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Orobanche lutea Baumg. (Orobanchaceae) in Poland: revised distribution, taxonomy, phytocoenological and host relations

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Abstract: The paper presents current distribution of *Orobanche lutea* Baumg. in Poland based on a critical revision of herbarium and literature data as well as results of field investigations conducted between 1999-2014. Majority of localities are centred around the Silesia-Cracow, Małopolska and Lublin-Lviv Uplands. The greatest density of sites with probably the most abundant populations in Europe is in the central part of Silesia-Cracow Upland, which, by several hundred years, was heavily exploited for calamine mining (rich in zinc, lead and silver). This resulted in the formation of large areas of gangue containing toxic heavy metals. Since limestone, dolomite, marl and postglacial calcareous clay and sands occur there in most places, the soil is often strongly calcareous. Populations of *O. lutea* contain here many thousands of shoots. The distribution of the species in Poland is mapped. The taxonomy, biology, ecology and threats are also discussed.

Key words: *Orobanche lutea*, Orobanchaceae, taxonomy, distribution, phytocoenoses, Poland

1. Introduction

Orobanche s.l. is the largest genus in the Orobanchaceae family, and comprises more than 200 species parasitizing on roots of other vascular plants (Uhlich *et al.* 1995; Pusch & Günther 2009). They belong to the most critical types of global flora, and are very difficult to classify due to a strongly reduced morphology resulting from parasitism. Broomrapes are sub-cosmopolitan, with the greatest biodiversity in the Mediterranean, Northern Africa, North America and western and central Asia. In central and northern parts of Europe, the genus contains about 30 species which are mostly rare, endangered or declining (e.g. Zázvorka 1997, 2000; Pusch & Günther 2009). In Poland, 17 native (including permanently established) species and 2 ephemerophytes have been recorded (e.g. Piwowarczyk & Przemyski 2009, 2010; Piwowarczyk *et al.* 2009, 2010, 2011; Piwowarczyk 2011, 2012a, 2012b, 2012c, 2012d, 2012e, 2012f, 2012g, 2012h, 2013, 2014).

Orobanche lutea Baumg. (Orobanchaceae) belongs to the sub-Mediterranean-European-western Asian element (Pusch & Günther 2009). It occurs in Central Europe (northward to the Netherlands, Germany, Poland, Baltic states) and in northern parts of southern Europe (Catalonia in Spain), Italy, Northern Greece in the south. It extends eastwards to the Caucasus, Iran and Central Asia (Kreutz 1995). It was recorded at up to 600 m in the Czech Republic and Slovakia (Zázvorka 1997, 2000). It reaches its highest altitudes in Europe in the Alps, ca. 1600 m above sea level and 2000 m in the Caucasus and in western Asia (Uhlich *et al.* 1995).

The species has been reported from xerothermic communities: *Festuco-Brometea*, *Origanetalia*, *Mesobromion*, *Arrhenatherion elatioris*, *Trifolio-Medicaginion*, *Festucion rupicolae* and alfalfa cultivations (Uhlich *et al.* 1995, Zázvorka 1997, 2000; Pusch & Günther 2009).

Orobanche lutea is an oligophagous species. It parasitizes on the species of *Fabaceae* family, mainly the *Medicago* genus. *M. falcata*, less frequently *M. sativa* and *M. ×varia* are its common hosts in Europe (Zázvorka 1997, 2000; Pusch & Günther 2009, Piwowarczyk 2012a; Piwowarczyk *et al.* 2011).

The aim of this study was to identify the current distribution of *Orobanche lutea* in Poland based on field

investigations and verified herbarium and literature data. Taxonomic problems, preferred habitats, communities, hosts, and threats are also discussed below.

2. Material and methods

Field investigations were conducted in 1999-2014. They were intensified between 2006 and 2013. Simultaneously, the first author revised all the herbarium materials of *Orobanche lutea* collected in Poland. The materials are deposited in the following Polish herbaria: BIL, CHRZ, KRA, KRAM, KTC, KTU, LBL, LOD, OPOL, POZ, TRN, UGDA, WA, WRSL, WSRP and also in Germany (B, GLM, HAL) and Russia (LE). Herbarium acronyms are given after Mirek *et al.* (1997) and Holmgren and Holmgren (1998). The nomenclature of vascular plants follows Mirek *et al.* (2002). The nomenclature of syntaxa is based on Matuszkiewicz (2006). The localities are listed alphabetically as ATPOL cartogram units (10 km ×10 km, based on Zając 1978; see http://www.ib.uj.edu.pl/chronpol/). Only localities recorded in our observations, identified or confirmed, and verified herbarium data are listed below (Appendix 1). Published data not confirmed by us in the field or not supported by herbarium materials are not reliable due to frequent determination errors and incorrect or doubtful localities are listed separately (Appendix 2). Localities are described as follows: ATPOL grid unit, geographic location, habitat description, abundance in brackets. The following information is also given for most localities: geographic coordinates and altitude (above sea level) and, for revised exsiccata, also the collector and collection date, herbarium acronym and the exsiccatum number (if they are assigned) are provided.

Archival maps of Western Poland and military maps were used for localities reported in old data (http://mapy.amzp.pl/maps.shtml, http://www.mapywig.org/).

The study is based on the analysis of phytosociological relevés with *Orobanche lutea* occurrence according to Braun-Blanquet approach (Braun-Blanquet 1964) and originating from Poland. We performed more than 100 phytosociological relevés, but in this paper we presented 19 of the most representative or significant ones.

Host plants were also observed by delicately exposing the soil with a gardening shovel. The total of 150 localities were observed in the field and in the analysis of herbarium materials containing the attached host.

3. Results

3.1. Taxonomic remarks

Orobanche lutea Baumgarten Enum. Strip. Transsilv. 2: 215, 1816. – Syn. *Orobanche rubens* Wallr. Sched. Crit. 1: 307, 1822; *O. medicaginis* Duby Bot. Gall. 1: 349, 1828; *O. buekiana* Koch Syn. Fl. German. Helvet., ed. 2, 619, 1844; *O. hians* Steven Bull. Soc. Imp. Natur. Moscou 30/1: 354, 1857.

Type: Romania, Transylvania, "in pratis montosis siccioribusque ubique" Baumgarten, 1816 (p. 215). Type in Vienna.

Orobanche lutea is included into grex *Galeatae* Beck containing species having the corolla with straight or slightly curved dorsal line with characteristically galeate upper lip, large flowers 17-35 mm long, yellow-brown, purple, lilac, usually purplish towards the margin, with high colour variability (Beck 1890, 1930). The species is placed in the section *Orobanche* Teryokhin, subsection *Galeatae* (Beck) Teryokhin (Teryokhin *et al*. 1993), in the most recent approach. Central European *O. caryophyllacea* and *O. teucrii* also belong to the subsection *Galeatae*. Determination errors are very often made between *O. lutea* and these species, especially in herbarium materials. *O. lutea* and *O. caryophyllacea* are the earliest flowering species in Central Europe. The flowering peak is observed in the second half of May and the first half of June. Interestingly, phylogenetic dendrograms (Schneeweiss *et al.* 2004; Weiss-Schneeweiss *et al.* 2006) show that *O. caryophyllacea* and *O. teucrii* are mutually more closely related, while *O. lutea* is the closest to *O. rapum-genistae*, also a parasite; a species of the family of Fabaceae (mainly *Sarothamnus scoparius*).

Several varieties and forms were described within subject species. The greatest variation, although not as high as in *Orobanche caryophyllacea* (Piwowarczyk 2014) was observed in plant colouration. Specimens with stems and flowers intensively lilac- or light violet-coloured, with a white stigma, were described as *O. lutea* f. *liliacea* Beck (Beck 1890, 1930). Plants with an intensively coloured corolla, dark brown-violet with a violet stem, often black-violet when dry, with a yellow stigma, were described as f. *porphyrea* Beck (Beck 1890, 1930). This form was observed in Ząbkowice above a limestone quarry. Plants with yellow-coloured stems and flowers were described as var. *pallens* (A. Braun) Asch. et Graebn. (Ascherson & Graebner 1898/1899). In Poland, specimens similar to var. *pallens*, with yellow stems and very light yellow to white-yellow flowers were observed near Nowa Huta and Huta Katowice. Albinotic specimens with a white corolla, separated as *O. lutea* f. *hypoleuca* Beck (Beck 1890), were recorded very rarely (e.g. in Podskale) and should be confirmed. Corolla length was similar (20-30 mm) in these forms. The form f. *evanida* Beck was distinguished for considerably smaller flowers, up to 15 mm long (Beck 1922, 1930).

Apart from typical specimens with the corolla turned upwards (*Orobanche lutea* var. *typica* Beck), specimens with the corolla strongly curved, spreading to almost horizontal were described from Germany as *O. buekiana*

Koch [*O. lutea* var. *buekiana* (Koch) Beck] (Koch 1844; Beck 1930), from the Crimea as *O. hians* Steven, and from Tajikistan as *O. linczevskyi* Novopokr. (Novopokrovskij 1950; Novopokrovskij & Tzvelev 1958). This taxon was found also in Poland (see Appendix 1).

Forms are also distinguished by inflorescence density: spike almost lax – *Orobanche lutea* f. *rubens* (Wallr.) Beck (Beck 1890); spike dense – *O. lutea* f. *collecta* Beck (Beck 1890).

Similarly to, e.g., the Czech Republik and Slovakia (Zázvorka 1997, 2000), all of these forms and varieties most probably occur in Poland. However, they are definitely a smaller group within typically-coloured plants in populations. Their taxonomic importance is probably low and colour intensity depends on sun exposure, host condition and soil parameters. The position of the corolla tube can also vary and plants having a horizontal corolla occur among plants having typically placed flowers. Specimens with a lax and dense spike and small or large flowers can occur within one population.

The horizontal position of flowers in a lax spike and abundant inflorescence was related to habitat shading at the localities in Poland and typical specimens were found in full sun. Specimens having enormous flowers, ca 4 cm long, or with a reduced corolla and calyx divided into numerous narrow parts, star-shaped (teratological abnormality), were rarely observed (mainly in industrial areas of Dąbrowa Górnicza).

Orobanche lutea mostly had a single stem. However, the stem was very rarely branched in the largest specimens. Flowers of these specimens were often very large; in addition, the lower flowers above branches were sometimes pedunculate (unbranched specimens also had only lower flowers pedunculate, but did not have plural inflorescences). Some specimens were found in Winkler's and Reichenbach's herbarium (leg. Reichenbach fil., after Beck 1930). It was described from "Silesia" as *O. lutea* f. *podantha* Borbás (Borbás 1887-88) [=*O. lutea* var. *typica* f. *ramulosa* Beck] (Beck 1930). Plant branching consistent with the above description was found at over ten localities in the central part of the Silesia-Cracow Upland (Piwowarczyk & Krajewski, in prep., see Appendix 1). Only few specimens were always found. They were some of the most robust specimens within very abundant populations of individuals exhibiting typical features.

3.2. Distribution in Poland

Orobanche lutea mostly occurs in the belt of Polish uplands, i.e. Silesia-Cracow (west), Małopolska (central)

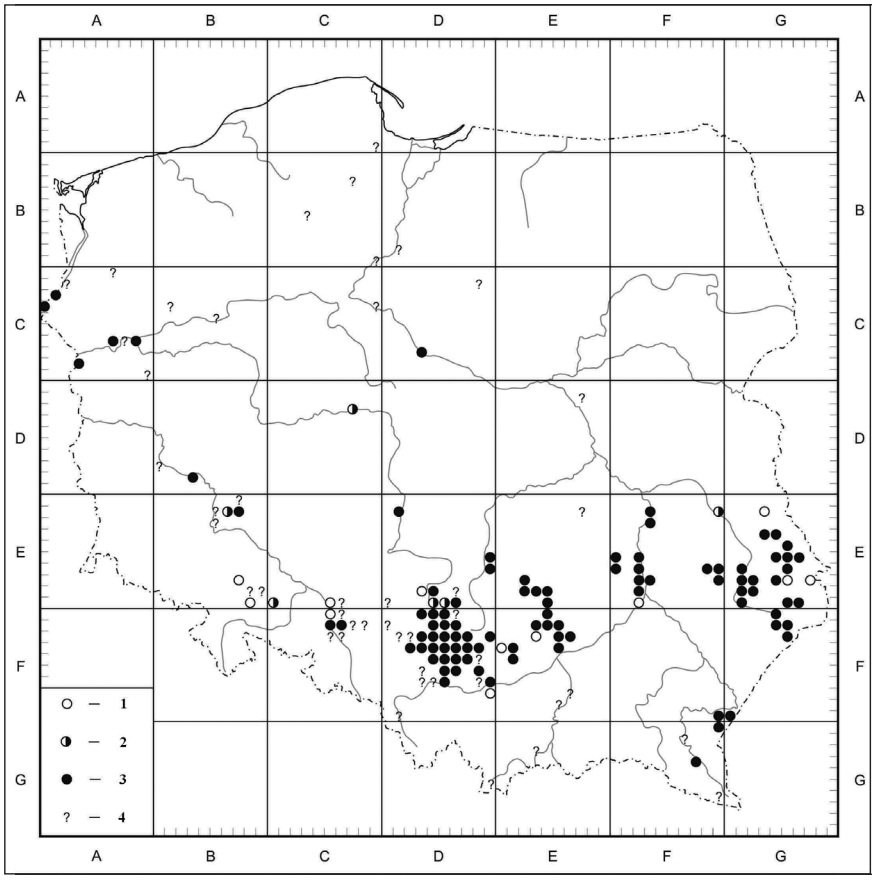

Fig. 1. Distribution of *Orobanche lutea* in Poland

Explanations: 1 – before 1950, 2 – 1950-2000, 3 – after 2000, 4 – locality doubtful or requiring confirmation

Table 1. Plant communities with *Orobanche lutea* in Poland

No. of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Area of relevé (m^2)	50	50	50	50	30	50	25	25	25	25	25	25	25	25	25	25	25	20	20	
Exposure	-	S	SW	S	S	S	S	SE	SE	SW	SSW	S	SSW	S	SSW	S	S	N	S	
Inclination [°]	-	-	15	15	30	15	15	20	10	40	15	15	15	15	5	5	10	5	5	
Cover of tree layer A (%)	-	-	-	-	-	-	-	-	-	-	-	-	20	15	-	-	-	-	50	
Cover of shrub layer B (%)	40	-	15	20	20	15	30	-	-	20	-	10	20	20	10	-	20	30	20	
Cover of herbaceus layer C (%)	100	95	95	80	100	90	75	100	100	100	80	95	70	95	85	60	100	95	70	
Cover of moss layer D (%)	5	5	10	5	5	5	5	5	5	5	5	5	5	5	5	2	5	5	5	
Number of species	54	58	62	65	44	43	30	25	33	31	37	52	41	33	24	25	38	21	33	
Orobanche lutea	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	**V**
Ch. *Festuco-Brometea*, *Festucetalia valesiacae*																				
Brachypodium pinnatum	4	1	.	2	3	1	4	4	1	4	3	2	1	4	2	.	1	.	1	V
Euphorbia cyparissias	+	+	2	1	.	+	+	.	+	+	+	+	+	+	+	+	1	.	1	V
Centaurea scabiosa	+	+	1	+	+	+	.	+	.	+	.	+	.	.	.	.	1	.	.	III
Campanula sibirica	+	+	+	+	+	.	.	+	+	+	.	+	.	.	.	.	.	.	.	III
Salvia verticillata	+	.	.	3	+	.	.	.	.	+	+	.	.	+	+	.	+	.	.	III
Onobrychis viciifolia	+	+	.	+	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	II
Dianthus carthusianorum	+	.	1	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	1	II
Carlina vulgaris	.	.	.	+	.	.	+	.	.	.	+	+	.	.	.	+	+	.	.	II
Plantago media	+	.	.	+	.	+	.	.	1	.	+	.	+	.	.	.	.	.	.	II
Carex flacca	+	.	.	+	.	.	2	.	1	+	.	.	.	.	.	.	.	.	.	II
Centaurea stoebe	.	.	+	.	+	1	.	.	.	.	.	+	+	.	.	.	.	.	.	II
Melampyrum arvense	.	1	.	.	.	.	.	.	+	+	.	1	.	.	2	.	.	.	.	II
Potentilla arenaria	.	.	+	.	.	3	.	+	.	.	.	+	+	.	.	.	.	.	.	II
Seseli annuum	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	II
Teucrium chamaedrys	.	.	.	.	.	.	3	1	1	1	+	.	.	.	.	.	.	.	.	II
Thesium linophyllon	1	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	II
Stachys recta	+	.	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	II
Asperula tinctoria	.	.	+	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	II
Carex humilis	.	.	1	1	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	II
Filipendula hexapetala	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	+	II
Phleum phleoides	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	II
Scabiosa ochroleuca	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	+	.	.	II
Inula ensifolia	.	.	.	3	.	.	.	.	1	.	3	.	.	.	.	.	.	.	.	I
Linum flavum	.	+	.	.	.	.	.	.	+	2	.	.	.	.	.	.	.	.	.	I
Helianthemum nummularium	.	.	+	+	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	I
Artemisia campestris	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	1	.	.	.	I
Adonis vernalis	1	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Anthemis tinctoria	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Asperula cynanchica	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Veronica spicata	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Aster amellus	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	I
Hieracium bauhinii	.	.	.	.	.	.	.	.	2	+	.	.	.	.	.	.	.	.	.	I
Koeleria macrantha	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	1	I
Achillea collina	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Achillea pannonica	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Acinos arvensis	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Asparagus officinalis	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Carex michelii	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Eryngium campestre	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Petrorhagia prolifera	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	I
Poa compressa	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Sisymbrium polymorphum	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Thlaspi perfoliatum	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Ch. *Trifolio-Geranietea sanguinei*, *Geranion sanguinei*																				
Medicago falcata	2	3	3	2	3	2	1	2	2	2	3	2	3	3	2	3	4	.	3	V
Agrimonia eupatoria	+	+	+		+	+		+	.	+	+	1	+	+	+	.	+	.	+	IV
Galium verum	1	.	+	1	1	+	1	1	.	.	.	+	+	+	.	.	3	.	.	III
Fragaria viridis	+	2	1	.	+	.	+	.	.	.	.	+	+	+	1	.	1	.	.	III
Coronilla varia	+	.	+	+	+	.	.	.	.	+	.	+	+	+	+	+	.	.	.	III
Peucedanum cervaria	1	.	.	+	.	.	.	.	1	3	.	3	.	3	.	.	.	.	.	II

Constancy

No. of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Area of relevé (m^2)	50	50	50	50	30	50	25	25	25	25	25	25	25	25	25	25	25	20	20	C
Exposure	-	S	SW	S	S	S	S	SE	SE	SW	SSW	S	SSW	S	SSW	S	S	N	S	o
Inclination [°]	-	-	15	15	30	15	15	20	10	40	15	15	15	15	5	5	10	5	5	n
Cover of tree layer A (%)	-	-	-	-	-	-	-	-	-	-	-	-	20	15	-	-	-	-	50	s
Cover of shrub layer B (%)	40	-	15	20	20	15	30	-	-	20	-	10	20	20	10	-	20	30	20	t
Cover of herbaceus layer C (%)	100	95	95	80	100	90	75	100	100	100	80	95	70	95	85	60	100	95	70	a
Cover of moss layer D (%)	5	5	10	5	5	5	5	5	5	5	5	5	5	5	5	2	5	5	5	n
Number of species	54	58	62	65	44	43	30	25	33	31	37	52	41	33	24	25	38	21	33	c
																				y
Verbascum lychnitis	.	.	.	+	.	.	.	.	.	.	.	+	+	.	+	+	+	.	.	II
Origanum vulgare	.	.	.	.	+	.	.	.	1	+	1	.	1	.	.	.	.	.	.	II
Anemone sylvestris	+	.	.	.	.	.	+	.	1	+	.	+	.	.	.	.	.	.	.	II
Trifolium alpestre	+	+	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	II
Campanula rapunculoides	.	+	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	II
Anthericum ramosum	.	.	1	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	I
Viola hirta	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Astragalus cicer	.	.	.	.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Geranium sanguineum	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Thalictrum minus	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	I
Orchis purpurea	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Valeriana angustifolia	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Vicia tenuifolia	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	I
Ch. *Molinio-Arrhenatheretea*, *Arrhenatherion*																				
Arrhenatherum elatius	.	2	.	1	1	.	.	2	2	.	2	1	+	.	+	.	2	3	1	IV
Dactylis glomerata	+	+	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	1	+	III
Galium mollugo	+	+	+	2	+	.	.	1	.	1	.	.	.	.	.	.	+	.	.	III
Festuca rubra s.l.	.	+	+	.	+	.	.	.	+	.	.	.	+	+	.	.	.	+	1	III
Knautia arvensis	+	+	+	+	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	II
Leucanthemum vulgare	+	.	.	.	.	.	+	.	2	.	.	.	+	+	.	.	.	.	.	II
Leontodon hispidus	.	1	.	+	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	II
Achillea millefolium	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	1	II
Centaurea jacea	+	.	.	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	II
Galium boreale	.	+	2	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	II
Anthyllis vulneraria	.	+	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	II
Agrostis vulgaris	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	I
Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	I
Tragopogon pratensis	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	.	.	I
Trifolium repens	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	I
Daucus carota	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	+	.	.	I
Festuca pratensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	I
Lotus corniculatus	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	I
Taraxacum officinale s.l.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I
Vicia cracca	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Trifolium montanum	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Lolium perenne	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	I
Ch. *Rhamno-Prunetea*, *Berberidion*																				
Prunus spinosa A	+	2	+	.	1	.	1	+	+	.	+	+	.	1	.	.	.	1	.	III
Crataegus monogyna B	.	.	.	.	.	+	.	.	.	.	.	1	+	+	+	.	2	1	+	III
Prunus spinosa B	.	.	1	.	2	.	1	.	.	.	.	.	.	1	.	.	.	3	2	II
Rhamnus cathartica B	.	.	1	1	.	.	.	.	.	+	.	+	.	+	+	.	.	.	.	II
Rhamnus cathartica C	.	.	+	+	+	.	.	+	.	.	.	.	+	.	.	.	.	.	+	II
Rosa canina B	.	.	.	.	.	1	.	.	.	.	.	+	.	.	+	.	.	.	1	II
Cornus sanguinea C	+	.	.	.	+	.	+	1	.	.	.	.	.	.	.	.	.	.	.	II
Crataegus monogyna C	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	II
Ligustrum vulgare C	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	I
Cornus sanguinea B	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	I
Crataegus monogyna A	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	I
Ch. *Artemisietea vulgaris*, *Onopordetalia*																				
Echium vulgare	.	+	.	+	.	+	.	.	.	.	.	+	.	.	.	+	.	.	.	II
Rubus caesius	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	II
Artemisia vulgaris	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	+	II
Cichorium intybus	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I

No. of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Area of relevé (m^2)	50	50	50	50	30	50	25	25	25	25	25	25	25	25	25	25	25	20	20	C
Exposure	-	S	SW	S	S	S	S	SE	SE	SW	SSW	S	SSW	S	SSW	S	S	N	S	o
Inclination [°]	-	-	15	15	30	15	15	20	10	40	15	15	15	15	5	5	10	5	5	n
Cover of tree layer A (%)	-	-	-	-	-	-	-	-	-	-	-	-	20	15	-	-	-	-	50	s
Cover of shrub layer B (%)	40	-	15	20	20	15	30	-	-	20	-	10	20	20	10	-	20	30	20	t
Cover of herbaceus layer C (%)	100	95	95	80	100	90	75	100	100	100	80	95	70	95	85	60	100	95	70	a
Cover of moss layer D (%)	5	5	10	5	5	5	5	5	5	5	5	5	5	5	5	2	5	5	5	n
Number of species	54	58	62	65	44	43	30	25	33	31	37	52	41	33	24	25	38	21	33	c
																				y
Cirsium arvense	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	I
Melilotus officinalis	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	I
Solidago gigantea	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Ch. *Agropyretea intermedio-repentis*																				
Convolvulus arvensis	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	+	II
Elymus repens	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	II
Equisetum arvense	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	II
Elymus hispidus	.	+	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Falcaria vulgaris	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch. *Koelerio glaucae-Corynephoretea canescentis*																				
Silene otites	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	+	.	.	.	II
Sedum acre	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	I
Ch. *Stellarietea mediae*																				
Silene vulgaris	.	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	II
Lithospermum arvense	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch. *Nardo-Callunetea*																				
Hieracium pilosella	.	1	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	II
Polygala vulgaris	.	+	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	II
Cuscuta epithymum	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Others																				
Hypericum perforatum	+	.	.	+	+	.	.	+	+	.	+	+	+	+	.	+	+	+	.	IV
Salvia pratensis	.	+	1	.	+	.	1	1	2	+	+	+	.	+	.	.	1	.	.	III
Sanguisorba minor	+	+	+	.	.	.	+	.	.	.	.	+	+	.	.	1	.	.	.	II
Festuca trachyphylla	+	3	+	+	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	II
Briza media	+	.	.	.	.	.	+	.	.	.	+	+	.	+	+	.	.	.	.	II
Linum catharticum	.	+	+	.	.	.	+	.	+	.	.	+	.	+	.	.	.	.	.	II
Primula veris	+	.	.	+	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	II
Vincetoxicum hirundinaria	.	+	+	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	II
Juniperus communis B	3	.	.	.	.	.	2	.	.	.	.	+	.	+	.	.	.	.	.	II
Pimpinella saxifraga	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	II
Carlina acaulis	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Festuca sp.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	3	.	.	I
Frangula alnus C	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Medicago x*varia*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	4	+	I
Medicago sativa	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Ononis spinosa	+	.	.	.	.	.	.	.	.	.	+	.	.	.	3	.	.	.	.	I
Orchis militaris	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Orobanche caryophyllacea	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Juniperus communis C	3	.	.	.	.	.	2	.	.	.	.	.	.	+	.	.	.	.	.	I
Peucedanum oreoselinum	.	.	2	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	I
Rosa sp. C	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	I
Senecio jacobaea	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	I
Thymus pulegioides	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	I
Anthoxanthum odoratum	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	I
Cerinthe minor	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Malus sp. C	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Medicago lupulina	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Melampyrum nemorosum	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Pyrus communis B	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	I
Rosa sp. B	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	I
Sedum maximum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	I

Sporadic taxa: **Ch. *Festuco-Brometea*,** **Ch. *Festucetalia valesiacae*,** *Ajuga genevensis* 7; *Allium oleraceum* 17; *Arabis hirsuta* 15; *Bromus inermis* 17; *Carex caryophyllea* 15; *Cirsium pannonicum* 1; *Gentiana cruciata* 17; *Linosyris vulgaris* 5; *Linum hirsutum* 1; *Scabiosa columbaria* 3; *Scorzonera purpurea* 3; *Sesleria uliginosa* 4(3); *Stipa capillata* 6(4); *S. joannis* 3(1); *Tetragonolobus maritimus* subsp. *siliquosus* 4; *Thymus kosteleckyanus* 3; *T. marschallianus* 4; *Veronica austriaca* 8; **Ch. *Trifolio-Geranietea sanguinei*, *Geranion sanguinei*,** *Clematis recta* 10; *Clinopodium vulgare* 12; *Lathyrus pannonicus* 1(1); *Trifolium rubens* 10; *Veronica teucrium* 10; **Ch. *Molinio-Arrhenatheretea*,** *Campanula patula* 4; *Euphrasia* sp. 4; *Geranium pratense* 8; *Molinia caerulea* 4; *Ranunculus acris* 9; *Trifolium pratense* 2; *Betonica officinalis* 14; **Ch. *Rhamno-Prunetea, Berberidion*,** *Acer campestre* B 19; *Berberis vulgaris* B 4; *Rosa rubiginosa* B 4; *Ulmus minor* C 5; *Viburnum opulus* B 7(1); **Ch. *Artemisietea vulgaris*, *Onopordetalia*,** *Melilotus albus* 4; *Picris hieracioides* 17; *Tanacetum vulgare* 2; **Ch. *Epilobietea angustifolii*,** *Calamagrostis epigejos* 4, 12, 16(2); *Fragaria vesca* 18, 19; *Betula pendula* A 13(2), B 13(1), C 16; *Populus tremula* B 19; **Ch. *Koelerio glaucae-Corynephoretea canescentis*,** *Chondrilla juncea* 6; *Festuca ovina* 19(4); **Ch. *Querco-Fagetea*,** *Carpinus betulus* C 1; *Cephalanthera damasonium* 1(r); *Corylus avellana* B 10(1); *Fagus sylvatica* A 14, B 10; *Padus avium* B 19; *Tanacetum corymbosum* subsp. *corymbosum* 1; **Ch. *Vaccinio-Piceetea*,** *Pinus sylvestris* A 14(1), 19(4), B 1, 14(1), C 1(1), 11, 19; **Others,** *Alyssum alyssoides* 16; *Arenaria serpyllifolia* 3; *Carex transsylvanica* 7; *Convallaria majalis* 13; *Cruciata glabra* 1; *Erigeron acris* 16; *Eryngium planum* 5; *Euphorbia virgultosa* 16; *Genista tinctoria* 11; *Hieracium piloselloides* 2; *Larix decidua* subsp. *decidua* A 19(1); *Lithospermum officinale* 11; *Melampyrum pratense* 11; *Oenothera rubricaulis* 16; *Orobanche kochii* 3; *Peucedanum alsaticum* 9; *Plantago major* 18; *Platanthera bifolia* 9; *Pulsatilla pratensis* 3; *Quercus robur* A 14(1), B 14, C 13, 14; *Ranunculus bulbosus* 2; *Rosa gallica* C 2; *Sonchus arvensis* 2; *Tussilago farfara* 4; *Viola collina* 11

Explanations: Number of relevé – Location (Latitude – N; Longitude – E; Altitude a.s.l. [m]), date. 1 – Polana Polichno (50°28'02.8"; 20°28'01.7"; 258), 29.06.2009; 2 – Dębska Wola (50°42'49.2"; 20°35'34.6"; 292), 13.06.2009; 3 – Sędziejowice (50°34'21.8"; 20°39'45"; 271), 30.05.2013; 4 – Kików (50°25'05.51"; 20°51'24"; 268), 09.07.2013; 5 – Kulin (52°39'50.3"; 19°08'13.8"; 71), 07.08.2010; 6 – Owczary (52°28'29.5"; 14°38'43"; 44), 25.06.2009; 7 – Turowiec (50°58'02.3"; 23°38'11"; 234), 03.06.2011; 8 – Gliniska (50°51'30.4"; 23°38'13.5"; 226), 03.06.2011; 9 – Kąty (50°40'22"; 23°07'32"; 272), 03.06.2011; 10 – Biała Góra (50°28'39.1"; 23°28'36.7"; 309), 11.07.2008; 11 – Bochotnica (51°20'28.7"; 21°59'52.4"; 125), 26.07.2009; 12 – Dobromierz (51°00'33.9; 19°55'16.9; 307), 05.07.2008; 13 – Niegowonice (50°23'51.5"; 19°24'52.3"; 387), 05.07.2008; 14 – Mstów (50°49'03.8"; 19°17'55.2"; 277), 05.07.2008; 15 – Dąbie (50°24'24.6"; 19°07'48.4"; 344), 05.07.2008; 16 – DG Ujejsce (50°23'16.2"; 19°13'14.2"; 280), 06.07.2008; 17 – Kamień Śląski (50°32'20.9"; 18°04'04.3"; 197), 19.07.2011; 18 – Gogolin (50°30'07.9"; 18°02'10.3"; 196), 19.07.2011; 19 – Gródek (51°23'01.7"; 16°47'41.5"; 173), 16.07.2011

and Lublin (east) Uplands, considerably less frequently in the lower Vistula and Oder valley slopes and in the Carpathian Foothills.

The revision and detailed field investigations into *Orobanche* genus in Poland revealed considerable differences in the distribution, especially in relation to the previous distribution map of *Orobanche lutea* (Zając & Zając 2001). Due to frequent determination errors, only verified data was listed below (Appendix 1). As our revision showed, *O. lutea* was often mistaken for another species, considered erroneously as *O. caryophyllacea* or *O. kochii* (given under the name *O. elatior*). For example, incorrect data was reported from Jaworzno (Tokarska-Guzik 1999, all records given as *O. caryophyllacea*), the Tarnowskie Góry Ridge (Nowak 1999, sometimes confused with *O. kochii*), the Silesia Upland (Babczyńska-Sendek 2005, mainly confused with *O. kochii*) and the Cracow-Częstochowa Upland (Urbisz 2004a, 2004b, mistaken with a few *Orobanche* species) or Lublin region (Fijałkowski 1994). Some literature data could not be verified as the herbarium material was lacking, or despite our (unsuccessful) research in the field (Appendix 2). This data were marked with a special symbol on the map ("?"), (Fig. 1).

3.3. Preferred habitats and plant communities

Orobanche lutea prefers sunny sites, usually gentle S or SW-facing slopes, but it is also found at flat sites and N exposure; altitude about (40) 200-430 m. These include xerothermic grasslands, thermophilous shrublands; located on slopes of hills, river valleys, gullies, margins of forests and fields, in former quarries, baulks, alfalfa fields, ruderal habitats. It is sometimes recorded at archaeological sites, e.g. remnants of medieval fortified settlements (e.g. fortifications near Imbramowice, Rabsztyn and Olsztyn castles, fortified settlement in Bzów, all in the Silesia-Cracow Upland) or on hills and calcareous islands with xerothermic vegetation, located within wet meadows and marshes, e.g. *Cladietum marisci*, which is rare in Poland, and in calcareous fens of the alliance *Caricetalia davallianae* (e.g. "Torfowisko Sobowice" near Chełm). *O. lutea* prefers alkaline soils, usually shallow rendzinas formed on chalk marl and limestone, dolomite, loess, and chernozem (black-earth soil) or moraine substrate rich in calcium carbonate. It is recorded most frequently in communities of the *Cirsio-Brachypodion pinnati* alliance (class *Festuco-Brometea*), especially in flowery or initial dry grasslands, i.e. *Adonido-Brachypodietum pinnati, Inuletum ensifoliae, Thalictro-Salvietum pratensis,* and on hills, in old gypsum excavation pits in the Nida Basin also in *Seslerio-Scorzoneretum purpureae,* and in the community of *Carex glauca-Tetragonolobus maritimus*. In the eastern part of the Silesia-Cracow Upland, *O. lutea* sometimes occurs in the contact zone of rock grasslands (*Festucetum pallentis*) near monadnocks and thicket and fringe communities (*Peucedano-Coryletum*, *Geranion sanguinei*), also in steppe *Origano-Brachypodietum pinnati* association of the *Cirsio-Brachypodion* alliance. It is also often recorded in the ecotone of calcareous

and psammophilous grasslands (limestone monadnocks are usually surrounded by postglacial sands in the Polish Jura). The species is also recorded in *Sisymbrio-Stipetum capillatae* and *Potentillo-Stipetum capillatae* associations (e.g. Nida Basin, lower Oder and Vistula river valleys). As a result of natural plant succession in grasslands, the communities have a high contribution of a mosaic of species of thermophilous herbaceous forest edge communities of the *Geranion sanguinei* alliance (class *Trifolio-Geranietea sanguinei*) and shrub communities, particularly of the *Berberidion* alliance (class *Rhamno-Prunetea*), as well as meadow species of the *Arrhenatherion elatioris* alliance (class *Molinio-Arrhenatheretea*). *O. lutea* is also found in or on the margin of alfalfa cultivations, near orchards (e.g. on the side of the Middle Vistula Gap, in the Silesia-Cracow Upland) or on the margins and baulks of calcareous fields with the contribution of species of the *Caucalidion lappulae* alliance (*Stellarietea mediae* class). The species also occurs in abandoned fields, wastelands or fallows, on roads by fields, railways sites, in communities of the *Artemisietea vulgaris* class, belonging to the *Dauco-Melilotenion* suballiance (especially, *Dauco-Picridetum hieracioidis, Echio-Melilotetum* associations). All the communities mentioned above include a high proportion of host species of the *Medicago* genus, especially of *M. falcata*, coverage app. (10) 25-50 (75)% (Table 1).

4. Conclusions and discussion

In Poland, *Orobanche lutea* (together with *O. kochii*) is one of the most abundant representatives of the *Orobanche* genus. It mostly occurs in the Polish Uplands and, less frequently, along the Lower Oder and Vistula rivers and in the Carpathian Foothills. The highest density of its localities and probably the most abundant populations in Europe are recorded in the Silesia-Cracow Upland. The highest density of its sites and the most abundant populations occur in the central part of the Silesia-Cracow Upland. The species is very often recorded there in places of former opencast mining: small, shallow and very numerous man-made excavations that are common in upper parts of hills built of limestones and dolomites, sometimes also rich in metal ores. The Silesia-Cracow Upland was a region of intensive shallow exploitation of calamine (rich in zinc, lead and silver), and its metallurgy, which resulted in the formation of large areas of gangue containing toxic heavy metals, covered by resistant plants forming specific associations, especially favourable for *O. lutea* in our observations. Zinc smelting caused strong pollution of soil, naturally less rich in heavy metals. Additionally, in recent years, large-scale transformations of the fast developing heavy industry, railways and motorways caused an abundant development of *O. lutea* populations in the landscape originally suitable for the species (numerous hills and ridges of moderate altitudes), geology (limestone, dolomites) and in the past – agriculture (common pasturages). These industrial modifications led to the development of extremely large fallow lands: numerous fields were abandoned due to changes in employment forms and many large buildings destroyed the former vegetation cover. In such large scale pioneer associations on lime- and magnesium-rich soils (especially with calcareous stones and gravel, known as rendzinas), *O. lutea* formed populations comprising many thousands of shoots, sometimes so numerous that it was difficult to distinguish individual localities. The area east of large steelworks, Huta Katowice, between Dąbrowa Górnicza and Sławków, was the most characteristic region. Highly abundant *O. lutea* populations occurred along kilometers of roadsides, railways, large crosscuts and embankments, surrounded by ruderal and industrial areas, fallow rendzinas on hills where the species first occurred considerably less numerously in field baulks and old excavations. The species similarly benefited from stone-pits (even small, formerly used for local stone building) where pioneer vegetation also began to cover the rocky soil and formed grasslands with the passage of time. It is unknown whether it was the host or the parasite that was particularly resistant to heavy metal pollution. The issue should be investigated further.

The western margin of the Polish Jura, a natural, large-scale geological formation known as cuesta, a limestone cliff stretching over long-distances, up to 100 m high, with a predominant SW and W warm exposure, was also a characteristic habitat of *Orobanche lutea* in the Silesia-Cracow Upland.

The taxon was recorded in Poland mostly in uplands, at altitudes of about 160-430 m. Its habitats were typically warm, sunny, with plant communities of the *Cirsio-Brachypodion pinnati* alliance (class *Festuco-Brometea*) interspersed with thermophilous herbaceous forest margin communities of the *Geranion sanguinei* alliance (class *Trifolio-Geranietea sanguinei*) and shrub communities, especially of the *Berberidion* alliance (class *Rhamno-Prunetea*). *Orobanche lutea* preferred alkaline soils, most frequently shallow rendzinas formed on chalk marls and limestones, dolomites, loess, and czernozems.

Field investigations conducted in Poland in 2006-2014, including gentle soil exposure with a gardening shovel, showed that *Orobanche lutea* was a parasite on *Medicago falcata*, rarely *M. sativa* and *M. ×varia.*

Population size varied greatly between localities and between years. Local populations of *Orobanche lutea* were usually numerous, typically between a few to 100

shoots. The largest populations (thousands of shoots) were located in the central part of the Silesia-Cracow Upland (e.g. Dąbrowa Górnicza, Sławków, Jaworzno, Niegowonice).

Orobanche lutea is a strictly protected species in Poland (Regulation 2012). It is also included in regional red lists and books: Gdańsk Pomerania, CR (Markowski & Buliński 2004); Western Pomerania and Wielkopolska, E (Żukowski & Jackowiak 1995); Wielkopolska, CR (Jackowiak *et al.* 2007); Kujawy-Pomerania region, rare R (Rutkowski 1997); Sudetes Mts, EN (Fabiszewski & Kwiatkowski 2002); Central Poland, CR (Jakubowska-Gabara & Kucharski 1999); Opole province, EN (Nowak & Nowak 2002; Nowak *et al.* 2003, 2008), endangered, EN, in the Lower Silesia province (Kącki *et al.* 2003), Silesia province, near-threatened, NT (Parusel & Urbisz 2012); Małopolska Upland, VU (Bróż & Przemyski 2009); former Cracow province, EN (Zając & Zając 1998); Proszowicki Plateau, EN (Towpasz & Kotańska 2001). The species also is vulnerable (VU) in neighbouring countries, i.e. Germany (Korneck *et al.* 1996; Ludwig *et al.* 2007), the Czech Republic (Procházka 2001) and Slovakia, NT (Feráková *et al.* 2001).

The progressing process of secondary succession of tree- and shrub vegetation, the density of the herb layer and the cessation of former management methods are the main threats to *Orobanche lutea*. Its localities are also often situated near arable fields where they are exposed to chemical agents. The influence of invasive and expansive species also poses a considerable threat. Mass self-sowing of *Solidago gigantea* and *Calamagrostis epigejos* is observed at many sites. Scrubs of *Robinia pseudoacaccia* and patches with *Lupinus polyphyllus* cause soil fertilization and rapid succession. Majority of localities are not protected and only a few sites are protected in reserves (e.g. Stary Przylep, Bielinek, Stawska Góra hill, Machnowska Góra hill, Skarpa Dobużańska), as ecological sites (e.g. Dwikozy, Owczary) or within Natura 2000 sites. This does not ensure preservation of the species as active protection is needed. Many localities are at disturbed sites or at operating excavation sites (e.g. limestone quarries). At least some of the localities should be protected as ecological sites and active protection measures should be implemented: e.g. mowing or grazing of excessively developing field- and herbaceous vegetation, preserving unique mosaic systems and fringe communities and nature monitoring.

Species biodiversity at localities occupied by *Orobanche lutea* was also high. Many rare and endangered species of Polish grasslands were observed when phytosociological relevés were performed in the communities with *O. lutea*. These included: *Orchis purpurea*, *O. ustulata*, *O. militaris*, *Orobanche elatior*, *O. bartlingii*, *O. kochii*, *Thalictrum simplex*, *Lathyrus pannonicus*, *Linum flavum*, *L. hirsutum*, *Stipa joannis*, *S. pulcherrima*, *Scorzonera purpurea*, also in phytosociological relevés not included in our study, e.g. *O. bohemica*, *O. alsatica* and *O. picridis.*

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Appendix 1. List of localities of *Orobanche lutea* in Poland

Symbols and abbreviations: app. – approximately, ATPOL – Distribution Atlas of Vascular Plants in Poland database, com. – commune, DG – Dąbrowa Górnicza, distr. – district, exp. – exposure, leg. – collected by, n. – near, phot. – photography, res. – reserve, US – University of Silesia database, v. – valley, xer. gras. – xerothermic grassland; vid. – seen by, ? – doubtful locality.

AC: **21** – Zatoń Dolna, Raduń state farm, Chojna Odrzańska distr., leg. K. Rostański, 27.06.1958 (KTU, 41266), xer. gras., wasteland, margins of a xer. oak forest, (<15), 53°00'11.2"N, 14°15'41.7"E, 32 m, 52°59'59.6"N, 14°15'31.7"E, 46 m, vid. R. Piwowarczyk, 24.06.2009 (Schulz 1919); **30** – Bielinek, leg. R. Schulz 1914-1925 (B), (Schulz 1916, 1919; Hueck 1927, Libbert 1932; Celiński & Filipek 1958); slopes in a grassland community n. old brickyard, 500 m E of last buildings in Bielinek village on the Oder, leg. F. Celiński, M. Filipek (KRAM, 494809); Bielinek res. on the Oder, leg. Exc.Inst.Bot.U.P., 06.1952 (POZ); vid. R. Piwowarczyk, 07.09.2007; **66** – Łupowo n. Gorzów Wielkopolski, xer. gras. and scrub, escarpments of old railway tracks, 52°42'41.6"N, 15°08'49.9"E, 47 m, vid. R. Piwowarczyk, 25.06.2010, (var. *buekiana*); **68** – Górki n. Gorzów Wielkopolski, 52°43'50.7"N, 15°22'18.48"E, vid. E. Szczęśniak, 09.06.2001, phot.; **83** – Owczary, xer. gras., *Potentillo-Stipetum capillatae*, *Cirsio-Brachypodion pinnati*, 52°28'29.5"N; 14°38'43.0"E, 44 m, (<40), vid. R. Piwowarczyk, 25.06.2009; **BD: 83** – Szczyglice n. Głogów, Wzgórza Dalkowskie hills, sun-exposed slope, on *Medicago lupulina*, leg. E. Kozioł, 20.06.1979 (WRSL, 93919); Szczyglice, on a sun-exposed slope SE of Szczyglice in a gras. of the alliance *Koelerion glaucae*, leg. E. Kozioł, 21.05.2004 (HAL, 242805); Turów n. Głogów, Wzgórza Dalkowskie hills, sun-exposed slope SE of Turów, leg. E. Kozioł, 03.07.1990 (WRSL, 97625); **BE**: **16** – Stary Wołów, sandy hill, leg. Z. Głowacki, 21.09.1955 (KRAM, 494778, 494779), 30.06.1963 (WRSL, 31629), 23.06.1970 (KRA, 70735; KRAM, 211446; LOD, 154404; WRSL, 41705; LBL, LE, POZ, TRN); sandy hill W of Stary Wołów, peak, on *M. falcata*, xer. hill, leg. E. Kozioł, 08.06.1970, 23.06.1970, 10.06.1973 (WRSL, 32269, 38791, 74916, 93124); **17** – Grodki (Gródek) n. Strupin, Wołów distr. [Grottke geg. Stroppen] (Fiek 1881, Schube 1903), hill E of the village border, leg. Z. Głowacki, 02.07.1965 (WRSL, 31630); thermophilous fringe community on the margin of a pine forest, n. a gravel pit (<15), 51°23'01,7"N, 16°47'41,5"E, 173 m, vid. R. Piwowarczyk, 16.07.2011; **77** – Jordanów Śląski [Breslau: Augsenburg and Kupferberg at Jordansmühl], Miedzianka [Jordansmühle], leg. R. Uechtritz, 12.06.1853 (WA, 36735), leg. Heuser, 06.1854 (GLM, 138797), leg. B. Stein, 10.06.1868 (GLM, 149859); **98** – Góra Miedzianka hill, Dankowice close to Niemcza [Kupferberg bei Dankowitz vor Nimptsch], (Wimmer 1841 after Wichura; Wimmer 1869; Fiek 1881, Schube 1903), leg. H. Kivula, 02.07.1888 (GLM, 28665); **CD: 27** – Konin, calcareous-clay hill, leg. Ciernia, 06.1974 (LOD, 154402); **CE: 90** – Przeworno [Prieborner Marmorbruch] (Fiek 1881, Schube 1903); in a quarry, E of the excavation pit, leg. K. Pender, 06.07.1984 (WRSL, 71163); **95** – Opole [Oppeln], leg. Rakete (GLM, 106749); **CF: 05** – Groszowice n. Opole, leg. Bialucha, 06.1925 (OPOL, P/843); **15** – between Chorula and Malnia, xer. gras., (<20), 50°31'21.2"N, 17°58'09.9"E, 165 m, vid. R. Piwowarczyk, 21.07.2011, [Grose Strehlitz: Chorulla] (Schube 1930; Nowak *et al.* 2000, unpubl., US); Malnia, xer. gras., 50°31'20.3"N, 17°58'13.3"E, 172 m, vid. R. Piwowarczyk, 21.07.2011, (Nowak & Nowak 2002); **16** – Kamionek [Kl.-Stein] (Fiek 1881, Schube 1903), fallows close to airport (Nowak & Nowak 2002), Kamionek, xer. gras., fallows, (>100), 50°31'04.3"N, 18°03'30.8"E, 180 m, vid. R. Piwowarczyk, 22.07.2011; Gogolin, an feldrainen, leg. Kunisch, 07.06.1894 (B; LE; WA, 38719); (Engler 1869, unpubl., US; Fiek 1881, Schube 1903); Gogolin-Podbór, roadside on the N margin of the quarry, on the margin of scrub with *Prunus spinosa* (>10), 50°30'07.9"N, 18°02'10.3"E, 196 m, vid. R. Piwowarczyk, 22.07.2011; Kamień Śląski, xer. gras., (<40), 50°32'20.9"N, 18°04'04.3"E, 197 m, vid. R. Piwowarczyk, 22.07.2011, (Wimmer 1841 after Grabowski 1833; Wimmer 1869; Nowak & Nowak 2002); **DC**: **73** – Kulin res. n. Włocławek, Vistula embankment n. Stary Kulin, (var. *buekiana*), leg. R. Kobendza, 17.06.1911 (WA, 018920=28445), ravine slopes, (var. *buekiana*), leg. M. Kobendza, 05. and 06.1916 (WA, 018862=28446), xer. slope, leg. R. Markowski, 20.05.1979 (UGDA 01/05); Vistula v. slope, leg. M. Ceynowa, 04.06.1966, 07.07.1962, 06.06.1967 (TRN); Szpetal res., Włocławek forest inspectorate, sun-exposed slope, leg. A. Kawecka, 06.06.1973 (BIL, 70084); xer. gras. E of Kulin res., (<30), 52°39'50.3"N, 19°08'13.8"E, 71 m, vid. R. Piwowarczyk, 08.07.2010, (15), vid. I. Dembicz, Ł. Kozub, 11.2013; **DE: 11** – Majaczewice, Sieradz distr., border between a gras. and *M. sativa* cultivation, leg. J.T. Siciński, 10.06.1968 (LOD, 154403), (Siciński 1976); Winnica res., Burzenin distr., thermophilous gras., leg. M. Kurzac, 04.06.2010 (LOD, 155099), xer. gras., 51°26'13.8"N, 18°50'00"E, vid. P. Niedźwiedzki, 22.05.2011; **59** – Brzostek-Policzko, hill 267 m, between Jabłonna and Brzostek, xer. gras., leg. M. Kurzac, 14.06.2010 (LOD, 154945); **59/69** – Murawy Dobromierskie res. n. Dobromierz, xer. gras. and scrubs, former excavation pits, (<200), 51°00'31.4"N, 19°55'15"E, 288 m, 51°00'33.9"N, 19°55'16.9"E, 307 m, 51°00'34.9"N, 19°54'37.2"E, 273 m, leg. R. Piwowarczyk, 04.06.2008 (KTC), [Murawy Dobromierskie], leg. P. Niedźwiedzki, 09.06.2006 (LOD, 154347), leg. D. Wołkowycki, 01.06.2010 (0613, D. Wołkowycki private herbarium), [Dobromierz] (Błaszczyk 1959, Szwagrzyk 1987, Piwowarczyk 2012a); **83** – Częstochowa-Ostatni Grosz, in fields, sown fields, forest margin, leg. F. Karo 1865, 26.07.1874, 18.06.1877, 20.06.1875, 24.06.1875, 26.06.1879 (B, WA, 018915=28448, 018912=28439, 018919=28438, 018917=28437, 018914=28447), (Rostafiński 1871, Karo 1881); **84** – Olsztyn, sown fields, leg. F. Karo, 07.1877 (WA, 018921=28453, 018916=28452); Olsztyn n. Częstochowa, leg. B. Gajos-Kędzierska, 20.05.19?? (KRA, 0121728); Mstów SE, xer. gras. and thermophilous scrub on the margin of an oak forest, (>200), 50°49'03.8"N, 19°17'55.2"E, 277 m, leg. R. Piwowarczyk, 04.06.2008 (KTC); Jaskrów, Częstochowa distr., Babiak hill vel Mały Dół, xer. gras. on a calcareous hill, leg. J. Hereźniak, 17.07.1984 (LOD, 082992); Przymiłowice, Olsztyn distr., midfield scrub, leg. J. Hereźniak, 23.05.1986 (LOD, 154397) (Urbisz 2004a); **94** – Skrajnica, Dolny Ostrówek hill, Olsztyn distr., limestone quarry, leg. J. Hereźniak, 21.08.1986 (LOD, 154396), (Hereźniak *et. al.* 2001, Urbisz 2004a); Choroń, Poraj distr., dry

calcareous hill, leg. W. Duda, 29.06.1985 (KTU); **95** – Sosnowa Góra, Złoty Potok SW, Janów distr., abandoned agricultural cultivation, leg. J. Hereźniak, 10.06.1988 (LOD, 154398, 154401), (Hereźniak *et al.* 2001); forest margin by the Siedlec-Ostrężnik road, Złoty Potok forest inspectorate, Dąbrowa forest distr., section 252 g, leg. J. Hereźniak, 18.07.1988 (LOD, 154400), (Hereźniak *et al.* 2001); **96** – Złoty Potok SEE, Góra Krzemionka, xer. gras., (<50) 50°42'15"N, 19°26'30.3"E, 308 m, leg. R. Piwowarczyk, 04.06.2008 (KTC); Trzebniów, Niegowa distr., psammophilous gras., leg. D. Kasparek, 1983 (KTU, 37330); **DF: 03** – Woźniki SE, Coglowa Góra, hill 355 above Woźniki-Cynków road, xer. gras., roadsides, (150), 50°35'13"N, 19°04'05"E, 50°34'55"N, 19°04'01"E, 340-350 m, leg. Ł. Krajewski, 28.07.2011 (KTC, also monstrous shoot) [Woischnik: am Zogelberge] (Uechtritz 1886, Schube 1903, 1919), xer. gras. leg. A. Sendek, 21.06.1974 (KRA, 0138563; KTU, 10551), (Celiński *et al.* 1976 as *O. caryophyllacea*); Woźniki E, roadside of yellow trail to Gniazdów, NW slope of hill 359 (highest peak of the Coglowa massif), (15), 50°35'14,1"N, 19°04'39"E, 355 m, vid. Ł. Krajewski, 28.07.2011 [Woischnik: Quartberg] (Schube 1903); **04** – Rzeniszów-Świnica, hill 331, Myszków distr., xer. gras. on old limestone quarries, fallows, W, SW, S exp., (90), 50°34'57"N, 19°09'20"E, 320-330 m, leg. Ł. Krajewski, 28.07.2011 (KTC) (Babczyńska-Sendek 2005 as *O. elatior*); **05** – Żarki NW, roadsides of Żarecka Droga, (25), 50°38'26"N, 19°21'06"E, 352 m, vid. P. Kmiecik, Ł. Krajewski, T. Święciak, 16.11.2008; Góra Włodowska (hill 410), Zawiercie distr., W slopes, gras. on roadsides, (<100), 50°34'36"N, 19°25'16"E, 390 m, leg. Ł. Krajewski, 07.09.2011 (KTC); **14** – Markowice SW, Myszków distr., fallows, S exp., (25), 50°33'17"N, 19°09'36"E, 355 m, 50°33'12"N, 19°10'02"E, 365 m, leg. Ł. Krajewski, 28.07.2011 (KTC); Brudzowice W, hill 368 m, gras. on fallows and field baulks, W exp., S, (30), 50°30'15"N, 19°10'37"E; 50°30'11"N, 19°11'04"E, 340-365 m, leg. Ł. Krajewski, 23.07.2011 (KTC); Krusin N, Myszków distr., calcareous xer. gras. on old limestone quarries, SW exp., (very rare), 50°33'37,5"N, 19°08'36"E, 355 m, leg. Ł. Krajewski, 28.07.2011 (KTC); Dziewki SW, W of a large dolomite quarry, xer. gras., S exp., (25), 50°30'04"N, 19°12'27"E, 340-345 m, vid. Ł. Krajewski, T. Święciak, 24.06.2012; **15** – Skałka N, hill Skałka, Zawiercie distr., xer. gras. and scrubs, SW exp. (25, mixed with *O. kochii*), 50°32'04"N, 19°24'03"E, 375-387 m, vid. T. Święciak 2010, vid. Ł. Krajewski, 26.10.2014, phot.; **16** – Włodowice E, hill 391, rocky gras., W exp., (1 young shoot), 50°33'04"N, 19°28'17"E, 390 m, vid. Ł. Krajewski 29.05.2013, phot.; **23** – Góra Siewierska S/Strzyżowice N, Równa Góra (hill 390), xer. gras. (>10), 50°23'42.3"N, 19°04'50.7"E, 370 m, [Krzasek] leg. R. Piwowarczyk, 05.06.2008 (KTC), E slope, (5), 50°23'44"N, 19°05'05"E, 380 m, vid. Ł. Krajewski 06.08.2012, phot., (Nowak 1999); Strzyżowice N, Krzasek (hill 372), xer. gras. slopes above road 913 Będzin-Pyrzowice, leg. T. Nowak, 26.05.2009 (KTC), *Adonido-Brachypodietum pinnati*, (15, mixed with *O. kochii*), 50°23'37.3"N, 19°04'19"E vid. Ł. Krajewski 10.09.2010, phot., (Nowak 1999); between Dąbie Dolne and Goląsza Dolna, xer. gras., (2 populations: >200, >500), 50°24'27.7"N, 19°08'04.6"E, 328 m, 50°24'24.6"N, 19°07'48.4"E, 344 m, leg. R. Piwowarczyk, 05.06.2008 (KTC) [Dąbie Dolne and Dąbie Doliny] (Nowak 1997, unpubl., US; Nowak 1999); **24** – Toporowice, Ostra Góra (hill 351), xer. gras., fringes of termophilous scrub, (<20), 50°25'37"N, 19°09'06.2"E, 334 m, leg. R. Piwowarczyk, 05.06.2008 (KTC), calcareous gras., S, SE exp., (15, mixed with much more numerous *O. kochii*), 50°25'36"N, 19°09'06"E, 330-340 m, leg. Ł. Krajewski, 25.09.2009 (KTC, also f. *podantha*), (Babczyńska-Sendek 1993, unpubl., US; Nowak 1999); Podskale NW, hill 317, fallows, gras., 50°25'25"N, 19°13'12"E, 305-315 m, (20, 150), vid. Ł. Krajewski 2009-2011, 2013, leg. Ł. Krajewski 13.06.2011 (KTC), phot.; DG, Podwarpie SE, 50 m E of field route climbing on hill, xer. gras., S exp., (very rare), 50°25'03.6"N, 19°14'13"E, 300 m, leg. Ł. Krajewski, 17.07.2011, phot. (KTC); DG-Trzebiesławice N, hill 344, gras. with *Cerinthe minor* close to old quarries, overgrown by *Solidago*, S exp., (15, 4, 0), 340 m, vid. Ł. Krajewski 2009, 2011, not found in 2012 [Trzebiesławice] (Babczyńska-Sendek 1994, unpubl., US; Babczyńska-Sendek 2005); DG, Trzebiesławice S, E roadside under large *Populus* tree (ca 10 in one clump), 50°25'22"N, 19°15'07"E, 320 m, leg. Ł. Krajewski, 02.08.2009 (KTC), (7, sparse), vid. Ł. Krajewski, 01.09.2013, phot. (checked, but not present 2010-2012); DG, Ujejsce-Podbuczyny N, E roadside with *Libanotis* and *Medicago* (25, close to locality of *O. bartlingii*), 50°24'44"N, 19°15'07"E, 302 m, leg. Ł. Krajewski, 01.08.2009 (KTC), phot., not found later; DG, Ujejsce NE, hill 335 (Podrowce), calcareous gras., W, SW, S exp., (500), 50°24'12"N, 19°15'09"E, 320-335 m, vid. Ł. Krajewski 2009-2011, phot.; DG, Ujejsce E, Chendówka hill, calcareous xer. gras., SW slopes, (600, 90), 50°23'31"N, 19°14'45"E, 320-330 m, vid. Ł. Krajewski 2009-2010, 17.07.2011, phot. [DG-Ujejsce] (Nowak 1999); DG-Ujejsce SE, limestone quarry S of Ujejsce-Wygiełzów road, (>500), 50°23'18"N, 19°14'45"E, 330 m, leg. Ł. Krajewski, 14.08.2009 (KTC); DG-Ujejsce SE, between Góra Pańska hill and old limestone quarry S of Gruszeckiego street, calcareous gras. on fallow rendzinas (>250), 50°23'13.5"N, 19°14'51.5"E, 330 m, leg. Ł. Krajewski, 27.06.2010 (KTC, specimen extremely large – 75 cm, host *M. sativa*); DG, Ujejsce, close to the Recki Las forest, S roadside with a small sand excavation, (5), 50°24'09"N, 19°16'04.5"E, 328 m, vid. Ł. Krajewski 2009 (not found later, close to *O. elatior* site); DG, Wygiełzów N, very sparsely along field roads, on roadsides, xer. gras., fallows, S and SW slopes of hill 374, (250), 50°23'13"N, 19°16'24"E; 50°23'18"N, 19°16'05"E; 50°23'23"N, 19°16'20"E; 50°23'49"N, 19°16'26"E; 50°23'42"N, 19°16'46"E, 320-370 m, vid. Ł. Krajewski 2009-2013, phot. [Ząbkowice-Wygiełzów] (Nowak 1999); **25** – Wysoka n. Łazy, summit of a large jurassic monadnock, close to a stone tower above limestone quarry, calcareous rocky gras., 50°25'37"N, 19°21'19"E, 370 m, (2, 60), vid. Ł. Krajewski 2009, 29.05.2011, phot.; between Chruszczobród and DG-Sikorka, xer. gras., leg. T. Nowak, 04.06.1992 (KTU, 99022) (Nowak 1999); Chruszczobród-Kamionki, overgrowing old limestone quarries, W, SW exp., (60), 50°24'36"N, 19°18'03"E, 350 m, vid. Ł. Krajewski 2009, phot. (Babczyńska-Sendek 1996, unpubl., US; Babczyńska-Sendek 2005); Chruszczobród S, Gawronów/DG, Tucznawa-Bugaj, overgrowing xer. gras., E exp., (2), 50°23'51"N, 19°18'14"E, 342 m, vid. Ł. Krajewski, 28.10.2009, not found later; Niegowonice W, Góra Lipowa (hill 411), xer. gras., exp. S, N, (100), 390-410 m, leg. Ł. Krajewski, 18.09.2009 (KTC, also monstrous shoot), phot., leg. A. Sendek, 27.06.1987 (KRA, 0139869) [Lipowa Górka] (Urbisz 2004a); Niegowonice N, Snopkowa Skała [rocks NE Cmentarna street], xer. gras. and scrub, (<1000), hosts *M. falcata* and *M. sativa*, 50°23'51.5"N, 19°24'52.3"E, 387 m, leg. R. Piwowarczyk,

04.06.2008 (KTC); Niegowonice N, Góra Wawrzynowa (hill 418 above cliff of limestone quarry), *Origano-Brachypodietum pinnati*, W exp., (200), 50°24'01"N, 19°24'41"E, 400-410 m, vid. Ł. Krajewski 2009, phot.; **26** – Zawiercie-Bzów, xer. gras. at the foot of Skała Rzędowa rock, (<500), vid. R. Piwowarczyk 2010-2013 (Piwowarczyk 2012e), (50, 500), vid. Ł. Krajewski 26.11.2009 (also f. *podantha*), 15.07.2010, 26.06.2011, phot.; Zawiercie-Bzów, xer. gras. above stone-pit, roadsides of the road to Zuzanka, fallows, (<500), 50°28'15,44"N, 19°31'23,98"E, vid. R. Piwowarczyk 2013, Bzów SE, roadsides and fallows above large limestone quarry (150), vid. Ł. Krajewski 2009-2011, phot.; Niegowonice, Zawiercie distr., calcareous grasslands, leg. K. Jędrzejko, 20.06.1974 (KTU, 10548), (Celiński *et al.* 1978/79, as *O. caryophyllacea*); Niegowonice NE, along the road to Ogrodzieniec, between Niegowonice and Kromołowiec rocks, roadsides, rocks, xer. gras., scrubs, (750), 360-420 m, vid. Ł. Krajewski 2009, 26.06.2011, phot.; Niegowoniczki/Niegowonice E, N of village border sign (20), 50°23'09"N, 19°26'21"E, 362 m, rendzina fallows, leg. Ł. Krajewski, 02.10.2009 (KTC), [between Niegowonice and Grabowa] (Urbisz 2004a); Grabowa E, Wierzgóry (hill 423), SE part, xer. gras. (700), 50°23'22"N, 19°28'28"E, 360-405 m, leg. Ł. Krajewski, 02.10.2009 (KTC), [Grabowa] (Urbisz 2004a); Grabowa NW, hill 412, xer. gras. (80), 50°23'52"N, 19°27'06"E, 405-410 m, leg. Ł. Krajewski, 02.10.2009 (KTC), *Geranion sanguinei*, 50°23'42.8"N, 19°26'48.3"E, 420 m, leg. Ł. Krajewski, 02.10.2009 (KTC, f. *podantha*); Hutki-Kanki S, roadsides of red marked "Szwajcaria Zagłębiowska' Trail", (20), 50°24'17"N, 19°29'34"E, 365 m, vid. Ł. Krajewski, 22.04.2014, phot.; **27** – between Ryczówek and Kwaśniów Górny, Grabówki, vid. D. Oruba 2009, 2013, phot.; **29** – Biała Góra res. n. Tunel, xer. gras. and wastelands (<150), 50°26'37,2"N, 19°58'07"E, 382 m, leg. R. Piwowarczyk, 16.06.2006 (KTC), E part of the res. and adjacent fields and fallows, belt of grasslands and scrubs in forest sec. no. 132 (Szeląg 1997; Binkiewicz 2009); Klonów n. Miechów, in a steppe res., *Inuletum ensifoliae* association, leg. A. Jasiewicz, 20.06.1953 (KRAM, 414022); Tunel, edge of arable field, leg. D. Wołkowycki, 02.08.2010 (6447, D. Wołkowycki, private herbarium); NEE of Kępie village, xer. gras. n. the railway line (<50), 50°27'37", 19°57'49"E, 345 m, vid. B. Binkiewicz, 19.08.2005; **32** – Wojkowice, Kamyce W above boundary with Bobrowniki, calcareous fallow with numerous *Solidago* sp. (17 in one clump), 50°22'14"N, 18°59'15"E, leg. Ł. Krajewski, 03.06.2011 (KTC); **33** – Czeladź, gras. in Madera, host *Medicago* sp., leg. P. Wąsowicz, 13.07.2004 (KTU, 99020); Czeladź-Madera, calcareous gras. around a small limestone quarry, SW exp., (150), 50°19'39"N, 19°03'41"E, leg. Ł. Krajewski, 04.06.2011 (KTC); **34** – Będzin, Warpie-Wschód, hill 301, sparse in overgrowing gras. on S slopes, old limestone quarries, (200), 50°18'50"N, 19°09'22"E; 50°18'58"N, 19°09'13"E; 50°18'45"N, 19°09'36"E, 265-300 m, leg. Ł. Krajewski, 05.10.2009 (KTC, also 3 shoots of f. *podantha*); Sosnowiec, Środula Dolna, ruderal sites in an old limestone quarry, strongly overgrowing *Populus tremula* and *Solidago* (25), 50°18'15"N, 19°08'52"E, 275 m, leg. Ł. Krajewski, 05.10.2009 (KTC); DG, Ujejsce-Podlesie, sandpit Kuźnica Warężyńska, SW of Kryniczna street, xer. gras., *Betula* scrubs, wastelands, dumps, (>50), 50°23'16,2"N, 19°13'14,2"E, 280 m, leg. R. Piwowarczyk, 04.06.2008 (KTC), calcareous sands, scrubs, (20), vid. Ł. Krajewski 2011, phot.; DG, Pańska Góra hill, Ujejsce/Ząbkowice, xer. gras. on a summit, old quarry, roadsides (>1000), 50°23'02"N, 19°14'48"E; 50°23'03.5"N, 19°14'48"E, 320-335 m, leg. Ł. Krajewski, 14.08.2009, 17.07.2011 (KTC); DG-Ząbkowice E, roadsides, old limestone quarry N Górzysta street (>1000), 50°22'20"N, 19°16'46"E, 320-340 m, leg. Ł. Krajewski, 15.08.2009 (KTC); DG, SE of Ząbkowice, S of Górzysta street, quarries, ruderal sites on an old sodium heap, (1000) 50°22'06"N, 19°16'48"E, leg. Ł. Krajewski, 12.09.2009, 13.09.2009 (KTC, also f. *podantha*), vid. L. Bernacki, Ł. Krajewski, T. Nowak, 27.05.2011, phot., vid. R. Piwowarczyk 11.05.2011; DG, Gołonóg, lawn close to railway station, (1), 50°20'37"N, 19°13'420"E, 280 m, vid. Ł. Krajewski, 29.05.2014, phot.; DG, Gołonóg, Mała Góra Gołonoska hill, calcareous xer. gras. (80, 120, 50; mixed with *O. elatior* and *O. kochii*), 50°20'04"N, 19°14'30"E, 50°20'06"N, 19°14'22"E, 50°20'05"N, 19°14'34"E, 325-335 m, leg. Ł. Krajewski, 04.08.2009 (KTC), vid. Ł. Krajewski 1998, 2007, 2009-2013, phot.; DG-Tworzeń, Huta Katowice NW, roadside of Roździeńskiego street, close to a bus stop, ruderal sites, (120, 40), 50°21'17"N, 19°15'55"E, 298 m, leg. Ł. Krajewski, 08.08.2009 (KTC, var. *buekiana*), vid. Ł. Krajewski 2010-2013, phot.; **35** – DG-Tucznawa, field road, leg. R. Sumara, 11.06.1974 (KTU, 10558), Tucznawa S, Trakt Siewierski, Pod Górami, field roadsides with xer. gras., (10, 25), 340-360 m, vid. Ł. Krajewski 2009, 4.01.2014, phot.; DG, Tucznawa-Smardz, hill 330, gras. around summit shrubbery (50), 50°23'00"N, 19°18'15"E, 330 m, leg. Ł. Krajewski, 15.08.2009 (KTC); DG, gras., leg. S. Barwicka, 10.07.1999 (KTU, 99078); DG-Ząbkowice, close to a stone-pit, xer. gras., leg. T. Nowak, 18.06.1992 (KRA, 0307928; KTU, 99019), around large dolomite-quarry, Kamionka hill, xer. gras., roadsides, thermophilous fringes, (>1000, sometimes with *O. kochii*), 50°22'20"N, 19°17'57"E; 50°22'07"N, 19°17'28"E, 335-360 m, vid. Ł. Krajewski 2008-2013, phot., (Nowak 1999); DG, Starosiedle, midforest Łady quarry, thermophilous scrubs, (2, 25), vid. Ł. Krajewski 2009, 04.12.2013, phot., (Nowak 1999); DG-Łosień, around two planned water reservoirs, one unfinished, xer. gras. roadsides, ruderal areas (600), 50°21'29"N, 19°18'49"E, 355 m, leg. Ł. Krajewski, 07.08.2009 (KTC), phot.; DG, SW of dam in Łosień, roadside (25), 50°21'29"N, 19°18'25"E, 355 m, leg. Ł. Krajewski, 08.08.2009 (KTC); DG, Łosień W, shady roadside in young forest, (20), 50°21'14"N, 19°18'22"E, 350 m, leg. Ł. Krajewski, 16.07.2009 (KTC, f. *podantha*), phot.; DG, Łosień N, hill 390, fallows, xer. gras., SW, S, E exp., mostly on the E slope in a clearing under power line, (250), 50°21'22"N, 19°20'09"E, 365-390 m, vid. Ł. Krajewski 2008-2011, [Łosień, hill to Łęka] (Nowak 1997, unpubl., US; Nowak 1999); DG-Łosień N, roadside close to cemetery (30, 10), 50°21'19"N, 19°20'23"E, 365 m, leg. Ł. Krajewski, 15.08.2009 (KTC), vid. Ł. Krajewski 06.09.2013; DG-Łosień SE, Orna street, midshadow roadside of a forest road, in a clearing under power line (15), 50°20'53"N, 19°20'24"E, 355 m, leg. Ł. Krajewski, 06.08.2009 (KTC); DG-Łosień SW, n. waterworks, old fallows, (25), 50°20'59"N, 19°18'46"E, 363 m, vid. Ł. Krajewski 2009, 2012; DG, 1 km Łosień S, xer. and calamine gras., roadsides, (90), 50°20'29"N, 19°19'26"E, 50°20'30.7"N, 19°19'24"E, 340-355 m, leg. Ł. Krajewski, 06.08.2009 (KTC); DG-Łosień, Trakt Siewierski medieval route, roadsides N of village (200), 50°21'18"N, 19°19'37"E, 365 m, leg. Ł. Krajewski, 07.08.2009 (KTC), vid. L. Bernacki, Ł.

Krajewski, T. Nowak, 27.05.2011, (15) 50°21’26”N, 19°19’3”E, 372 m, vid. Ł. Krajewski 2010, 06.09.2013; DG, Zagrabie W, roadside of Trakt Siewierski, (5), 50°21’48”N, 19°19’24”E, 372 m, vid. Ł. Krajewski 16.06.2011; DG, Łęka NW, hill 361 (Łosy), thermophilous shrubs (very rare, mixed with *O. elatior* s.l.), 50°22’11”N, 19°20’01”E, leg. Ł. Krajewski, 15.06.2011 (KTC), vid. Ł. Krajewski 06.09.2013; DG, Łęka E, roadsides, along railway tracks, initial gras. on fallow rendzinas, together with numerous *O. bartlingii*, (90), 50°21’25”N, 19°22’14”E, 320-350 m, leg. Ł. Krajewski, 07.08.2009 (KTC), (500), vid. Ł. Krajewski 26.06.2011; DG, Okradzionów W, along railway lines, roadsides, gras., fallows (>1000), 50°19’59”N, 19°22’10”E, 325-340 m, leg. Ł. Krajewski, 06.08.2009 (KTC), [DG-Okradzionów, central part] (Nowak 1997, unpubl., US; Nowak 1999); DG, Strzemieszyce Wielkie, Srocza Góra (hill 330), scrubs, overgrowing calcareous gras., (10), 50°18’50”N, 19°17’36”E, 305 m, 50°19’01”N, 19°17’51”E, 330 m, vid. Ł. Krajewski 06.2008, not found later; DG-Strzemieszyce Wielkie, N of Strzemieszycka street, calcareous gras. with *Libanotis* and *Medicago*, (50), 50°18’34”N, 19°18’01”E, 50°18’37”N, 19°18’48”E, 300-315 m, leg. Ł. Krajewski, 07.09.2009 (KTC, also monstrous shoots), [DG, Strzemieszyce Wielkie N] (Nowak 1997, unpubl., US; Nowak 1999); DG, between Strzemieszyce Wielkie and Anna, ruderal areas, leg. Ł. Krajewski, 06.09.2009 (KTC); DG-Strzemieszyce Małe, xer. gras., leg. A. Sendek, 10.08.1976 (KTU, 34395); DG, Strzemieszyce Małe NE, hill 345, W, SW, S exp., strongly overgrowing calcareous gras., (50), 50°19’55”N, 19°19’27”E, 340-345 m, vid. Ł. Krajewski 2009; DG, Strzemieszyce Małe E, hill 335, gras., fallows, shrubs (>1000, mixed with *O. picridis*), 50°19’27”N, 19°19’34”E, 325-335 m, leg. Ł. Krajewski, 08.10.2009; DG, abandoned Lipówka village, forest margin, SW exp., (5), 50°19’43.6”N, 19°21’17.7”E, 335 m, vid, Ł. Krajewski, 2009, [DG, Strzemieszyce, Krakówka and Lipówka] (Nowak 1997, unpubl., US; Nowak 1999); DG, Strzemieszyce Małe-Kawa, xer. gras. overgrowing *Libanotis* (30), 50°18’50”N, 19°19’19”E, 310-315 m, leg. Ł. Krajewski, 10.08.2009 (KTC); SE of DG-Towarowa railway station, Strzemieszyce Małe E, roadsides with *Libanotis* and *Medicago*, near tracks, xer. and calamine gras., ruderal areas (>1000), 50°19’01”N, 19°19’40”E, 325 m, leg. Ł. Krajewski, 10.08.2009 (KTC), [DG, Strzemieszyce Małe] (Nowak 1997, unpubl., US); Sławków, western slopes of Góra Wielka hill, 50°19’12.8”, 19°21’07.2”E, 348 m, vid. R. Piwowarczyk, 12.07.2007, calamine rocky gras. W of the summit and W slopes, (500), 50°19’15”N, 19°21’17”E, 345-360 m, vid. Ł. Krajewski 2009-2011, (Nowak 1999); DG-Zakawie/Sławków, Gieraska Mt. N part [G. Ponorówka], leg. R. Piwowarczyk, 13.07.2007 (KTC), vid. R. Piwowarczyk 11.05.2014; DG, Strzemieszyce Małe-Zakawie E/Sławków, Góra Gieraska massif, roadsides, calamine gras. (400), 50°18’40”N, 19°20’22”E, 50°18’38”N, 19°20’55”E, 50°18’48”N, 19°20’40”E, 300-340 m, leg. Ł. Krajewski, 13.08.2009 (KTC); DG, between Strzemieszyce Małe and Zakawie, old calamine quarries, gras., fallows (100), 50°18’45”N, 19°19’51”E, 315-320 m, leg. Ł. Krajewski, 13.08.2009 (KTC); DG, N of Zakawie, N of railway, route along Bobrek stream, roadside shrubs (30), 50°19’12”N, 19°20’20”E, 305 m, leg. Ł. Krajewski, 08.10.2009 (KTC); DG-Zakawie N, roadside N of railway embankment, 50°19’12.3”N, 19°20’15.2”E, 315 m, leg. Ł. Krajewski, 17.06.2010 (KTC, large specimen: 73 cm), vid. Ł. Krajewski 04.07.2011; Sławków N, alongside Okradzionów – Zakawie road, roadsides with *Libanotis* and *Medicago*, initial gras. in large railway crosscut, ruderal sites (>1000), 50°19’08”N, 19°22’40”E, 50°19’02”N, 19°20’55”E, 320-330 m, leg. Ł. Krajewski, 06.08.2009, 09.08.2009 (KTC), vid. Ł. Krajewski 04.07.2011; DG-Okradzionów/Sławków, roadside of asphalt road with patches of secondary xer. gras., leg. P. Kauzal, 2006/2007 (KTC, f. *podantha*); Sławków, W Chwaliboskie, roadside, leg. Ł. Krajewski, 15.09.2009 (KTC, f. *podantha*); Bolesław-Krzykawka W, Góra Kantorstwo (hill above Biała Przemsza valley), fallows, fringes, (15), 50°18’45”N, 19°24’07”E, 305-320 m, vid. Ł. Krajewski 17.10.2010; Sławków-Kozioł N, *Geranion sanguinei*, ruderal sites, roadsides, fallows, (1000), 50°18’41”N, 19°21’57”E, 320-330 m, vid. Ł. Krajewski, 2011; Sławków W, Łąki Kozioł, fallows overgrown by *Libanotis*, (30), 50°18’08”N, 19°21’22”E, 305-315 m, leg. Ł. Krajewski, 06.09.2009 (KTC), between a road and railway, (15), 50°18’01,5”N, 19°21’33”E, 305 m, vid. L. Bernacki, Ł. Krajewski, T. Nowak, 17.06.2011, [between railway station DG-Wschodnia and Sławków] (Nowak 1999); Sławków, Kołdaczka (hill 320), xer. gras. overgrowing *Solidago* and *Libanotis*, NW, W, SW, S, E exp., leg. Ł. Krajewski, 15.09.2009 (KTC, var. *buekiana*); Sławków-Piasek, N roadsides of Katowice-Olkusz route, (15), vid. Ł. Krajewski 09.07.2011, (Szeląg 2000, unpubl., US); Sławków, Ciołkowizna, roadsides, (25), 50°17’57”N, 19°20’22”E; 300 m, vid. Ł. Krajewski 02.05.2012; Podlipie W, roadsides, (100), 50°17’46”N, 19°24’54”E, 320 m, vid. Ł. Krajewski 2009, 2012; **36** – Chechło N, Klucze distr., calcareous gras., roadsides (90), 50°22’43”N, 19°30’40”E, 340-360 m, leg. Ł. Krajewski, 25.09.2009 (KTC), (Urbisz 2004a); Chechło n. Klucze, alfa alfa field close to a crossroads of the small asphalt road to the Błędów Desert viewing point and the road to the village centre, 340 m, leg. W. Bartoszek, M. Wayda, 17.06.2005 (KRA, 0276471, 0276472); Chechło-Pustkowie, Buczna Góra hill, xer. gras. (25), 50°21’50”N, 19°32’15”E, 350 m, leg. Ł. Krajewski, 26.09.2009 (KTC); Klucze, Olkusz distr., scrub, leg. R. Kobendza, 1922 (WA, 018878=28387); between the Olkusz and Błędów Desert, leg. R. Kobendza, 1928 (WA, 018870=28386); Klucze, Czubatka Mt., near yellow route to the Błędów Desert, meadow on fallow rendzina, 375 m, leg. W. Bartoszek and M. Wayda, 17.06.2005 (KRA, 027620, 027621, 027622), summit 382 (Jałowce hill) and gras. on E slopes, (100), 50°20’09”N, 19°33’06”E, vid. Ł. Krajewski, 10.07.2011, phot.; Małobądz, Bolesław distr., S part of hill 372, fallows, gras., (80), vid. Ł. Krajewski 17.10.2010, (Nowak 1999); **37** – Knaśniów Dolny S, roadside, (10), 50°22’19.6”N, 19°34’42.8”E, 345 m, vid. Ł. Krajewski 13.07.2014, phot.; Klucze SE, fallows and sun-exposed hills by rocks, leg. K. Piech, 14.06.1924 (KRAM, 095388; Klucze E, Marglok (hill 405), thermophilous fringe, 50°20’27”N, 19°34’03”E, 370 m, leg. Ł. Krajewski, 26.09.2009 (KTC); Klucze E, Dupnica (hill 421), ecotone of calcareous and psammophilous gras. (25), 50°19’59”N, 19°34’19”E, 395 m, leg. Ł. Krajewski, 26.09.2009 (KTC); Klucze, Bukowica, S-exposed slope, leg. B. Babińska, 03.06.1977 (KRA), Bukowiec rocks, calcareous, rocky gras., roadsides, NW exp., W, SW, S, SE, (>100), 50°19’38”N, 19°33’58”E, 380-400 m, leg. Ł. Krajewski, 09.09.2011 (KTC); Klucze SE, 250 m S of Bukowiec, fallows, W exp., 50°19’33”N, 19°33’58”E, 380 m, leg. Ł. Krajewski, 09.07.2011 (KTC); Bogucin Duży NW, Olkusz distr., roadside of Olkusz-Klucze road crosscut,

50°19’20”N, 19°33’39”E, 375 m, leg. Ł. Krajewski, 10.07.2011 (KTC); between Klucze and Olkusz, SE of Pomorzańskie Skały rocks, gras. on fallow rendzinas, NE, W exp., (20), 50°18’26”N, 19°33’27”E; 50°18’20”N, 19°33’30”E, 395-405 m, leg. Ł. Krajewski, 10.07.2011 (KTC); Rabsztyn, Olkusz distr., field hummocks, leg. A. Zalewski, 21.07.1893 (WA, 018922=28443), castle hill rocks, leg. A. Sendek (KTU, 32672), (Urbisz 2004a), SE slope, 100 m E of the “Rabsztyn” castle, gras. with *M. falcata* and *Libanotis* (1), vid. Ł. Krajewski, 10.07.2011, phot.; Cieślin W, Bagna, sandy roadsides, (25), 50°22’19”N, 19°36’25,5”E, 345-350 m, vid. Ł. Krajewski, 10.09.2013, phot.; **38** – Gołaczewy SW, Stara Wieś, fallow meadow, leg. M. Szewczyk, 09.06.1999 (KRAM, 527021), (Urbisz 2004a); Imbramowice, xer. gras. on the slopes of Dłubnia v., known as ‘Grodzisko’, (>50), 50°18’12,1”N, 19°49’44,5”E, 350 m, 50°18’11,8”N, 19°49’44,3”E, 348 m, vid. R. Piwowarczyk, 2012, (Gawroński & Szewczyk 1996, unpubl., ATPOL); Glanów S vid. R. Piwowarczyk 30.09.2011, (Urbisz 2004a); **44** – Sosnowiec-Zagórze, hill 324, ruderal areas, scrubs and gras. around limestone quarries, (20, 10), 50°17’46.5”N, 19°11’31”E; 50°17’36.5”N, 19°11’55.5”E, leg. Ł. Krajewski, 03.09.2009 (KTC), vid. Ł. Krajewski, P. Kauzal, 15.10.2011; Sosnowiec-Sielec [Sielce bei Bendzin], leg. G. Schneider, 21.06.1876 (B); Sosnowiec S, Pod Klimontowem (between Sielec and Klimontów), hill 297, overgrowing old baulkfield close to a patch, SE, E, NE exp., (65), 50°16’17”N, 19°10’18”E, 295 m, leg. Ł. Krajewski, 26.07.2010 (KTC; very close to/identical with the Schneider’s precedant data); Jaworzno-Szczakowa NW, sand n. a railway/road crossing, leg. A. Rostański, 21.09.2007 (KTU, 96755); Jaworzno-Szczakowa N, between a soda heap and the Maczki-Stara Wieś road, young scrubs with *Populus tremula* and *Salix*, (very rare), 50°14’55”N, 19°16’34”E, leg. Ł. Krajewski, 13.08.2010 (KTC), (10), vid. Ł. Krajewski 12.06.2011, [Jaworzno-Szczakowa] (Chmiel 1993, unpubl., US), [Szczakowa] (Tokarska-Guzik 1999 as *O. caryophyllacea*); Jaworzno, Długoszyn E, hill with an iron cross, (>500), leg. Ł. Krajewski, 03.08.2010 (KTC), vid. Ł. Krajewski 2010-2012; Jaworzno-Długoszyn, Wał, xer. gras. and shrubs, 50°14’37,1”N, 19°14’49,6”E, 289 m, vid. R. Piwowarczyk, 12.07.2007, leg. R. Piwowarczyk, 13.07.2007 (KTC), (Babczyńska-Sendek 1996, unpubl., US; Babczyńska-Sendek 2005) (Tokarska-Guzik 1999 as *O. caryophyllacea*); Jaworzno-Długoszyn W, SW, xer. gras., fallows (1000, mixed with *O. alsatica*), 50°14’48”N, 19°14’33”E, 50°14’44”N, 19°14’38”, leg. Ł. Krajewski, 21.08.2010, 12.06.2011 (KTC, also f. *podantha*); Jaworzno N, Góra Sodowa hill, above an old limestone quarry, xer. gras., thermophilous scrubs, (>1000), 50°13’46”N, 19°16’41”E, 320 m, vid. Ł. Krajewski 2010, 2012, [Jaworzno, NE of the town centre, Góra Sodowa hill] (Babczyńska-Sendek 1996, unpubl., US; Babczyńska-Sendek 2005); Jaworzno-Niedzieliska, Wał, xer. gras., (very rare, mixed with much more numerous *O. elatior*), (15), 50°13’18”N, 19°15’53”E, 312 m, leg. Ł. Krajewski, 12.06.2011 (KTC); **45** – Bukowno-Stara Wieś N, calcareous gras. on fallow rendzinas, thermophilous shrubs, W, SW exp., (100), 50°17’17”N, 19°24’19”E, 330 m, (250), 50°17’17”N, 19°25’08”E, 345 m, leg. Ł. Krajewski, 04.10.2010 (KTC), vid. Ł. Krajewski 2009-2011, [between W part of Bukowno-Stara Wieś and the Przymiarki railway station] (Nowak 1999); Jaworzno, Szczakowa-Gadlin, hill 293 SW cemetery, *Cirsio-Brachypodion pinnati*, exposure NW, W, (30), 50°14’03”N, 19°17’44”E, 290 m, leg. Ł. Krajewski, 07.08.2010 (KTC), (Tokarska-Guzik 1999 as *O. caryophyllacea*); Jaworzno-Szczakowa S, hill 310, SE of forest, gras./thermophilous fringe, SE exp., (10), 50°13’55,5”N, 19°17’23”E, 295 m, leg. Ł. Krajewski, 04.08.2010 (KTC, lower flowers on long stalks); Jaworzno-Dobra, psammophilous gras. SE bus terminal, (<20), 50°13’22”N, 19°17’47”E, leg. Ł. Krajewski, 23.06.2011 (KTC); Jaworzno-Wilkoszyn, SE cemetery, secondary gras. on fallows, (<20), leg. Ł. Krajewski, 23.06.2011 (KTC); Jaworzno-Ciężkowice, Góra Wielkanoc hill, fallows, leg. B. Ciołczyk, 30.06.1980 (KTU, 28761), Wielkanoc hill SE Ciężkowice-Klucze, xer. gras., scrubs, fields, leg. P. Grzegorzek, 08.06.1992 (CHRZ), hill 331, *Origano-Brachypodietum*, *Thalictro-Salvietum pratensis*, fallows, (200), 50°12’39”N, 19°20’45”E, 50°12’37”N 19°20’56”E, 320-330 m, leg. Ł. Krajewski, 08.08.2010 (KTC), vid. Ł. Krajewski 12.06.2011, (Babczyńska-Sendek 1992, unpubl., US; Chmiel 1993, unpubl., US); Jaworzno-Ciężkowice, Góra Chrzanowska hill, summit part between roads to Okradziejówka and Góry Luszowskie, leg. P. Grzegorzek, 07.06.1994 (CHRZ); Jaworzno, Ciężkowice-Podleszczyna, hill 337, xer. gras., W, SW exp., (>30), 50°12’43”N, 19°21’34”E, leg. Ł. Krajewski, 13.08.2010 (KTC), (Tokarska-Guzik 1999 as *O. caryophyllacea*); Jaworzno, Ciężkowice-Kolawica, roadside, (25), 50°12’45”N, 19°22’34”E, 306 m, vid. Ł. Krajewski 12.06.2011; Jaworzno NE, hill under power line, E of Góra Przygoń hills, mesophilous gras. *Thalictro-Salvietum pratensis* varying to *Origano-Brachypodietum* (10, with very numerous *O. kochii*), 50°12’28”N, 19°23’18”E, leg. Ł. Krajewski, 13.08.2010 (KTC); Jaworzno-Pieczyska, Lisia Góra hill, above a diving base, around flooded “Gródek” quarry, top of a cliff, roadsides, smaller patches of *Origano-Brachypodietum*, (150), 50°13’44”N, 19°18’49”E, leg. Ł. Krajewski, 08.08.2010 (KTC); **46** – Podlipie S, Bolesław distr., hill 362, xer. gras., (500, very rare also *O. kochii*), 345-360 m, leg. Ł. Krajewski, 16.09.2009 (KTC), (Nowak 1999); Bukowno-Skotnica, xer. gras. on the dolomite south slope, 50°16’50”N, 19°25’40”E, leg. T. Nowak, 2008 (KTU), (25), vid. Ł. Krajewski 11.09.2011, (Nowak 1999); Bukowno, Jamna Góra hill, rocky roadside, (15), vid. Ł. Krajewski 11.09.2011; Bukowno, between Krążek and Wodąca, midfield gras., leg. T. Nowak, 26.05.1993, (KTU, 99018); Czyżówka N, Góra Cisowa hill, S slopes, calcareous xer. gras., roadsides, S, SW, SE exp. (>80), 50°12’48”N, 19°28’21”E, 50°12’43”N, 19°28’27”, 405 m, leg. Ł. Krajewski, 04.10.2010 (KTC); Olkusz-Mazaniec, Góra Krucza hill, xer. gras., leg. J. Drobnik, 04.07.2000 (KTU, 99019), SE part, secondary xer. gras., (50), 50°15’47”N, 19°32’41”E, 380 m, leg. Ł. Krajewski, 13.09.2011 (KTC, also f. *podantha*); Żurada SE, Olkusz distr., gras. on fallow rendzinas, roadside, N exp., (15), 50°15’00”N, 19°33’37”E, 410 m, leg. Ł. Krajewski, 15.09.2011 (KTC); **47** – Olkusz N, Parcze Dolne, hill 430, E of the road to Klucze, 100 m N of radio mast, close to a patch of *Heracleum mantegazzianum*, fallow, SW exp., (15), 50°17’40”N, 19°33’50”E, leg. Ł. Krajewski, 15.09.2011 (KTC), (Urbisz 2004a); Witeradów SE, Góra Kadzielnia hill and to E, hills W of Osiek, Olkusz distr., xer. gras., fallows, roadsides, baulks, W, S, SW exp., (90, mixed with *O. kochii*), 50°14’30”N, 19°34’57”E; 50°14’34”N, 19°35’29”E, 410-430 m, leg. Ł. Krajewski, 13.09.2011 (KTC), (Urbisz 2004a); **55** – Jaworzno-Śródmieście SE, Równa Góra (hill 318), beside patch close to a cross on the summit, *Origano-Brachypodietum* with planted *Tilia*, (very rare), 50°11’43”N, 19°17’41”E,

319 m, leg. Ł. Krajewski, 07.08.2010 (KTC); Jaworzno, close to field crossroads N of Góra Grodzisko hill, roadsides, gras., *Thalictro-Salvietum*, *Origano-Brachypodietum*, (120), 50°11'20"N, 19°17'49"E, 320 m, leg. Ł. Krajewski, 07.08.2010 (KTC); Jaworzno NE, hill W of Trzebinia-Stara Maszyna, summit N, N slopes, *Adonido-Brachypodietum pinnati*, (20, mixed with much more numerous *O. alsatica*), 50°12'18"N, 19°23'38"E, leg. Ł. Krajewski, 13.08.2010 (KTC), (45), vid. Ł. Krajewski 12.06.2011; Trzebinia, Stara Maszyna, S Modrzewiowa street, xer. gras., 50°12'09.9"N, 19°24'02.6"E, 328 m, vid. R. Piwowarczyk, 12.07.2007, leg. R. Piwowarczyk, 13.07.2007; Góry Luszowskie NW, S of Przygoń Mt, xer. gras., shrubs, wastelands, 50°12'07.3"N, 19°22'55.3"E, 321 m, vid. B. Babczyńska-Sendek, R. Piwowarczyk, 12.07.2007; Jaworzno, S of Przygoń Mt, roadsides, (25) 50°12'21"N, 19°22'33, (>250) 50°12'15"N, 19°22'43"E, leg. Ł. Krajewski, 13.08.2010, 24.08.2010 (KTC); Trzebinia, Góry Luszowskie NE, fallows around small limestone quarries, (>20), 50°11'16"N, 19°24'54"E, leg. Ł. Krajewski, 24.08.2010 (KTC); Luszowice, N of railway, W of the village, meadows with scattered buildings, leg. P. Grzegorzek, 08.06.1992 (CHRZ), [Luszowice, Piaski n. Trzebinia settlement] (Babczyńska-Sendek 1992, unpubl., US; Chmiel 1993, unpubl., US); Luszowice, xer. gras., leg. R. Piwowarczyk, 13.07.2007 (KTC); Balin Mały S, fields and gras. S Wianek hill, leg. P. Grzegorzek, 26.06.2006 (CHRZ); Balin Mały SW, gras., 50°09'46"N, 19°22'25"E, (>100), leg. Ł. Krajewski, 23.06.2011 (KTC); between Balin and the A4 motorway, baulk field (Dubiel *et al.* 2000, as *O. elatior*, phot.); **56** – Trzebinia, Wodna-Podkrystynów, gras., (50), 50°10'39"N, 19°26'14"E, 355-365 m, vid. Ł. Krajewski, 24.08.2010, [Trzebinia-Wodna] (Chmiel 1993, unpubl., US); Trzebinia E, hill 375 NE of ZWM housing estate, SW slopes above a road, scrubs, calcareous gras., (10, mixed with *O. kochii*), 50°09'42"N, 19°28'43"E, 352 m, vid. Ł. Krajewski, 24.08.2010; Młoszowa, meadow, leg. M. Piwowarczyk, 21.06.1997 (KTU, 64210); Trzebinia-Górka, S side of a limestone excavation, initial xer. gras., (80), 50°10'18"N, 19°27'18"E, 350 m, leg. Ł. Krajewski, 24.08.2010 (KTC), [Trzebionka, Górka] (Urbisz 2004a); **58** – Ojców, Wąwóz do Groty, leg. S. Michalik, 16.05.1960 (KRAM, 456146); Brama Będkowska: Lyczki, Łazy (Kosiński 1992), vid. R. Piwowarczyk 2012; **65** – Libiąż, Góra Grodzisko hill, SE slope, xer. gras., (>50), leg. T. Kowalczyk, 31.05.2008 (KRA), (Babczyńska-Sendek 2000, unpubl., US; Grzybowska 2001, unpubl., US; Kowalczyk 2012); **69** – Cracow-Pychowice, Górka Pychowicka hill, n. road, leg. A. Żmuda, 10.06.1908 (KRAM, 061505, 061507); hill SW of Cracow-Pychowice, in a gras. on a slope, leg. H. Trzcińska-Tacik, 29.05.1967 (KRAM, 386089); Górka Pychowicka hill, foothill, xer. gras., fringes, scrub, fresh meadow, (<250), 50°01'47.8"N, 19°52'39"E, 50°01'49.5"N, 19°52'34.1"E, vid. W. Heise, 2009, 22.05.2010, 22.06.2010, 2011; Cracow-Zakrzówek, Skały Twardowskiego rocks, xer. gras. above old flooded limestone quarry (20), 50°02'21"N, 19°54'47"E, vid. Ł. Krajewski, 01.06.2011, vid. W. Heise, 02.06.2011; Cracow-Bonarka, hill above cemetery, leg. A. Żmuda, 17.06.1908 (KRAM, 061504); Cracow-Krzemionki, leg. A. Żmuda, 06.1906 (KRAM, 061506); **79** – Cracow, Łagiewniki/Wola Duchacka, leg. I. Król, 06.06.1917 (KRAM, 202489; **EE: 72** – Gajówka, N of Milechowy village, NW part of the Grzęby Bolmińskie hills, xer. gras. n. roadsides (green trail) (>5), 50°49'39,7"N, 20°20'00"E, 286 m, vid. M. Podsiedlik, 07.2009, (Piwowarczyk 2012a); Gałęzice (E. Bróż, 1993, unpubl., ATPOL); **82** – Grzęby Bolmińskie hills, N and NEE of Bolmin, xer. gras. and scrubs, (<100), 50°48'34.25"N, 20°21'56.09"E, 287 m, 50°49'12.26"N, 20°20'51.60"E, 306 m, leg. R. Piwowarczyk, 2008 (KTC), (Piwowarczyk 2012a); Grzęby Bolmińskie, N of Bolmin, xer. gras., leg. G. Łazarski, 28.05.2011 (KRA); Jacłów n. Karsznica, xer. gras. and thermophilous scrubs on a mid-field escarpment (>50), 50°45'58.6"N, 20°20'29.2"E, 227 m, leg. R. Piwowarczyk, 10.06.2008 (KTC), (Piwowarczyk 2012a); Działki n. Bizorenda, dry gras. (Łazarski 2011); bounds near the Bizorenda-Szczepanów road (Piwowarski 2011); **83** – Góra Rzepka res., SW of Chęciny, xer. gras. and scrubs (<100), 50°47'55.75"N, 20°26'53.74"E, 326 m, leg. R. Piwowarczyk, 06.2003, 14.06.2007 (KTC), (Piwowarczyk 2012a); Zelejowa Mt, N of Chęciny, xer. gras. and scrubs (>50), 50°48'57.91"N, 20°27'44.05"E, 311 m, vid. R. Piwowarczyk, 2008, (Piwowarczyk 2012a); Sosnówka Mt., NWW of Chęciny, xer. gras. (>100), 50°48'22.74"N, 20°26'01.68"E, 296 m, leg. R. Piwowarczyk, 05.2006 (KTC), (Piwowarczyk 2012a); NE of Korzecko, hill SW of Sosnówka Mt, leg. G. Łazarski, 24.05.2011 (KRA); Podzamcze n. Chęciny, xer. gras. on a hill, on the SE forest margin, between a dirt road to the Chęciny castle and buildings in the Podzamcze village (>20), 50°46'59.77"N, 20°27'25.68"E, 235 m, leg. R. Piwowarczyk, 08.06.2006 (KTC), (Piwowarczyk 2012a); Polichno n. Chęciny, xer. gras., *Thalictro-Salvietum pratenis*, leg. J. Łuszczyński, 20.06.2012 (KTC); Sitkówka-Nowiny, xer. gras. on the Berberysówka Mt, leg. D. Molendowska, 11.08.1986 (KTC), vid. R. Piwowarczyk, 2006, (Piwowarczyk 2012a); Podwole n. Morawica, E of the Nidzki Forest, vid. M. Podsiedlik, 2008, phot., (Piwowarczyk 2012a); W part of Brzeziny n. Morawica, xer. scrub, leg. G. Łazarski, 29.05.2013 (KRA); Podmoszcze n. Bolechowice, margins of a quarry, xer. gras. and scrub with *Juniperus communis*, (<100), 50°48'25.9"N, 20°29'57.3"E, 269 m, leg. R. Piwowarczyk, 05.10.2013 (KTC), (Piwowarczyk 2012a); **84** – Brzeziny, xer. gras. on the Stokowa Mt, SW exp. (>30), 50°46'02.2"N, 20°35'01.3"E, 267 m, leg. R. Piwowarczyk, 2008 (KTC), (Piwowarczyk 2012a); Morawicka Mt n. Morawica, xer. gras. and wastelands, NE part of the quarry edge (<50), 50°44'24"N, 20°36'43.87"E, 257 m, vid. R. Piwowarczyk, 2008, (Piwowarczyk 2012a); **94** – Dębska Wola n. Morawica, xer. gras. and wastelands adjacent to blackthorn scrubs, S exp. (>100), 50°42'49.2"N, 20°35'34.6"E, 292 m, leg. R. Piwowarczyk, 13.06.2009 (KTC), (Piwowarczyk 2012a); **EF: 04** – between Chomentówek and Sędziejowice, xer. gras. on hills known as the Lipna Mt and Śliwie, on both sides of the road (<300), 50°34'22.57"N, 20°39'45.91"E, 265 m, leg. R. Piwowarczyk, 08.06.2006, 06.06.2007 (KTC), vid. R. Piwowarczyk 2006-2014, (Piwowarczyk 2012a); between Sędziejowice and Gartatowice, xer. gras. on gypsum, on both sides of the road (<100), 50°34'34.25"N, 20°37'33.87"E, 237 m, leg. R. Piwowarczyk, 08.06.2006 (KTC), vid. R. Piwowarczyk 2006-2013, (Piwowarczyk 2012a); **13** – Skowronno res. n. Skowronno Dolne, xer. gras., wastelands (<200), 50°32'53"N, 20°29'07"E, 217 m, vid. R. Piwowarczyk, 2001-2013, leg. R. Piwowarczyk, 06.2006 (KTC), leg. Z. Stróżykowska, 10.09.2008 (KTC); (Piwowarczyk 2012a); [Skowronno Dolne, leg. Z. Głowacki, 25.06.1989, WSRP, 5166]; Pińczowskie Mts, NW of Pińczów, xer. gras. and scrubs, field margins (>20), 50°32'06"N, 20°31'06"E, 246 m, leg. R. Piwowarczyk, 2010, 2013

(KTC), (Piwowarczyk 2012a); [Pińczów, grassland on a xerothermic hill, leg. M. Mazur, 07.08.1980 (KRA, 105036)]; Polana Polichno res., W of Młodzawy Duże, xer. gras. and thermo-scrubs (<300), 50°28'01.9"N, 20°28'16.7"E, 50°28'01.6"N, 20°28'15.5"E, 243 m, 50°28'02.8"N, 20°28'01.7"E, 50°28'01.9"N, 20°28'06.7"E, vid. R. Piwowarczyk, 2002-2013, leg. R. Piwowarczyk, 02.06.2007, 29.06.2009, 01.07.2010 (KTC), (Piwowarczyk 2012a); [in a glade known as Polichno, app. 3 km W of Młodzawy, leg. J. Mądalski, 01.06.1966 (KRAM, 494801); Polana Polichno, 3 km W of Młodzawy, leg. M. Ciaciura, 01.06.1966 (KRAM, 356934); xer. scrubs on chalky rendzina in the Polana Polichno res., leg. M. Halewska (KTC, 004094), (Bróż & Przemyski 1989]; **14** – Pasturka n. Pinczów, xer. gras., ecotone zones of xer. gras. and alfalfa fields, also in an alfalfa cultivation (>100), 50°30'35.79"N, 20°33'35"E, 220 m, vid. R. Piwowarczyk, 1999-2013, leg. R. Piwowarczyk, 10.06.2008, 04.06.2009 (KTC), (Piwowarczyk 2012a); Wełecz n. Busko Zdrój, S-facing xer. gras. on a hill by a hardened road from Wełcz towards Siesławice (<50), 50°28'14.92"N, 20°41'12"E, 261 m, leg. R. Piwowarczyk, 21.07.2006 (KTC), vid. R. Piwowarczyk 2006-2013, (Piwowarczyk 2012a); **15** – between Szaniec and Zwierzyniec, xer. gras. on slopes (>200), 50°30'43.88"N, 20°42'04"E, 250 m, leg. R. Piwowarczyk, 18.08.2006 (KTC), (Piwowarczyk 2012a); Łagiewniki n. Busko Zdrój, S and SW-facing xer. gras. (Zimne Wody res.) (<30), 50°28'58.72"N, 20°44'00"E, 254 m, vid. R. Piwowarczyk, A. Przemyski, 2006, leg. R. Piwowarczyk, 22.06.2006 (KTC), (Piwowarczyk 2012a); Czarownica Mt n. Żerniki Górne, xer. gras. (<50), 50°27'31.7"N, 20°47'01"E, 264 m, leg. R. Piwowarczyk, 28.08.2008 (KTC), (Piwowarczyk 2012a); [Żerniki, Busko Zdrój distr., on chalky slopes, leg. A. Jasiewicz, 16.06.1957 (KRAM, 413638, 413637)]; **23** – Chroberskie Forests, scrubs on the forest margin, leg. ?, det. M. Kucowa, 1915-1916 (KRAM, 206795); **25** – Ostra Mt ecological site, S of Pęczelice, xer. gras., S-facing wastelands and field margins (>100), 50°26'35.46"N, 20°47'06"E, 240 m, leg. R. Piwowarczyk, 28.08.2008 (KTC), vid. R. Piwowarczyk, 2008-2013, (Piwowarczyk 2012a); [Orla Mt n. Żerniki (probably a misspelling mistake, correctly the Ostra Mt), leg. B. Brzyski, 06.06.1957 (KRAM, 274022)]; 6 km before Busko Zdrój, a Miocene hill with steppe flora, immediately by the road, leg. K. Kostrakiewicz, 06.06.1957 (KRAM, 262240); Przęślin res. n. Chotel Czerwony, xer. gras. (>100), 50°22'41.87"N, 20°42'59"E, 188 m, leg. R. Piwowarczyk, 15.07.2006 (KTC), (Piwowarczyk 2012a), vid. A. Trojecka, 2013, [Chotel Czerwony res., leg. S. Chrościelewska, 18.06.1934 (WA, 018861=28382); gypsum rock in the Czerwony Chotel res., app. 0.2 km E of the Chotel Czerwony village n. Busko Zdrój, leg. J. Mądalski, 03.06.1966 (KRAM, 494780, 494802; KTC, 002995)]; **26** – between Kików and Sułkowice, xer. gras. on a former limestone excavation pit, n. Kamienna Góra (>20), 50°25'05.51"N, 20°51'24"E, 268 m, 50°25'04"N, 20°51'38"E, 287 m, leg. R. Piwowarczyk, 28.05.2008 (KTC), vid. R. Piwowarczyk 2008-2013, (Piwowarczyk 2012a); Piestrzec, roadside of a hardened dirt road, leg. K. Brońska, 2008 (KTC), (Piwowarczyk 2012a); **30** – Jaksice, loess ravine, leg. A. Kozłowska, 17.07.19?? (KRAM, 242018); **31** – Opalonki res., N of Stara Wieś n. Klonów, ecotone zone of xer. gras. and a field (>5), 50°20'58.9"N, 20°10'39"E, 333 m, vid. R. Piwowarczyk, 2008, (Piwowarczyk 2012a); **35** – Górki n. Szczerbaków, xer. gras. on S, SW and SE-facing hills on gypsum in the central part of a fish pond complex (<50), 50°20'51"N, 20°43'54"E, 174 m, 50°20'55"N, 20°44'01"E, 179 m, vid. R. Piwowarczyk, 2007, 2013 (KTC), (Piwowarczyk 2012a); Góry Wschodnie res. n. Chotel Czerwony, xer. gras. (>20), vid. R. Piwowarczyk, 2008, (Piwowarczyk 2012a); **41** – Piotrkowice Wielkie, xer. gras. on the slope of the Szreniawa river, leg. n. Towpasz, 01.06.1996 (KRA); Łubinówka n. Bejsce, baulk, leg. K. Towpasz, 19.06.2001 (KRA); Kaczkowice n. Kazimierza Wielka, leg. K. Towpasz, 21.06.1999 (KRA), (Towpasz 2006); **FE: 13** – Wzgórza Włostowickie, leg. F. Berdau, 06.18?? (WA, 018923=28442); Bochotnica, xer. gras. and scrub on a calcareous escarpment, ca. 150 m NE of school building (>30), 51°20'28"N, 21°59'52"E, leg. P. Chmielewski, R. Piwowarczyk, 23.08.2008 (KTC), (Piwowarczyk *et al.* 2011); **19** – Trębaczów n. Łęczna Lublin distr., sunny loess slope, leg. D. Fijałkowski, 30.05.1959 (LBL); **23** – Kazimierz Dolny, high bank of the Vistula, leg. Cinger, 05.06.1905 (LBL); leg. prof. Sławiński, 15.06.1951 (BIL, 1718), (Kucharczyk 2001); scrub on a sunny slope, leg. D. Fijałkowski, 12.07.1948 (LBL); leg. M. Rejewski, 24.06.1968 (TRN); Męćmierz, xer. gras. and fallow fields on a hill, ca. 300 m SW of the village buildings (>30), 51°18'25"N, 21°54'28"E, leg. P. Chmielewski, R. Piwowarczyk, 23.08.2008 (KTC), vid. M. Podsiedlik, 15.08.2013, (Piwowarczyk 2012b; Piwowarczyk *et al.* 2011); Dobre, xer. gras. and a fallow field on the S side of the Kazimierz Dolny – Dobre road, ca. 0.5 km from the village buildings (>5), 51°16'08"N, 21°54'34"E, leg. P. Chmielewski, R. Piwowarczyk, 23.08.2008 (KTC), (Piwowarczyk *et al.* 2011); **50** – Ulów res. n. Bałtów, thermophilous fringe communities on the margin of an oak-hornbeam forest (forest sec. 401), over 50 m S of the Bałtów-Lemierze road (>10), 51°00'06"N, 21°31'55"E, 182 m, leg. B. Maciejczak, 2007 (KTC); vid. R. Piwowarczyk, 2007, (Piwowarczyk 2010, 2012a); **52** – S and SE part of Dorotka village, xer. gras. and scrubs by a field road to Wesołówka village (<200), 50°59'56"N, 21°47'11"E, 170 m, vid. R. Piwowarczyk, 2000-2008, leg. R. Piwowarczyk, 01.06.2002, 18.06.2006 (KTC), (Piwowarczyk 2010, 2012a, Piwowarczyk *et al.* 2011); **60** – 350 m S of the S border of Stoki Duże village, a SW-facing mid-field xer. gras., on the E side of a field road to Ruda Kościelna (>200), 50°56'57"N, 21°33'36"E, 163 m, leg. R. Piwowarczyk, 04.07.2004, 21.06.2005 (KTC), vid. R. Piwowarczyk, 2009, 2012 (Piwowarczyk 2010, 2012a); **62** – NE part of Wesołówka village, towards Sulejów. *O. lutea* is scattered here and forms over ten populations; in total over 400 specimens grow in xer. gras., wastelands, thermophilous scrubs, margins of fields and roadsides (Piwowarczyk 2006, 2010, 2012a; Piwowarczyk *et al.* 2011), 50°58'49"N, 21°47'47"E; 50°58'56"N, 47°38'73"E; 50°58'27"N, 21°47'48"E, 170 m, leg. R. Piwowarczyk, 13.07.2004, 17.06.2006 (KTC), vid. R. Piwowarczyk, 1999-2013; Biedrzychów, margin of a wasteland and scrubs, on S-facing chalky rendzina, N of the road to Lasocin (>10), 50°54'05.91"N, 21°47'13.67"E, 186 m, leg. R. Piwowarczyk, 2008 (KTC), (Piwowarczyk 2012a, Piwowarczyk *et al.* 2011); **68** – Nowy Dwór, fallow fields, roadsides, fringe communities and fragmentary patches of xer. gras. on the "Biała Góra" slopes, ca. 1.5 km N of the village (>100), 50°53'07"N, 22°40'13"E; 50°53'15"N, 22°40'20"E; 50°53'09"N, 22°39'59"E, leg. P. Chmielewski, R. Piwowarczyk, 11.07.2008 (KTC) (Piwowarczyk 2012c; Piwowarczyk *et al.* 2011); Biała Góra n. Tomaszów, leg. F. Błoński, 07.1890 (WA, 018867=28393); **69** – Guzówka,

fringe communities on the margin of a forest complex, ca. 0.5 km N of the village (>10), 50°52'16"N, 22°42'31"E, vid. P. Chmielewski, R. Piwowarczyk, 11.07.2008, (Piwowarczyk *et al.* 2011); **72** – Bandocha hills, S of Lasocin, overgrowing SW-facing xer. gras. (>5), 50°53'14"N, 21°45'08"E, 165 m, vid. R. Piwowarczyk, 2001 (KTC), (Piwowarczyk 2010, 2012a,b); **73** – Wymysłów, pastures and fallow fields on a hillside, ca. 350 m E of the village (>50), 50°50'45"N, 21°55'21"E, vid. P. Chmielewski, 08.05.2009, (Piwowarczyk *et al.* 2011); Opoka Wielka n. Annopol, sunny slopes on the Sanna v., leg. D. Fijałkowski, 20.05.1959 (LBL); Opoka n. Annopol on the Vistula, xer. gras. on a chalky slope, leg. M. Kucharczyk, 26.06.1980 (LBL); **79** – Elizówka, midfield initial gras. and xer. scrub on a hillside, ca. 0.5 km of the village buildings (>50), 50°51'35"N, 22°44'11"E; 50°51'16"N, 22°44'02"E, vid. P. Chmielewski, R. Piwowarczyk, 11.07.2008, (Piwowarczyk *et al.* 2011); Żabno, one population in a xer. gras. in a limestone excavation pit, by the Żabno – Żółkiewka road, ca. 0.5 km of the village (>15), the other ca. 1 km SE of the first, in a midfield xer. gras. (>20), 50°51'38"N, 22°47'03"E; 50°51'04"N, 22°47'28"E, leg. P. Chmielewski, R. Piwowarczyk, 09.06.2007 (KTC), (Piwowarczyk *et al.* 2011); **82** – Dwikozy, leg. R. Kobendza, 05.1930 (WA, 018871=28385); xer. gras. N of the stadium, leg. G. Worobiec, 17.06.1991 (KRAM, 403485), vid. R. Piwowarczyk, 2006, 2012, 2014 (Piwowarczyk 2012a, Piwowarczyk *et al.* 2011); Panieńska Góra ecological site, Słupcza n. Dwikozy, S-facing slope of the Vistula v., xer. gras., on loess, belonging to *Sisymbrio-Stipetum capillatae* association (20-100), 50°44'47"N, 21°47'54.3"E, 160 m, leg. R. Piwowarczyk, 06.06.2008 (KTC), vid. R. Piwowarczyk 2008-2014 (Piwowarczyk 2012a, Piwowarczyk *et al.* 2011); **92** – Sandomierz, ravines, leg. R. Kobendza, 05.1930 (WA, 018873=28383); **FF: 99** – Góra Wapielnica hill (Lipnik), on rendzina in Helicha fortifications, leg. M. Wolanin, 12.07.2010 (KRA); **FG: 09** – Kopystno, dry grassland by a forest road, leg. M. Wolanin, 22.07.2009 (KRA); Brzozowiec (Pogórze Leskie), gras. transforming into fresh meadow, 49°25'N, 22°11'E, 498 m, leg. T. Kowalczyk, 07.06.2012 (KRA); **37** – Myczkowce n. Olszanica, slope on the San v., vid. M. Szewczyk, 07.06.2012, phot., (Zemanek 1989); **GE: 13** – Tarnów in Chełmskie province, on baulks of clay fields, leg. K. Łapczyński, (probably before 1892) (WA, 018864=28390); **33** – Zawadówka n. Chełm, a hill surrounded by a marl peat bog in the „Torfowisko Sobowice" reserve, ca. 0.5 km W of the village (<15), 51°07'02"N, 23°23'09"E, leg. J. Wójciak, R. Piwowarczyk, 12.07.2008 (KTC), (Piwowarczyk *et al.* 2011); **34** – Wolwinów – fringe communities and roadsides on the edge of a forest complex in the „Wolwinów" res. (>20), 51°06'46"N, 23°30'41"E, leg. R. Piwowarczyk, P. Chmielewski, 08.06.2007 (KTC), (Piwowarczyk *et al.* 2011); **45** – Żmudź, initial xer. gras. and scrub in the „Żmudź" res., ca. 0.5 km W of Kolonia Żmudź (>200), 51°00'33"N, 23°40'26"E, leg. R. Piwowarczyk, P. Chmielewski, 08.06.2007 (KTC), (Piwowarczyk *et al.* 2011); Wólka Leszczańska, a xer. gras. between the „Żmudź" res. and Wólka Leszczańska (>15), 51°00'40"N, 23°39'09"E, leg. P. Chmielewski, R. Piwowarczyk, 08.06.2007 (KTC), (Piwowarczyk *et al.* 2011); **54** – Nowy Folwark, xer. gras., ca. 1.5 km E of the village (>5), 50°57'36"N, 23°29'26"E, vid. P. Chmielewski, 17.07.2009, phot. (Piwowarczyk *et al.* 2011); **55** – Leszczany n. Chełm, loess slopes, leg. H. Miszczyk, 11.06.1958 (LBL); Kolonia Leszczany, thermophilous juniper scrub and fringe communities near the forest complex growing on the W slope of the Kurawica hill (<50), 51°00'17"N, 23°35'44"E, leg. A. Cwener, P. Chmielewski, R. Piwowarczyk, 13.07.2007 (KTC), (Piwowarczyk *et al.* 2011); Kolonia Wygnańce, roadside in N part, in a juniper scrub complex (>10), 50°58'13"N, 23°36'14"E, vid. P. Chmielewski, 2008, (Piwowarczyk *et al.* 2011); Turowiec, initial xer. gras. and juniper scrub, ca. 1.5 km N of the cemetery near Turowiec – Popówka villages (<5), 50°58'03"N, 23°38'10"E, vid. P. Chmielewski, 25.04.2009, (Piwowarczyk *et al.* 2011); Maziarnia, forested complex of xer. gras. and scrub, ca. 300 m S of the village (>10), 50°58'31"N, 23°39'20"E, vid. P. Chmielewski, 04.07.2009, (Piwowarczyk *et al.* 2011); **55/56** – Kolonia Teresin – fallow fields and gras. on a vast hill, ca. 0.5 km S of the village (>20), 50°59'21"N, 23°41'58"E; 50°59'04"N, 23°41'09"E; 50°58'48"N, 23°42'00"E, leg. P. Chmielewski, 2007, (Piwowarczyk *et al.* 2011); **61** – Wirkowice n. Izbica, scrubs of a chalky slope, leg. D. Fijałkowski, 03.06.1958 (LBL); Bryczówki near Wirkowice, xer. gras. near a closed limestone quarry (>50), 50°52'56"N, 23°03'03"E, vid. R. Piwowarczyk, W. Michalczuk, 15.07.2006, (Piwowarczyk *et al.* 2011); **65** – Białowody, a xer. gras. on a hillside, ca. 400 m E of the Grabowiec – Uchanie road (>10), 50°52'34"N, 23°36'52"E, vid. P. Chmielewski, 2008, phot., (Piwowarczyk *et al.* 2011); Gliniska, xer. gras. and *Prunus spinosa* scrub in the „Gliniska" reserve and on the calcareous slope of the Kalinówka river (<50), 50°51'30"N, 23°38'12"E; 50°51'22"N, 23°38'04"E, vid. P. Chmielewski, 2008, (Piwowarczyk *et al.* 2011); **71** – Kolonia Staw Noakowski, xer. gras. on the slope of the Wieprz v., ca. 0.5 km SE of the village (>100), 50°49'48"N, 23°04'11"E, vid. W. Michalczuk, 09.08.2006, phot., (Piwowarczyk *et al.* 2011); **72** – Chomęciska Małe, xer. gras., fallow fields and alfalfa cultivation on a hillside, ca. 0.5 km SE of the village (>30), 50°48'25"N, 23°12'44"E, leg. P. Chmielewski, R. Piwowarczyk, 09.06.2007 (KTC), (Piwowarczyk *et al.* 2011); **74** – Hajowniki, a degraded xer. gras. on the loess slope of the Wolica river v., on the S side of the Skierbieszów – Grabowiec road, ca. 1 km before village buildings in Hajowniki (>20), 50°50'16"N, 23°25'50"E, vid. P. Chmielewski, 10.05.2008, (Piwowarczyk *et al.* 2011); Kolonia Łaziska – degraded xer. gras. on a S- and SW-facing hillside, ca. 400 m E of the village (>10), 50°48'42"N, 23°24'00", leg. A. Cwener, 29.07.2006 (LBL), (Piwowarczyk *et al.* 2011); **75** – Korytyna n. Grabowiec, slopes of a chalky slope, leg. D. Fijałkowski, 18.06.1973 (LBL); **77** – Czumów n. Hrubieszów, loess slopes, leg. D. Fijałkowski, 18.07.1956 (LBL); **81** – Klemensów n. Zamość, calcareous slopes, leg. D. Fijałkowski, 22.06.1955 (LBL); Dziewicza Góra n. Klemensów, Zamość distr., xer. slopes, leg. H. Piotrowska, 04.06.1957 (POZ); hill n. the Dziewicza Góra, in the vicinity of Zwierzyniec, leg. Exc.Inst.Bot.U.P, 28.06.1952 (POZ); Niedzieliska, sunny chalky slope, leg. D. Fijałkowski, 18.06.1959 (KRA, 0236231; LBL); xer. gras. and thermophilous scrub with an abundant occurrence of juniper on a midfield hill, ca. 0.5 km S of the village (>30), 50°41'32"N, 23°04'23"E, vid. P. Chmielewski, A. Cwener, W. Michalczuk, 09.10.2008, phot., (Piwowarczyk *et al.* 2011); **82** – Kąty II n. Zamość, oak forest on chalk, leg. D. Fijałkowski, 29.06.1951 (KRA, 0236229); in xer. gras. *Inuletum ensifoliae*, on chalky rendzina, leg. J. Wójcicki, 30.06.1981 (KRAM, 404324), (Piwowarczyk *et al.* 2011); pine forest on humic chalky rendzina, D. Fijałkowski,

05.07.1959 (LBL); xer. gras. on a midfield hill known as the Wieprzecka Góra Mt, near a dirt road from Wymysłówka village to Wychody (>100), 50°40’22”N, 23°07’32”E, leg. R. Piwowarczyk, W. Michalczuk, P. Chmielewski, 2006 (KTC), 02.06.2005, leg. A. Cwener, 2007 (LBL), vid. R. Piwowarczyk 2006, 2009, 2011, (Piwowarczyk 2012b,c; Piwowarczyk *et al.* 2011); Zwierzyniec (Łęczyński), midfield glades, leg. B. Gustawicz, s.d. (KRAM, 092527); **91** – Kosobudy, xer. scrub on a hillside, ca. 500 m S of the village (<5), 50°37’26”N, 23°05’49”E, vid. P. Chmielewski, 2008, phot., (Piwowarczyk *et al.* 2011); **95** – Kozia Wola near Wożuczyn**,** a xer. gras. on the slope of a water course valley flowing into the Rachanka river, ca. 1 km NW of village buildings (>15), 50°34’41”N, 23°32’46”E, vid. P. Chmielewski, 2007, phot., (Piwowarczyk *et al.* 2011); **96** – Dobużek n. Łaszczów, calcareous slope with a thin loess layer, leg. K. Izdebski, 02.06.1957 (LBL); Dobużek, xer. grasslands in the “Skarpa Dobużańska” res. ca. 1 km NW of the village, on a steep slope of the Huczwa river v., on chalky rendzina and chernozems (>200), 50°34’49”N, 23°42’44”E, leg. P. Chmielewski, R. Piwowarczyk, 2008 (KTC), (Piwowarczyk *et al.* 2011); **GF: 04** – Huta Tarnawacka**,** a fringe community on the S border of a small forest complex located ca. 300 m N of village buildings (>10), 50°32’06”N, 23°27’23”E, leg. P. Chmielewski, 2006, (Piwowarczyk *et al.* 2011); Przecinka, xer. gras., roadsides and fringe communities on the forest edge, ca. 300 m N of the W border of the Justynówka village (>30), 50°29’15”N, 23°28’23”E, vid. P. Chmielewski, 2007, (Piwowarczyk *et al.* 2011); Huta Dzierążyńska, xer. gras. on the W-facing slope of the „Borowina” midfield hill, ca. 3 km SE of the village (>20), 50°33’32”N, 23°25’34”E, leg. P. Chmielewski, R. Piwowarczyk, 15.07.2006 (KTC), (Piwowarczyk *et al.* 2011); **14** – Majdanek, xer. gras. and fringe communities on the S- and SW-facing slope of the „Biała Góra” ecological site, between Majdan Górny and Justynówka villages (>100), 50°28’39”N, 23°28’35”E, leg. P. Chmielewski, R. Piwowarczyk, 13.07.2006 (KTC), (Piwowarczyk *et al.* 2011); Ruda Wołoska, xer. gras. on the W- and SW-facing „Borowa Góra” slope, ca. 2 km NE of the village (>200), 50°26’29”N, 23°29’56”E, vid. P. Chmielewski, 2008, (Piwowarczyk *et al.* 2011); **15** – Przewłoka, fringe communities in a midforest glade in a small forest complex, ca. 2 km S of the village (>10), 50°26’20”N, 23°32’40”E, leg. P. Chmielewski, R. Piwowarczyk, 13.07.2008 (KTC), (Piwowarczyk *et al.* 2011); Kolonia Jarczów I, a fallow field in the W part of the village, by the road running S towards Kolonia Korhynie (>10), 50°26’15”N, 23°33’49”E, leg. P. Chmielewski, R. Piwowarczyk, 13.07.2008 (KTC), (Piwowarczyk *et al.* 2011); Kolonia Jarczów II, xer. gras. and alfalfa cultivations on the SW forest edge, ca. 1 km S of the village (>100), 50°24’13”N, 23°32’58”E, leg. P. Chmielewski, R. Piwowarczyk, 12.07.2008 (KTC), (Piwowarczyk *et al.* 2011); Korhynie, one population is located near the exit from the village, by the road towards Jarczów near a roadside shrine; the other population is located in the “Korhynie” ecological site, on the calcareous slope of the Sołokija river v. in a xer. gras. (>100), 50°24’15”N, 23°32’37”E; 50°24’35”N, 23°32’26”E, vid. P. Chmielewski, 2008, (Piwowarczyk *et al.* 2011); Żurawce, xer. gras. on the slope of the Sołokija v., in the „Żurawce” ecological site (>100), 50°23’43”N, 23°33’15”E, vid. P. Chmielewski, R. Piwowarczyk, 2007, (Piwowarczyk 2012c; Piwowarczyk *et al.* 2011); Przeorsk, xer. gras. on the „Łysa Góra” slopes, on the S edge of the „Klimowice” forest, also on roadsides on chalky rendzina between Przeorsk and a former Przeorsk state farm (>150), 50°25’26”N, 23°30’47”E; 50°25’13”N, 23°30’57”E; 50°25’48”N, 23°31’06”E, leg. P. Chmielewski, R. Piwowarczyk, 09.06.2007 (KTC), (Piwowarczyk *et al.* 2011); **25** – Machnów Stary, xer. gras. in the Machnowska Góra res. (>100), 50°22’05”N, 23°35’14”E, leg. P. Chmielewski, R. Piwowarczyk, 09.06.2007 (KTC), (Piwowarczyk *et al.* 2011); **90** – Przemyśl, on rendzina of the Wzniesienie fortifications, xer. gras., leg. M. Wolanin, 05.06.2009 (KRA); Pikulice, xer. gras., leg. M. Wolanin, 10.06.2009, 31.05.2010 (KRA).

Appendix 2. List of doubtful or requiring confirmation localities of *Orobanche lutea* in Poland based on the literature reports (Symbols and abbreviations: see Appendix 1)

AC: 06 – Stary Przylep (Głazek 1971); **12** – Widuchowa (Holzfuss 1931, after ATPOL); **67** – Wieprzyce (Libbert 1930, after ATPOL); **99** – Poznań: Międzyrzecz [Meseritz] (Ascherson & Graebner 1898/99; Decker 1911); **BC: 31** – Jezioro Rolewiec, Rolewiec (Potonié 1884); **45** – Ciszkowo n. Czarnkowa [Czarnikau: Ciszkowo] (Straehler 1893, after ATPOL; Ascherson & Graebner 1898/99); **BE: 07** – Trzcinica Wołowska, Wołów distr. [Gr.-Strenz] (Fiek 1881, Schube 1903); **15** – Konary, Wińsko com., Wołów distr., baulks [Kunern unweit Winzig, Feldrainen] (Uechtritz 1877), [Kuhnern] (Fiek 1881, Schube 1903); **25** – Gliniany n. Libiąż [Gleinau] (Schube 1903); **88** – Piotrowice n. Strzelin [Peterwitz] (Schube 1903); **89** – Strzelin, Niemcza (Schube 1903); **CA**: **87** – Lapalice [Lappalitz] (Abromeit *et al.* 1898 after Schnee 25.6.76. Herb. Regim.; Abromeit *et al.* 1903); **99** – Pręgowo (Klinggräff 1848, after ATPOL); **CB: 27** – Chwarzno n. Kościerzyna [Berent: Chwarsznau (Trieichel)] (Scholz 1896; Abromeit *et al.* 1898, f. *pallens*; Ascherson & Graebner 1898; Preuss 1912); **53** – Chojnice (Haub 1847); **99** – Chełmno (Wacker 1862); **CC: 39** – Gajtowo (n. Cierpice) (Spribille 1888; Scholz 1896); **CE: 95** – Opole, apophyte of xer. gras., (Szczotkowski, 1988, after Michalak 1970, 1971); Opole, Maurycy hill (currently cement plant) [Oppeln, Moritzberg] (Fiek 1881, Schube 1903); Opole-Śródmieście N, railway embankment close to Opole Wschodnie old railway station and ditch along Oleska street (Michalak 1970); Opole-Zakrzów, railway embankment close to Luboszycka street (Michalak 1970); **96** – Opole, Kępa [Kempa] (Schube 1903); **CF**: **06** – Kosorowice [Kossorowitz] (Fiek 1881, Schube 1903, Nowak & Nowak 2002); **15** – Zimnice Wielkie, Opole distr. [Gr. Schimnitz] (Fiek 1881, Schube 1903); Krapkowice-Otmęt [Krappitz: Ottmuth] (Fiek 1881, Schube 1903); Droszkowice n. Gogolin (Babczyńska-Sendek 1998, unpubl., US; Babczyńska-Sendek 2005); **16** – Tarnów Opolski S (Schube 1903, Nowak *et. al.* 2000, unpubl. US); Zakrzów, Gogolin distr. (Nowak & Nowak 2000/2002, unpubl., US); **17** – Szymiszów, Strzelce Opolskie distr. [Schimischow] (Fiek 1887, Schube 1903, Kobierski 1974); Kalinowice, Strzelce Opolskie com. [Kalinowitz] (Fiek 1881, Schube 1903); **18** – Strzelce Opolskie (Kobierski 1974); **25** – Żywocice, Krapkowice distr. (Schube 1925); **26** – Żyrowa n. Leśnica [Leschnitz: Zyrowa] (Schube 1925); **DB: 81** – between a grove in the Grudziądz fortress and the Vistula bank (Scholz 1896); Grudziądz (Klinggräff 1854); Grudziądz, fortress slopes (Ascherson & Graebner 1898; Preuss 1912); **DC: 18** – Klonowo, Lidzbark (Abromeit *et al.* 1911); **DE: 84** – Mirów, Babiak hill (Hereźniak *et al*. 1973); Przymiłowice-Kotysów (Hereźniak *et al.* 2001); Hektary N (Urbisz 2004a); **86** – Julianka, quarry (Hereźniak *et al.* 2001); Krasice (Urbisz 2004a); **90** – Lubecko [Lubetzko] (Schube 1903); Lubliniec (Schube 1903); **94** – Wojnówka Chorońska (Urbisz 2004a), **95** – SW of Złoty Potok (Urbisz 2004a); Pustkowie Przybynowskie (Urbisz 2004a); **96** – Janów (Urbisz 2004a); Złoty Potok S, Parkowe res., car park by the springs (Urbisz 2004a); **DF: 03** – Woźniki NW, hill 340 with Woźniki-Ligota Woźnicka road (Góra Floriańska/Dolnica) [Floriansberg] (Schube 1903); **06** – Rzędkowice, Skały Rzędkowickie rocks (Urbisz 2004a; probably confused with *O*. *bartlingii*); **10** – Wielowieś, Gliwice distr. (Schube 1930, Schalow 1934); **21** – Miedary-Kopanina, Płonowskie Góry Mts (Kobierski 1974); **22** – Tarnowskie Góry Mts (Schube 1904); Orzech, Świerklaniec com. (Schube 1903, maybe confused with *O*. *elatior*); **23** – Myszkowice and Celiny (Nowak 1999, probably confused with *O*. *kochii*); Łubianki n. Siemonia, Góra Korzystna hill (Nowak 1999, confused with *O*. *kochii*); Twardowice (Nowak 1999); Najdziszów (Nowak 1999); Rogoźnik (Nowak 1999); Toporowice W (Nowak 1999); **24** – between Zawarpie and Kuźnica Świętojańska (Nowak 1999, probably confused with *O*. *kochii*); between Podwarpie and Glinianki (Nowak 1999, probably confused with *O*. *alsatica*); S of Siewierz, Tuliszów and Chmielowskie (Nowak 1999; confused with *O*. *kochii*); Warężyn E (Nowak 1999); **27** – Podzamcze (Dyrga 1994, Urbisz 2004a, probably confused with *O*. *bartlingii*) [summit rocks near the „Ogrodzieniec" castle in Podzamcze] (Mączyński 2010; confused with *O*. *bartlingii*, phot.); between Wierbka and Sławniów (Babczyńska-Sendek *et al*. 2011); **32** – Bytom [Beuthen] (Schube 1904); Piekary Śląskie-Szarlej [Scharley] (Schube 1903, probably confused with *O*. *kochii*); Piekary Śląskie-Brzeziny [Wojkowice-Brzeziny] (Babczyńska-Sendek 1993, unpubl., US; Nowak 1997, unpubl., US; Babczyńska-Sendek 2005); **33** – Wojkowice-Żychcice (Nowak 1999, confused with *O*. *kochii*); Rogoźnik SW (Babczyńska-Sendek *et al.* 2012) [between Rogoźnik and Wojkowice] (Nowak 1999); Będzin-Grodziec, Góra św. Doroty hill (Nowak 1999, confused with *O*. *kochii*); **35** – DG-Łęka N (Nowak 1999); **36** – Laski (Bednarz 1993, unpubl., US); **37** – Kolbark SE (Urbisz 2004a, probably confused with *O*. *elatior*); **46** – Bukowno, Tłukienka and Wygiełza (Nowak 1997, unpubl., US); **47** – Olkusz, E part (Nowak 1997, unpubl., US); Sieniczno (Urbisz 2004a); **48** – Skała W, Grodzisko (Urbisz 2004a, probably confused with *O*. *bartlingii*); **53** – Lędziny-Blich, hill with St. Clement's church (Fiek 1892, Schube 1904, confused with *O*. *elatior* s. l.), [Berun: Clemensberg] (Schube 1903); **55** – Jaworzno-Bory, and to W, SW (Chmiel 1993, unpubl., US; Babczyńska-Sendek 1996, unpubl., US; Babczyńska-Sendek 2005); Chrzanów-Kąty (Babczyńska-Sendek 1992, unpubl., US; Chmiel 1993, unpubl., US; Babczyńska-Sendek 2005); **56** – Myślachowice N (Urbisz 2004a); Płoki (Urbisz 2004a); Trzebinia-Siersza S (Urbisz 2004a); Chrzanów E (Chmiel 1993, unpubl., US); **58** – Ojców S, Prądnik Ojcowski (Urbisz 2004a); Wąwóz Korytania (Michalik 1978); Będkowice N (Urbisz 2004a); Dolina Będkowska v., S part (Urbisz 2004a); **63** – Bieruń Stary (Schube 1904); **64** – Bieruń Nowy (Schube 1904); **68** – Aleksandrowice W (Urbisz 2004a); **69** – Cracow-Podgórze (Berdau 1859); **91** – Harbutowice n. Skoczów (Ciaciura 1971); **DG: 59** – cfr. Zakopane-Krzeptówki, leg. I. Król, 01.06.1898 (KRAM, 092529); **ED: 27** – Wygoda n. Warsaw (Rostafiński 1872); **EE: 17** – Radom (Rostafiński 1872 after Jastrzębowski); **EF: 76** – Wielka Wieś, Panieńska Góra hill (Pacyna 2004); Wielka Góra hill (Złota) (Pacyna 2004); **85** – Faliszewice (Pacyna 2004); **EG: 23** – Padoły, between Maszkowice and Jazowsko (Rams 1998, after ATPOL); **FG: 16** – Trepcza (Zemanek 1981); **69** – Pacołowa Mt, SE, meadow (Zemanek & Winnicki 1999); **GF: 90** – Jaksmanice; between Jaksmanice and Rożubowice; between Łuczyce and Rożubowice, SW Rożubowice (on the Wiar) (Paul 2013).