* order.

Many such characteristic combinations of phytocoenoses can be found in the vicinity of rocky monadnocks, with a large participation of *Libanotis pyrenaica*, especially in the Kraków-Częstochowa Upland. Therefore, it is very likely that further populations of the species can be found in this region.

Secondary succession and related excessive shading are main threats to the populations of *Orobanche bartlingii*. Therefore, its localities should be protected and monitored, and protective measures, such as the periodical removal of overgrown shrubs, should be taken. The distribution pattern of its localities is quite characteristic as they are mostly located in summit parts, on slopes or at the foothills of rocky hills or on slopes of steep river valleys. Such sites are frequently used for sport and recreation and quite often serve as climbing

areas. Excessive tourist pressure, especially trampling, mechanical plant destruction and bonfires, may cause progressive eutrophication leading to habitat degradation.

Acknowledgements. Scientific work financed from the resources earmarked for science in the years 2005-2008 as the Research Project no. NN303357733.

References

ADLER W., OSWALD K. & FISCHER R. 1994. Exkursionsflora von Österreich. 1180 pp. Ulmer, Stuttgart und Wien.

BECK VON MANNAGETTA G. R. 1890. Monographie der Gattung *Orobanche*. Biblioth. Bot. 19, 275 pp. Cassel.

BECK VON MANNAGETTA G. R. 1930. *Orobanchaceae* L. In: A. ENGLER (ed.). Das Pflanzenreich IV. (261). 348 pp. Verlag von W. Engelmann Leipzig.

BINZ A. & HEITZ C. 1990. Schul- und Exkursionsflora für die Schweiz. 659 pp. Schwabe & Co., Basel.

BUIA A. 1985. *Orobanchaceae* B. Juss. In: T. SAVULESCU (ed.). Flora Republicii Populare Romine, 8, pp. 33-72. Academia Republici Populare Romine, Bucuresti.

GILLI A. 1966. Bestimmungsschlüssel der mitteleuropäischen Varietäten und Formen von *Orobanche*. Verh. Zool.-Bot. Ges. in Wien. 105-106: 171-181.

KREUTZ C. A. J. 1995. *Orobanche*. The European broomrape species. Central and northern Europe. 159 pp. Natuurhistorisch Genootschapin Limburg.

KUKK T. 1999. Vascular plant flora of Estonia. 464 pp. Teaduste Akadeemia Kirjastus, Tartu-Tallin.

LILLELEHT V. (ed.). 1998. Red Data Book of Estonia. 150 pp. Eesti Teaduste Akadeemia Looduskaitse Komisjon.

MAYEVSKY P. F. (ed.). 2006. Flora sredney polosy evropeiskoy chasti SSSR. 600 pp. KMK, Moskwa.

MATUSZKIEWICZ W. 2006. Przewodnik do oznaczania zbiorowisk roślinnych Polski. In: J. B. FALIŃSKI (ed.). Vademecum Geobotanicum 3, 537 pp. Wyd. Nauk. PWN, Warszawa.

MELZER H. & BARTA T. 1995. *Orobanche bartlingii* Grisebach, die Bartling-Sommerwurz – neu für das Burgenland und andere Neuigkeiten zur Flora dieses Bundeslandes, sowie von Nieder- und Oberösterreich. Linzer Biol. Beitr. 27(2): 1021-1043.

MIREK Z., PIĘKOŚ-MIRKOWA H., ZAJĄC A. & ZAJĄC M. 2002. Flowering plants and pteridophytes of Poland. A checklist. In: Z. MIREK (ed.). Biodiversity of Poland 1, 442 pp. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

MOSYAKIN S. L. & FEDORONCHUK M. M. (eds.). 1999. Vascular plants of Ukraine: A nomenclatural checklist. 345 pp. National Academy of Sciences of Ukraine, M. G. Kholodny Institute of Botany, Kyiv.

NIESCHALK A. & NIESCHALK C. 1968. *Orobanche libanotidis* (= *O. bartlingii* Grisebach) in Hessen. Hess. Florist. Briefe 17(199): 35-42.

NIESCHALK A. & NIESCHALK C. 1974. Mitteilung zur Verbreitung von *Orobanche bartlingii* Grisebach (= *Orobanche libanotidis* Ruprecht, *O. alsatica* Kirschleger var. *libanotidis* [Ruprecht] Beck) in Bayern. Ber. Bayer. Bot. Gez. 45: 71-74.

NOWAK-DAŃDA A. & DAŃDA P. 2006. Nowe stanowisko *Orobanche bartlingii* w Polsce. – A new station of *Orobanche bartlingii* (Orobanchaceae) in Poland. Fragm. Flor. Geobot. Polonica 13(2): 409-432.

PROKUDIN Y. N. (ed.). 1999. Opredelitel` vysshikh rasteniĭ Ukrainy. 548 pp. Fitosociocentr, Kiev.

PUJADAS A. & GÓMEZ D. 2000. *Orobanche montserratii* A. PUJADAS & D. GÓMEZ (Orobanchaceae), especie nueva del Pirineo oscense. Anales Jard. Bot. Madrid 57(2): 267-275.

PUSCH J. & BARTHEL K. J. 1992. Über Merkmale und Verbreitung der Gattung *Orobanche* L. in der östlichen Bundesländern Deutschlands. Gleditschia 20(1): 33-56.

RAKOWSKI W. 2004. A new locality of *Orobanche bartlingii* (Orobanchaceae) in Poland. Pol. Bot. Jour. 49(1): 103-105.

REGULATION OF THE MINISTER OF ENVIRONMENT OF 09 JULY 2004 on wild species of plants under protection. Journal of Laws No 168 (2004), item 1764.

ROTHMALER W., JÄGER E. J. & WERNER K. 2002. Exkursionsflora von Deutschland. Gefäßpflanzen: Kritischer Band, 4, 948 pp. Spektrum Akademischer Verlag. Heidelberg-Berlin.

ROYER J. M., BUGNON F. & PROST J. F. 1992. *Orobanche bartlingii*, espĕce méconnue du centre-est de la France. Monde des Plantes, Toulouse 443: 11-12.

SOÓ R. 1968. A magyar flora és vegetáció rendszertani-növényföldrajzi kézikönyve, 3, 506 pp. Akadémiai Kiadó, Budapest.

SZELĄG Z. 2001a. *Orobanche bartlingii* (Orobanchaceae) a species new to Poland. Pol. Bot. J. 46(1): 79-81.

SZELĄG Z. 2001b. *Orobanche bartlingii* Griseb. – zaraza oleśnikowa. In: R. KAŹMIERCZAKOWA & K. ZARZYCKI (eds.). Polish Red Data Book of Plants, pp. 342-343. Polish Academy of Sciences, W. Szafer Institute of Botany & Institute of Nature Conservations, Kraków.

TZVELEV N. N. 1981. *Orobanchaceae*. In: A. A. FEDOROV (ed.). Flora evropeyskoy chastii SSSR, 5, pp. 317-335. Izdatel'stvo Nauka, Leningrad.

UHLICH H., PUSCH J. & BARTHEL K. J. 1995. Die Sommerwurzarten Europa: Gattung *Orobanche*. 235 pp. Westarp-Wiss., Magdeburg.

ZAJĄC A. 1978. Założenia metodyczne "Atlasu rozmieszczenia roślin naczyniowych w Polsce". Wiad. Bot. 22(3): 145-155.

ZARZYCKI K. & SZELĄG Z. 2006. Red list of the vascular plants in Poland. In: Z. MIREK, K. ZARZYCKI, W. WOJEWODA & Z. SZELĄG (eds.). Red list of plants and fungi in Poland, pp. 9-20. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

ZÁZVORKA J. 1997. *Orobanchaceae* Vent. Zárazovité. In: K. GOLIÁŠOVÁ (ed.). Flóra Slovenska 5(2): 460-529. VEDA, Bratislava.

ZÁZVORKA J. 2000. *Orobanchaceae* – zarazovite. In: B. SLAVÍK (ed.), Kvetena Českе Republiky, 6, pp. 477-513. Academia, Praha.