

Microfungi of the Tatra Mts. 6. Fungus-like organisms: Albuginales, Peronosporales and Pythiales

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Mułenko W., Kozłowska M., Bacigálová K., Świdierska-Burek U., Wołczańska A.: *Microfungi of the Tatra Mts. 6. Fungus-like organisms: Albuginales, Peronosporales and Pythiales*. Acta Mycol. 49 (1): 3–21, 2014.

A list and the distribution of Oomycota species in the Tatra Mts (Western Carpathian Mts) are presented. Revised herbarium vouchers and literature data were used for analysis. Thirty two species of oomycetes on fifty seven plant species were noted in the area, including two species of the order Albuginales (genera: *Albugo* and *Pustula*, on nine plant species), 29 species of the order Peronosporales (genera: *Bremia*, *Hyaloperonospora*, *Peronospora* and *Plasmopara*, on 49 plant species), and one species of the order Pythiales (genus: *Myzocyttium*, on one species of algae). Twenty nine species were collected on the Polish side of the Tatra Mts and ten species were collected on the Slovak side. The oomycetes were collected at 185 localities.

Key words: microfungi, distribution, Oomycota, Western Carpathians, Poland, Slovakia

INTRODUCTION

The phylum Oomycota is a small group of approximately 1 000 species (Kirk et al. 2008), including aquatic and terrestrial, parasitic and saprobic fungus-like organisms which cause numerous plant diseases. Peronosporales, which mainly consists of obligatory parasites of vascular plants, is the largest order in the phylum. Three families were previously distinguished in this order: the *Albuginaceae*, *Peronosporaceae* and *Pythiaceae* (Kochman, Majewski 1970). However, modern taxonomy classifies them as three separate orders: Albuginales, Peronosporales and Pythiales (Kirk et al. 2008).

Species of these orders that are economically important as causative agents of considerable losses in cultivated crops are well recognized and described. Many studies on these organisms are important taxonomic monographs comprising the

entire order Peronosporales (in the former classification) (Kochman, Majewski 1974) or smaller taxonomic units [e.g. Plaats-Niterink (1981); Saharan et al. (1997)]. Much less is known about the diversity and abundance of these species in natural conditions, on plants growing in the wild. Only a few systematic studies of this group are identified in the Polish mycosociological literature spanning a period of over 50 years of research (Ławrynowicz et al. 2004). Downy mildews in alpine conditions were either not included in these studies or were investigated only sporadically.

The massif of the Tatra Mts is one of the most interesting alpine regions in central Europe and is almost entirely contained within national parks in Poland (TPN, Tatrzański Park Narodowy) and in Slovakia (TANAP, Tatranský Národný Park). It was declared a UNESCO Biosphere Reserve in 1992. While floristic, ecological, geological, hydrological and other research has been successfully conducted in the Tatra Mts (Vološčuk 1994; Mirek et al. 1996), detailed mycological investigations have not been carried out in the region. The geobotanical differentiation and the richness of plant species that are potential hosts of fungi in the region are high, and it can be expected that many interesting species of fungi and oomycetes, can occur in the area.

Results of studies to date indicate that microfungi in the Tatra Mts are poorly recognized. In-depth information on their ecology and distribution is not available and data are sometimes random. Consequently, information concerning the actual spread of fungi is highly differentiated and the data from individual areas of the Tatra Mts are considerably deficient. The majority of studies published so far are simple species lists or brief notes on a particularly interesting or rare species. Due to the lack of easy access to the area, analytical studies are undertaken infrequently (e.g. Urban 1952; Bacigálová et al. 2005; Mułenko et al. 2006, 2008). A similar problem is observed in other mountainous regions in Europe and worldwide.

The aim of our study was to summarize the existing literature data on the Oomycota occurring throughout the Tatra massif within the two national parks. More extensive research can be based on our results in the future. A similar study was carried out for representatives of the order Taphrinales in the mid-2000s (Bacigálová et al. 2005).

The present paper is part of the series named *Parasitic Microfungi of the Tatra Mts*. Five studies have been published to date: representatives of the order Taphrinales (Bacigálová et al. 2005), *Pseudocercospora tetrensis* (Mułenko, Bacigálová 2005), *Spermosporina gymnadeniae* (Wołczańska et al. 2008), *Melampsorium hiratsukanum* (Mułenko et al. 2005) and the *Plasmopara* spp. on the members of the genus *Geranium* (Mułenko et al. 2008). As only biotrophic species infect living plant organs and a considerable part of the collection are fungi occurring on decaying or dead organs (facultative parasites, facultative saprophytes), the word “parasitic” will now be omitted in the series title. Although this paper does not concern true fungi we left the name “microfungi” in the title of the series, because oomycetes are only a small part of all microorganisms which are published in this series.

HISTORY OF THE RESEARCH: AN OUTLINE

Research into microfungi in the Tatra Mts goes back to the end of the 19th century when Hazslinszky (1864) published a list of fungi collected in this area. The first information on downy mildews can be found in a study by Krupa (1886) and refers to *Albugo candida* on *Arabis alpina* on the Polish side of the Tatra Mts. In 1888 Krupa expanded the list of hosts by further four species: *Arabis soyeri* subsp. *subcoriacea*, *Cardaminopsis halleri*, *Hutchinsia alpina* and *Kerneria saxatilis*. Data on oomycetes were published at the beginning of the 20th century by Rouppert (1912), Wróblewski (1918, 1920, 1922a, 1922b, 1925) and Szulczewski (1930). The above-mentioned works included lists of species occurring on the Polish side of Tatra Mts. However, Wróblewski collected fungi on both sides of the border and was the first to publish information on microfungi in the Slovak part of the Tatra Mts. Further research in this region was carried out by Moesz (1930) and Picbauer (1933).

Mainly the Oomycota occurring on the Polish side of the Tatra Mts were discussed in the literature in the second half of the 20th century: Starmachowa (1963), Kućmierz (1968), Kochman & Majewski (1970), Sałata et al. (1984), Romaszewska-Sałata et al. (1986), and Mułenko et al. (1995). A species parasitizing algae, *Myzocyttium megastomum* on *Closterium lunula*, was reported in 1999 (Kadłubowska 1999). Only two studies investigating the Slovak side of the Tatra Mts were published in that period (Müller 1980, Skalický 1983).

Investigations in the Tatra National Park (TPN, TANAP) intensified in the late 20th and early 21st centuries. Results of studies conducted jointly with the Slovak Academy of Science (SAV) in the entire region of the Tatra Mts were first reported. For example, a detailed analysis of *Plasmopara* spp. on the members of *Geranium* was conducted by Mułenko et al. (2008). Specimens from the Tatra Mts were also examined during research into *Plasmopara praetermissa*, a species new to science (Voglmayr et al. 2006).

Both original results and summative studies have been reported in the literature. The first list of fungi of the Tatra Mts dates from the early 20th century and can be found in a study on the fungi and slime moulds of two historical regions: Galicia and Bukovina (Namysłowski 1914). However, a monograph by Starmachowa (1963) is the first synthesis of microfungi. It comprises the entire Tatra Massif, i.e. both the Polish and the Slovak sides. The monograph was the main source of microfungi-related information for over thirty years until the late 20th century.

An extensive discussion of the results of mycological research conducted in the Polish Tatra Mts was given in a monograph on the Tatra National Park (TPN, PL) (Sałata, Mułenko 1996). However, a list of species was not included due to both popular and scientific focus of the study. A full list of fungi and fungus-like organisms, considerably extended in comparison with the study by Starmachowa (1963), was published in 2004 (Mułenko et al.). A similar study for the Slovak part of the National Park was completed by Bacigálová (1999).

MATERIAL AND METHODS

The list of species was based on literature reports published in the last 128 years. The oldest publications did not always contain detailed data. Some records were given in very general terms and only information that a species had been found in the Tatra Mts was reported while the location, site or study area were not indicated and the Polish or Slovakian part of the region was not specified.

Some of the specimens listed in this work have not survived. The majority, however, are deposited in the herbaria in Poland (KRA and KRAM in Kraków, WAUF in Warsaw, LBL in Lublin) and in Slovakia (SAV in Bratislava) (acronyms according to Holmgren et al. 1990). In some cases information from exsiccatum labels was used, which was not published previously. Wherever possible, we provided the habitat of the oomycetes listed.

RESULTS

Since 1886 a total of 32 species belonging to the Oomycota have been collected in the Tatra National Park. They are representatives of three orders: Albuginales (two species), Peronosporales (29 species) and Pythiales (one species). The fungus-like organisms were collected on 56 species of vascular plants and on one species of algae (Tab. 1).

The number of reported species is not very high and oomycetes are underexplored in the Tatra Mts. Mycosociological research in Poland to date shows that the abundance of the species of the Oomycota is greater, not only in considerably smaller regions but also in less floristically diversified areas. Majewski (1967) collected 58 species in the Puszcza Kampinowska forest, Kućmierz (1973) collected 59 species in

Table 1
General distribution of the oomycete in the Tatra Mts according to number of localities for each species

Species	Host plant	Slovakia number of localities				Poland number of localities			Total number
		ZT	VT	BT	WI	TZ	TW	WI	
Albuginales									
<i>Albugo candida</i>	<i>Arabis alpina</i>		1	2		7			10
	<i>Arabis soyeri</i> subsp. <i>subcoriacea</i>					1			1
	<i>Biscutella laevigata</i>			1		3			4
	<i>Capsella bursa-pastoris</i>					1			1
	<i>Cardaminopsis arenosa</i>			1		3			4
	<i>Cardaminopsis halleri</i>					3			3
	<i>Hutchinsia alpina</i>					2			2
	<i>Kernera saxatilis</i>					1			1
<i>Pustula tragopogonis</i>	<i>Cirsium palustre</i>						1	1	
			1	4		21		1	27

Table 1 – cont.

Peronosporales							
<i>Bremia lactucae</i>	<i>Carlina acaulis</i>					3	3
	<i>Cicerbita alpina</i>					1	1
	<i>Cirsium erisithales</i>					1	1
	<i>Crepis paludosa</i>					1	1
	<i>Hieracium aurantiacum</i>					1	1
	<i>Hieracium murorum</i>					1	1
	<i>Hieracium vulgatum</i>	1		1	6		8
	<i>Senecio subalpinus</i>				5		5
	<i>Senecio vulgaris</i>				1		1
	<i>Taraxacum officinale</i>				1		1
<i>Hyaloperonospora arabidis-alpinae</i>	<i>Arabis alpina</i>					1	1
<i>Hyaloperonospora cardaminopsidis</i>	<i>Cardaminopsis arenosa</i>					1	1
<i>Hyaloperonospora lunariae</i>	<i>Lunaria rediviva</i>					3	3
<i>Hyaloperonospora parasitica</i>	<i>Cardamine amara</i>					1	1
	<i>Cardamine trifolia</i>					1	1
<i>Peronospora alpicola</i>	<i>Ranunculus plataniifolius</i>					3	3
<i>Peronospora alta</i>	<i>Plantago major</i>					7	7
<i>Peronospora boni-henrici</i>	<i>Chenopodium bonus-henricus</i>					3	3
<i>Peronospora conferta</i>	<i>Cerastium fontanum</i>					2	2
	<i>Cerastium holosteoides</i>					2	2
	<i>Cerastium tatrae</i>					1	1
<i>Peronospora debaryi</i>	<i>Urtica urens</i>					1	1
<i>Peronospora erysimi</i>	<i>Erysimum hieraciifolium</i>	1					1
<i>Peronospora galii</i>	<i>Galium anisophyllum</i>					1	1
	<i>Galium schultesii</i>					3	3
<i>Peronospora grisea</i>	<i>Veronica beccabunga</i>					1	1
	<i>Veronica serpyllifolia</i>					1	1
<i>Peronospora knautiae</i>	<i>Scabiosa lucida</i>					3	3
<i>Peronospora mayorii</i>	<i>Vicia cracca</i>	1					1
<i>Peronospora myosotidis</i>	<i>Myosotis palustris</i>					1	1
<i>Peronospora phyteumatis</i>	<i>Phyteuma spicatum</i>					2	2
<i>Peronospora potentillae</i>	<i>Potentilla aurea</i>	2				8	10
<i>Peronospora ranunculi</i>	<i>Ranunculus oreophilus</i>					1	1
	<i>Ranunculus repens</i>					3	3
<i>Peronospora rumicis</i>	<i>Rumex acetosa</i>					2	2
	<i>Rumex acetosella</i>					1	1
	<i>Rumex alpestris</i>					1	1
<i>Peronospora septentrionalis</i>	<i>Cerastium cerastoides</i>		1				1
<i>Peronospora sordida</i>	<i>Scrophularia scopoli</i>					3	3
<i>Peronospora trifoliorum</i>	<i>Lathyrus pratensis</i>					1	1
	<i>Trifolium repens</i>					1	1
<i>Peronospora violae</i>	<i>Viola biflora</i>					1	1
<i>Plasmopara densa</i>	<i>Rhinanthus serotinus</i>					1	1
<i>Plasmopara geranii-silvatici</i>	<i>Geranium palustre</i>	1					1
	<i>Geranium pratense</i>			1		1	2
	<i>Geranium sylvaticum</i>	11	6	5		19	41
	<i>Geranium sp.</i>			1		1	2

Table 1 – cont.

<i>Plasmopara nivea</i>	<i>Aegopodium podagraria</i>					2			2			
	<i>Anthriscus sylvestris</i>					1			1			
	<i>Mutellina purpurea</i>		1				1		2			
<i>Plasmopara praetermissa</i>	<i>Geranium sylvaticum</i>	2	2	2			1		7			
	<i>Geranium</i> sp.					1			1			
<i>Plasmopara pusilla</i>	<i>Geranium pratense</i>		5			1			6			
	<i>Geranium sylvaticum</i>		1			2			3			
		14	20	10	1	104	8		157			
Pythiales												
<i>Myzocyttium megastomum</i>	<i>Closterium lunula</i>					1			1			
						1			1			
Number of species		Number of host plants			Total number of localities							
32		57			14	21	14	1	126	8	1	185

Denotations: **ZT** – Zápádne Tatry Mts (SK); **VT** – Vysoké Tatry Mts (SK); **BT** – Belianské Tatry Mts (SK); **TZ** – Tatry Zachodnie Mts (PL); **TW** – Tatry Wysokie Mts (PL); *Wl* – without precise localization

the Ojców National Park and 73 species in the Pieniny Mts (Kućmierz 1977). Similar investigations were carried out in the Bug river valley and in the Polesie National Park, from which 85 species (Daniliewicz 1987) and 55 species (Mułenko 1988 a, b) were reported respectively. In other areas, however, a smaller number of oomycetes was noted. For instance, 36 species were recorded in the Białowieża National Park (Majewski 1971), 31 species in the Słowiński National Park (Adamska 2001), and 36 species in the Jura Krakowsko-Częstochowska upland (Ruszkiewicz-Michalska 2006).

As an analysis of the list of downy mildews in the Tatra Mts shows, the current state of knowledge of them varies considerably in Poland and Slovakia. The majority of species were reported from the Polish side of the Tatra Mts (29) while only ten were noted on the Slovak side (Tab. 2). The numbers of species found in individual parts of the Tatra Mts are highly divergent. The greatest numbers of fungus-like organisms were collected in the Western Tatras – 26 species. All of them (26 species) were recorded on the Polish side and only two on the Slovak side. Thirteen species were reported in the High Tatra Mts, including nine in Slovakia and six in Poland. Two of them (*Plasmopara nivea* and *Plasmopara praetermissa*) are common to both countries. Four species were recorded in the Belianské Tatry Mts, including one (*Peronospora septentrionalis*) that is known only from this region.

The spread of oomycetes, as measured by the number of existing localities, varies considerably. In total, fungus-like organisms were recorded at 185 localities. As

Table 2
Number of oomycete species in particular regions of Tatra Mts
(denotations see Table 1)

Slovakia				Poland		
ZT	VT	BT	<i>Wl</i>	TZ	TW	<i>Wl</i>
2	9	4	1	26	6	1
Total number of species: 10				Total number of species: 29		

many as 135 records (73%) were noted on the Polish side of the Tatra Mts and 126 (68%) were found in the Western Tatra Mts. Oomycetes were noted at 50 localities on the Slovak side (27%), mainly in the Vysoké Tatry Mts (21 records). The number of localities is the same in the remaining regions (Západné Tatry Mts and Belianské Tatry Mts; 14 in each) (Tab. 1).

Polyphagous species were recorded more frequently. They occurred sporadically on individual hosts. The most frequent combinations were: *Albugo candida*/*Arabis alpina* and *Peronospora potentillae*/*Potentilla aurea* (10 records each), *Bremia lactucae*/*Hieracium vulgatum* (8 records) and *Peronospora alta*/*Plantago major* (7 records). Of the above-mentioned species, only species of the genus *Plasmopara* occurring on *Geranium* spp. have been examined in greater depth in the last few years and the research data have been published (Mułenko et al. 2008). The species were found at 63 localities: 26 in the Polish and 37 in the Slovak part of the Tatra Mts. The study provides the only relatively objective results on the research into the spread of fungus-like organisms in the region available to date. There is a great need for further intensive and systematic research in the area.

LIST OF OOMYCOTA

Arrangement: The list of species is organized alphabetically by order name (Albuginales, Peronosporales, Pythiales) and by species name within the orders. Host plant species are listed alphabetically. Names of species of oomycetes are in bold. Names of doubtful species are not given in bold (see below).

Notes: Explanations are placed in two ways. If a note refers to a particular plant species (or an oomycete on this plant), it is placed at the end of the paragraph relating to the plant. If a note refers to a particular oomycete species (regardless of the host), it is placed as an independent paragraph below the list of host plants.

Doubtful species: Some species of oomycetes and of plants may be doubtful or may have been reported incorrectly. To retain the information given in the literature, names of such species are given in full but a note or a reference is added. Neither the name of an oomycete species nor the name of the plant is given in bold in such instances.

Names of oomycetes: Names of oomycetes are given after Kochman & Majewski (1970), Constantinescu (1991), Thines & Spring (2005), and Index Fungorum (<http://www.indexfungorum.org>). Old names of oomycetes are given for some species, that is the names under which they were previously published, while some of them are not synonymous. Only the names cited in studies regarding this region are given in the synonyms.

Names of plants: Names of host plants are given after Mirek et al. (2002) and Marhold & Hindak (1998). In some plant species their synonyms or their old names, under which they were published previously, are given. Only the names cited in studies referring to the Tatra Mts were used.

Division of the Tatra Mts: The entire Tatra Mts system is divided into regions differentiated on both sides of the Tatra: Western Tatra Mts – Tatry Zachodnie (PL) and Západné Tatry Mts (SK). Eastern Tatra Mts – Tatry Vysokie (PL), Vysoké Tatry Mts (SK) and Belianské Tatry Mts (SK). The respective regions of the Tatra Mts follow local names used on Tatra Mts tourist maps no. 112 and no. 113 (1:50,000), published by Vojensky kartograficky ustav (Harmanec, Slovakia, 1992-1996) and “*Wielka Encyklopedia Tatrzanska*” (Radwańska-Paryska & Paryski 2004).

Abbreviations: TNP – Tatra National Park; PL – Polish side of the Tatra Mts; SK – Slovak side of the Tatra Mts; V-X – collection months.

Literature sources and citations: Not all the authors mentioned in the section “History of the research: an outline” provided data on their own collections. Many authors cited previously published information. This method is a common practice, particularly in the preparation of taxonomic or synthetic studies. However, the list of authors may be wrongly identified with a number of known locations in this way. Thus the original data source is given for each species in this study, whereas citations are provided separately and placed as supplementary information below the description of the locality.

OOMYCOTA

ALBUGINALES

Albugo candida (Pers.) Roussel [*Cystopus candidus* (Pers.) Lév.]

- *Arabis alpina* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Strażyska valley; VII-VIII (Krupa 1886, 1888; Rouppert 1912; Starmachowa 1963). Dolina Kościeliska valley; VII-IX (Krupa 1888; Wróblewski 1918, 1922b). Dolina Mała Łąka valley; VIII-IX (Krupa 1888; Rouppert 1912). Dolina Białego valley; Mała Dolinka pod Giewontem valley; VII-VIII (Wróblewski 1922b). Przełęcz Iwaniacka pass; VII (Kućmierz 1968). Cited by Namysłowski (1914), Wróblewski (1920, 1925), Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004). **SK** – Vysoké Tatry Mts: Belanská kopa Mt. at alt. 1690 m (Moesz 1930). Belianské Tatry Mts: Kopské sedlo pass; Tatranská Javorina village (Picbauer 1933). Cited by Starmachowa (1963) and Bacigálová (1999).
- *Arabis soyeri* Reut. & A. Huet subsp. *subcoriacea* (Gren.) Breistr. (*Arabis bellidifolia* Jacq. non Crantz). **TNP: PL** – Tatry Zachodnie Mts: Hruby Regiel Mt. (Krupa 1888). Cited by Namysłowski (1914), Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004).
- *Biscutella laevigata* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Strażyska valley; Mały Giewont Mt.; VI-VII (Wróblewski 1922b). Mały Giewont Mt. at alt. 1650 m, limestone bedrock; VIII (Sałata et al. 1984). Cited by Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004). **SK** – Belianské Tatry Mts: Dolina Siedmich prameňov valley (Picbauer 1933). Cited by Starmachowa (1963) and Bacigálová (1999).
- *Capsella bursa-pastoris* (L.) Medik. **TNP: PL** – Tatry Zachodnie Mts: Dolina Kościeliska valley; VII, IX (Wróblewski 1918). Cited by Starmachowa (1963) and Mułenko et al. (2004).
- *Cardaminopsis arenosa* (L.) Hayek [*Arabis arenosa* (L.) Scop.]. **TNP: PL** – Tatry Zachodnie Mts: Dolina ku Dziurze valley (Szulczewski 1930). Dolina Białego valley at alt. 1000 m, calcareous plants; Mały Giewont Mt. at alt. 1650 m, limestone bedrock; VIII (Sałata et al. 1984). Cited by Starmachowa (1963) and Mułenko et al. (2004). **SK** – Belianské Tatry Mts: without localization at alt. 1320 m (?Bujačí vrch Mt.) (Moesz 1930). Cited by Starmachowa (1963) and Bacigálová [1999, incorrectly on *Arabis hirsuta* (L.) Scop.].
- *Cardaminopsis halleri* (L.) Hayek (*Arabis halleri* L.). **TNP: PL** – Tatry Zachodnie Mts: Kuźnice village (Krupa 1888). Dolina Strażyska valley; Dolina Kościeliska valley; VI, VIII (Wróblewski 1922b). Cited by Wróblewski (1920), Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004).
- *Hutchinsia alpina* (L.) R. Br. (*Lepidium alpinum* L.). **TNP: PL** – Tatry Zachodnie Mts: Dolina za Bramką valley (Krupa 1888). Mała Dolinka pod Giewontem valley; VII (Wróblewski 1922b). Cited by Namysłowski (1914), Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004).
- *Kernera saxatilis* (L.) Rchb. **TNP: PL** – Tatry Zachodnie Mts: Dolina Strażyska valley (Krupa 1888). Cited by Namysłowski (1914), Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004).

Pustula tragopogonis (Pers.) Thines [*Albugo tragopogonis* (DC.) Gray, *Cystopus tragopogonis* Schröt.]

- *Cirsium palustre* (L.) Scop. **TNP: PL** – Tatra Mts: without localization; VIII (Wróblewski 1922a, leg. J. Krupa, 1886). Cited by Starmachowa (1963) and Kochman & Majewski (1970).

NOTES: The herbarium collections need revision because this oomycete was treated as a collective species occurring on representatives of the family Asteraceae according to Kochman & Majewski (1970). This fungus-like organism can be divided into two species: *Pustula tragopogonis* and *Pustula spinulosa*.

PERONOSPORALES

Bremia lactucae Regel s.l.

- *Carduus personata* (L.) Jacq. NOTES: reported by Kochman & Majewski (1970) from Tatra Mts (without localization), however the collection was located in Zakopane town (WAUF, 01 Aug 1961, leg. J. Kochman).
- *Carlina acaulis* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Białego valley; Dolina Strążyska valley; Dolina za Bramką valley; VI (Wróblewski 1922b). Cited by Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004).
- *Carlina vulgaris* L. NOTES: Starmachowa (1963) and later Mułenko et al. (2004) wrongly reported presence of this oomycete at Toporowe Stawy lakes (PL) after Rouppert (1912). However, Rouppert (1912) did not mention this species. Similarly, Bacigálová (1999) reported the oomycete on this plant from Vysoké Tatry Mts (SK) after Picbauer (1933), however the latter author did not mention this information.
- *Cicerbita alpina* (L.) Wallr. **TNP: PL** – Tatry Zachodnie Mts: Ścieżka nad Regłami tourist route at alt. 1270 m, herbaceous plants; VIII (Romaszewska-Sałata et al. 1986). Cited by Mułenko et al. (2004).
- *Cirsium erisithales* (Jacq.) Scop. **TNP: PL** – Tatry Zachodnie Mts: Dolina Spadowiec valley at alt. 910 m, herbaceous plants; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004).
- *Crepis paludosa* (L.) Moench. **TNP: PL** – Tatry Zachodnie Mts: Dolina ku Dziurze valley at alt. 910 m, spruce forest with *Abies alba*; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004).
- *Hieracium aurantiacum* L. **TNP: PL** – Tatry Zachodnie Mts: Niznia Świstówka Mt. at alt. 1500 m, grassland; IX (Mułenko et al. 1995). Cited by Mułenko et al. (2004).
- *Hieracium murorum* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Białego valley at alt. 960 m, *Dentario glandulosae-Fagetum*; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004).
- *Hieracium vulgatum* Fr. **TNP: PL** – Tatry Zachodnie Mts: Dolina Olczyska valley at alt. 962 m; Dolina ku Dziurze valley at alt. 970 m; Dolina Strążyska valley at alt. 1020 m; Boczań Mt. at alt. 1150 m; Igła Mt. at alt. 1150 m; Czoła Jaworzyńskie hill at alt. 1160 m, spruce forest for all localities; VIII (Sałata et al. 1984). Cited by Mułenko et al. 2004. **SK** – Tatra Mts: without localization (Kochman & Majewski 1970). Vysoké Tatry Mts: Štrbské pleso lake (Picbauer 1933). Cited by Starmachowa (1963) and Bacigálová (1999). NOTES: The name of *Hieracium vulgatum* Fr. has not been changed because according to Mirek et

al. (2002) it can be a synonym for 2 different species: *Hieracium lachenalii* C.C. Gmel and *Hieracium laevicaule* Jord.

- *Senecio subalpinus* W. D. J. Koch. **TNP: PL** – Tatry Zachodnie Mts: Dolina Kościeliska valley [WAUF, 26 July 1961, leg. T. Majewski; reported by Kochman & Majewski (1970), without localization], Dolina Strążyska valley at alt. 900 m; Dolina ku Dziurze valley at alt. 920 m; Dolina Kościeliska valley (Stare Kościeliska) at alt. 940 m; Igła Mt. at alt. 1025 m, herbaceous plants for all localities; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004).
- *Senecio vulgaris* L. **TNP: PL** – Tatry Zachodnie Mts: Toporowe Stawy lakes; IX (Wróblewski 1918).
- *Taraxacum officinale* F. H. Wigg. **TNP: PL** – Tatry Zachodnie Mts: Dolina Kościeliska valley (KRAM, 10 Sept. 1966, leg. T. Majewski). Reported by Kochman & Majewski (1970) on *Taraxacum* sp., without localization. Cited by Mułenko et al. (2004).

Hyaloperonospora arabidis-alpinae (Gäum.) Göker, Riethm.; Voglmayr, Weiss & Oberw. [*Peronospora arabidis-alpinae* Gäum.]

- *Arabis alpina* L. **TNP: PL** – Tatry Zachodnie Mts: Ścieżka nad Reglami tourist route (near Zameczki rocks) at alt. 1200 m, damp alpine grassland (Mułenko et al. 1995). Cited by Sałata & Mułenko (1996) and Mułenko et al. (2004).

Hyaloperonospora cardaminopsidis (A. Gustavsson) Göker, Riethm. Voglmayr, Weiss & Oberw. [*Peronospora cardaminopsidis* A. Gustavson]

- *Cardaminopsis arenosa* (L.) Hayek. **TNP: PL** – Tatry Zachodnie Mts: Mały Giewont Mt. at alt. 1650 m, limestone bedrock; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004).

Hyaloperonospora lunariae (Gäum.) Constant. [*Peronospora lunariae* Gäum.]

- *Lunaria rediviva* L. **TNP: PL** – Tatry Zachodnie Mts: Wąwóz Kraków ravine at alt. 1030 m, herbaceous plants on limestone bedrock; VIII (Sałata et al. 1984) and 1000 m, scrub; VI-VIII (Mułenko et al. 1995). Dolina Kościeliska valley at alt. 980 m, *Dentario glandulosae-Fagetum*; VI-VIII (Mułenko et al. 1995). Cited by Sałata & Mułenko (1996) and Mułenko et al. (2004).

Hyaloperonospora parasitica (Pers.) Constant. [*Peronospora dentariae* Rabenh., *Peronospora parasitica* (Pers.) Fr.]

- *Cardamine amara* L. **TNP: PL** – Tatry Wysokie Mts: Włosienica glade at alt. 1320 m, streamside; VI (Mułenko et al. 1995). Cited by Mułenko et al. (2004).
- *Cardamine trifolia* L. **TNP: PL** – Tatry Zachodnie Mts: Igła Mt. at alt. 1080 m, spruce forest; VIII (Sałata et al. 1984). Cited by Sałata & Mułenko (1996) and Mułenko et al. (2004).

NOTES: The oomycete was also reported by Wróblewski (1922b) on *Hutchinsia alpina* (L.) R. Br. (*Lepidium alpinum* L.) and later cited by Starmachowa (1963). See notes on *Peronospora lepidii* (belove).

Peronospora alpicola Gäum. [*Peronospora ficariae* auct. p.p.]

- *Ranunculus platanifolius* L. **TNP: PL** – Tatry Wysokie Mts: near Wodogrzmoty Mickiewiczza waterfall; VII (Wróblewski 1922b). Morskie Oko lake at alt. 1405 m, herbaceous plants; surroundings of Czarny Staw Gąsienicowy lake at alt. 1610 m, herbaceous plants in *Pinetum mugo carpaticum*; VIII (Sałata et al. 1984). Cited by Starmachowa (1963), Kochman & Majewski (1970), Sałata & Mułenko (1996) and Mułenko et al. (2004).

? *Peronospora alsinearum* Casp. [*Peronospora media* Gäuman]. NOTES: The oomycete was reported on *Stellaria nemorum* L. from Dolina Mała Łąka valley (TNP, PL) by Wróblewski (1922b), and later cited by Starmachowa (1963). However, Kochman & Majewski (1970) did not find it in the herbarium specimen.

Peronospora alta Fuckel

- ***Plantago major*** L. TNP: PL – Tatry Zachodnie Mts: Dolina Chochołowska valley; VII (Kućmierz 1968). Dolina ku Dziurze valley at alt. 895 m; Dolina Białego valley at alt. 920 m; Dolina Kościeliska valley (Stare Kościeliska) at alt. 940 m; Dolina Olczyńska valley at alt. 980 m; Kuźnice village at alt. 1051 m; Boczań Mt. at alt. 1150 m, roadsides for all localities; VIII (Sałata et al. 1984). Cited by Sałata & Mułenko (1996) and Mułenko et al. (2004).

Peronospora boni-henrici Gäum. [*Peronospora effusa* auct. p.p.]

- ***Chenopodium bonus-henicus*** L. TNP: PL – Tatry Zachodnie Mts: Kuźnice village; VI (Wróblewski 1922b). and at alt. 1053 m, roadside; VIII (Sałata et al. 1984). Dolina Chochołowska valley; VII (Kućmierz 1968). Cited by Starmachowa (1963), Kućmierz (1968), Kochman & Majewski (1970) and Mułenko et al. (2004).

Peronospora conferta (Unger) Gäum. [*Peronospora alsinearum* auct. p.p.]

- ***Cerastium fontanum*** Baumg. TNP: PL – Tatry Zachodnie Mts: Kopa Królowa Mała Mt. at alt. 1455 m, herbaceous plants in *Pinetum mugo carpaticum*; Giewont Mt. at alt. 1850 m, calcareous grassland; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004).
- ***Cerastium holosteoides*** Fr. emend. Hyl. [*Cerastium fontanum* Baumg. subsp. *triviale* (Link) Jalas, *Cerastium vulgatum* L.]. TNP: PL – Tatry Zachodnie Mts: Dolina Jaworzynka valley at alt. 1080 m, grassland; Przełęcz między Kopami pass at alt. 1510 m, roadside; VI (Mułenko et al. 1995).
- ***Cerastium tatrae*** Borbás (*Cerastium raciborskii* Zapał.). TNP: PL – Tatry Zachodnie Mts: Mała Dolinka pod Giewontem valley; VII (Wróblewski 1922b). Cited by Starmachowa (1963), Kochman & Majewski (1970), Sałata & Mułenko (1996) and Mułenko et al. (2004).

Peronospora debaryi E. S. Salmon & Ware [*Peronospora urticae* (Lib.) de Bary]

- ***Urtica urens*** L. TNP: PL – Tatry Zachodnie Mts: Kuźnice village (Starmachowa 1963). Cited by Mułenko et al. (2004).

Peronospora erysimi Gäum.

- ***Erysimum hieraciifolium*** L. TNP: SK – Vysoké Tatry Mts: between Popradské pleso lake and Popradské pleso railway station at alt. 1400 m; VIII (Müller 1980). Cited by Bacigálová (1999, on *Erysimum marschallianum* Andr. ex M. Bieb.). NOTES: According to Marhold and Hindák (1998) *Erysimum hieraciifolium* L. is treated as a synonym of *Erysimum marschallianum* Andr. ex Bieb., however in the Polish literature (Mirek et al. 2002) the two species are treated separately. We cite the original record in this case.

Peronospora galii Fuckel

- ***Galium anisophyllum*** Vill. TNP: PL – Tatry Zachodnie Mts: Mały Giewont Mt. at alt. 1650 m, rock crevasse; VIII (Mułenko et al. 1995). Cited by Sałata & Mułenko (1996) and Mułenko et al. (2004).
- ***Galium schultesii*** Vest. TNP: PL – Tatry Zachodnie Mts: Wąwóz Kraków ravine at alt. 1018 m, spruce forest with *Abies alba*; Grzybowiec Mt. at alt. 1175 m, spruce

forest with *Abies alba*; VIII (Sałata et al. 1984). Dolina Białego valley at alt. 970 m, herbaceous plants; VI (Mułenko et al. 1995). Cited by Mułenko et al. (2004).

Peronospora grisea (Unger) de Bary

– *Veronica beccabunga* L. **TNP: PL** – Tatry Zachodnie Mts: Przełęcz Iwaniacka pass; VII (Kućmierz 1968). Cited by Mułenko et al. (2004).

– *Veronica serpyllifolia* L. **TNP: PL** – Tatry Wysokie Mts: Dolina Roztoki valley; VII (Wróblewski 1922b). Cited by Starmachowa (1963, as *Peronospora verna* Gäum.) and Mułenko et al. (2004).

? *Peronospora hiemalis* Gäum. NOTES: The species was noted on *Ranunculus lanuginosus* L. from Dolina Kościeliska valley (PL) by Wróblewski (1922b), and later cited by Starmachowa (1963) and Mułenko et al. (2004). However, Kochman & Majewski (1970) did not find it in the herbarium specimen.

Peronospora knautiae Fuckel

– *Scabiosa lucida* Vill. **TNP: PL** – Tatry Zachodnie Mts: Giewont Mt. – Suchy Żleb gully under Wrótkka pass at alt. 1380 m, calcareous grassland; VIII (Sałata et al. 1984). Hala Mała Łąka mountain pasture (Niżnia Świstówka – below Przełęcz Kondracka pass) at alt. 1500 m and 1600 m, alpine grassland; IX (Mułenko et al. 1995). Cited by Sałata & Mułenko (1996) and Mułenko et al. (2004).

? *Peronospora lepidii* (McAlp.) G. W. Wils. NOTES: The species was reported by Wróblewski (1922b, as *Peronospora parasitica*) on *Lepidium alpinum* L. [*Hutchinsia alpina* (L.) R. Br.] from Mała Dolinka pod Giewontem valley (PL). However, Kochman & Majewski (1970) did not find it in the herbarium specimen.

Peronospora mayorii Gäum.

– *Vicia cracca* L. **TNP: SK** – Vysoké Tatry Mts: Popradské pleso railway station at alt. 1280 m; VIII (Müller 1980). Cited by Bacigálová (1999).

Peronospora myosotidis de Bary

– *Myosotis palustris* (L.) L. emend. Rchb. (*Myosotis scorpioides* L.). **TNP: PL** – Tatry Wysokie Mts: Hala Gašienicowa mountain pasture at alt. 1530 m, herbaceous plants; VI (Mułenko et al. 1995). Cited by Mułenko et al. (2004).

Peronospora phyteumatis Fuckel

– *Phyteuma spicatum* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Białego valley at alt. 910 m, spruce forest with *Abies alba*; Dolina Spadowiec valley at alt. 915 m, spruce forest with *Abies alba*; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004).

Peronospora potentillae de Bary

– *Potentilla aurea* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Chochołowska valley; VII (Kućmierz 1968). Dolina Olczyska valley at alt. 950 m; Stara Polana glade at alt. 1060 m; Dolina Bystrej valley at alt. 1124 m; Czoła Jaworzyńskie hill at alt. 1195 m; Czerwona Przełęcz pass at alt. 1303 m; Giewont Mt. (Piekło) at alt. 1405 m; Kopa Magury Mt. at alt. 1560 m, grasslands for all localities; VIII (Sałata et al. 1984). Cited by Sałata & Mułenko (1996) and Mułenko et al. (2004). **SK** – Vysoké Tatry Mts: Mlynická dolina valley (near Štrbské pleso lake) at alt. 1350 m, spruce forest; VIII (Müller 1980). Bielovodská dolina valley; VII (Skalický 1983). Cited by Bacigálová (1999).

Peronospora ranunculi Gäum. [*Peronospora ficariae* auct. p.p.]

– *Ranunculus flammula* L. NOTES: reported by Kochman & Majewski (1970) from Tatra Mts after Wróblewski (1922b), however in the last paper it was located in Zakopane town.

- *Ranunculus lanuginosus* → see notes on *Peronospora hiemalis*.
- *Ranunculus oreophilus* M. Bieb. **TNP: PL** – Tatry Zachodnie Mts: Nosal Mt. at alt. 1150 m, alpine grassland; VI (Mułenko et al. 1995). Cited by Mułenko et al. (2004).
- *Ranunculus platanifolius* → see *Peronospora alpicola*.
- *Ranunculus repens* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Kościeliska valley; VIII (Wróblewski 1922b). Kuźnice village; Giewont Mt. – Suchy Żleb gully under Wrótko pass (Starmachowa 1963). Cited by Starmachowa (1963) and Mułenko et al. (2004).

***Peronospora rumicis* Corda**

- *Rumex acetosa* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Mała Łąka valley; VI (Wróblewski 1922b). Dolina Chochołowska valley; VII (Kućmierz 1968). Cited by Starmachowa (1963) and Mułenko et al. (2004).
- *Rumex acetosella* L. **TNP: PL** – Tatry Zachodnie Mts: Polana Chochołowska glade; VII (Kućmierz 1968). Cited by Mułenko et al. (2004, incorrectly reported after Starmachowa 1963 instead of Kućmierz l.c.).
- *Rumex alpestris* Jacq. (*Rumex arifolius* All.). **TNP: PL** – Tatry Zachodnie Mts: Mała Dolinka pod Giewontem valley; VIII (Wróblewski 1922b). Cited by Starmachowa (1963), Kochman & Majewski (1970), Sałata & Mułenko (1996) and Mułenko et al. (2004).

***Peronospora septentrionalis* Gäum.**

- *Cerastium cerastoides* (L.) Britton (*Cerastium trigynum* Vill.). **TNP: SK** – Belianské Tatry Mts: Kopské sedlo pass (Picbauer 1933). Cited by Starmachowa (1963) and Bacigálová [1999, on *Dichodon cerastoides* (L.) Rchb.].

***Peronospora sordida* Berk.**

- *Scrophularia scopoli* Hoppe. **TNP: PL** – Tatry Zachodnie Mts: Dolina Strążyska valley; Mała Dolinka pod Giewontem valley; Dolina Kościeliska valley; VI-VII (Wróblewski 1922b). Cited by Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004).

***Peronospora trifoliorum* de Bary [*Peronospora fulva* Syd.]**

- *Lathyrus pratensis* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Kościeliska valley (Stare Kościeliska) at alt. 960 m, meadow; VI (Mułenko et al. 1995). Cited by Mułenko et al. (2004).
- *Trifolium repens* L. **TNP: PL** – Tatry Zachodnie Mts: Kuźnice village at alt. 1051 m, roadside; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004).

***Peronospora violae* de Bary**

- *Viola biflora* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Strążyska valley; VI (Wróblewski 1922b). Cited by Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004).

***Plasmopara densa* (Rabenh.) J. Schröt.**

- *Rhinanthus serotinus* (Schönh.) Oborný [*Alectorolophus glaber* (Lam.) Beck]. **TNP: PL** – Tatry Zachodnie Mts: Polana Kalatówki mountain pasture (Starmachowa 1963). Cited by Mułenko et al. (2004).

***Plasmopara geranii-silvatici* Sävul. & O. Sävul.**

- *Geranium palustre* L. **TNP: SK** – Západné Tatry Mts: Jalovská dolina valley at alt. 740 m, roadside in spruce forest; VII (Mułenko et al. 2008).

- *Geranium pratense* L. **TNP: PL** – Tatry Zachodnie Mts: Polana Olczyńska glade at alt. 1050 m, meadow; VI (Mułenko et al. 1995, as *Plasmopara pusilla*). Cited by Mułenko et al. (2008). **SK** – Belianské Tatry Mts: Dolina Siedmich prameňov valley at alt. 900 m, roadside in spruce forest; VII (Mułenko et al. 2008).
 - *Geranium sylvaticum* L. **TNP: PL** – Tatry Zachodnie Mts: Polana Kalatówki mountain pasture at alt. 1225 m, herbaceous plants; VIII (Sařata et al. 1984, as *Plasmopara pusilla*). Dolina Olczyńska valley (Polana Olczyńska glade) at alt. 1059 m and 1115 m, meadow; Dolina Jaworzynka valley at alt. 1100 m, meadow; Dolina Miętusia valley at alt. 1120 m and 1180 m; Ścieżka nad Regłami tourist route (between Dolina Mała Łąka valley and Przysłop Miętusi pass) at alt. 1158 m, meadow; Przysłop Miętusi pass at alt. 1165 m, meadow; Dolina Kościeliska valley (between Ornak shelter house and Iwaniacka Przełęcz pass) at alt. 1220 m, herbaceous plants; tourist route between Przysłop Miętusi pass and Małołączniak Mt. at alt. 1342 m, 1362 m and 1394 m, spruce forest; Giewont Mt. – Suchy Źleb gully under Wrótka pass at alt. 1350 m, herbaceous plants on screen slope; Dolina Tomanowa valley at alt. 1351 m, spruce forest; Hala Miętusia mountain pasture at alt. 1410 m and 1470 m; Dolina Mała Łąka valley (between Hala Mała Łąka mountain pasture and Przełęcz Kondracka pass) at alt. 1450 m, herbaceous plants; Iwaniacka Przełęcz pass at alt. 1460 m, herbaceous plants; VI-VIII (Mułenko et al. 2008). Cited by Mułenko et al. (2008). **SK** – Západné Tatry Mts: Javorová dolina valley (near Tichá dolina valley) at alt. 1110 m, meadow; VIII (Voglmayr et al. 2006; Mułenko et al. 2008). Javorový Źlab gully (from the side of Tomanovská dolina valley) at alt. 1120 m; Roháčska dolina valley (blue tourist route to Spálena dolina valley) at alt. 1200 m; Kamenistá dolina valley at alt. 1200 m and 1340 m; Tichá dolina valley at alt. 1260 m; Tomanovská dolina valley at alt. 1260 m; Źiarska dolina valley (near Źiarska chata shelter house) at alt. 1289 m and 1320 m, herbaceous plants; between Źiarska chata shelter house and Malé Závraty cirque at alt. 1540 m, *Pinetum mughi carpaticum*; red tourist route between Pálenica and Sivý vrch Mt. at alt. 1640 m; VIII (Mułenko et al. 2008). Vysoké Tatry Mts: Tatranská Lomnica town at alt. 860 m; Dolina KeŹmarskej Bielej vody valley at alt. 920 m, roadside in spruce forest and 1090 m, spruce forest; Dolina Bielych Plies valley at alt. 1526 m, 1600 m and 1671 m, *Pinetum mughi carpaticum*; VII-IX (Mułenko et al. 2008). Belianské Tatry Mts: Dolina Siedmich prameňov valley (below chata Plesnivec shelter house) at alt. 1140 m and 1150 m, herbaceous plants; near chata Plesnivec shelter house at alt. 1270 m; Zadné Meďodoly valley at alt. 1400 m and 1410 m, herbaceous plants; VII-IX (Mułenko et al. 2008).
 - *Geranium* sp. **TNP: PL** – Tatry Zachodnie Mts: Ścieżka nad Regłami tourist route (between Dolina Mała Łąka valley and Dolina StraŹyńska valley) at alt. 1240 m; IX (Mułenko et al. 2008). **SK** – Belianské Tatry Mts: Monkova dolina valley at alt. 1650 m, mountain pasture, herbaceous plants; VIII (Mułenko et al. 2008).
- Plasmopara nivea* (Unger) J. Schröt. [*Plasmopara aegopodii* (Casp.) Trotter, *Plasmopara umbelliferarum* (Casp.) Schröt. ex Wartenw.]
- *Aegopodium podagraria* L. **TNP: PL** – Tatry Zachodnie Mts: Dolina Olczyńska valley (Starmachowa 1963). Dolina Chochołowska valley at alt. 1100 m, meadow; VII (Mułenko et al. 1995). Cited by Mułenko et al. (2004).

- *Anthriscus sylvestris* (L.) Hoffm. **TNP: PL** – Tatry Zachodnie Mts: Polana Olczyńska glade at alt. 1050 m, meadow; VI (Mułenko et al. 1995). Cited by Mułenko et al. (2004).
- *Mutellina purpurea* (Poir.) Thell. [*Ligusticum mutellina* (L.) Crantz., *Meum mutellina* (L.) Gaertn.]. **TNP: PL** – Tatry Wysokie Mts: Morskie Oko lake; VIII (Stec-Rouppertowa 1936). Cited by Starmachowa (1963), Kochman & Majewski (1970) and Mułenko et al. (2004). **SK** – Vysoké Tatry Mts: Temnosmrečinská dolina valley; VIII (Wróblewski 1922b). Cited by Starmachowa (1963) and Bacigálová (1999, incorrectly from Západné Tatry Mts).

NOTE: Information on the species was also cited in a paper by Sałata and Mułenko (1996).

Plasmopara praetermissa Voglmayr, Faethi & Constant.

- *Geranium sylvaticum* L. **TNP: PL** – Tatry Wysokie Mts: tourist route between Morskie Oko lake and Szpiglasowy Wierch Mt. at alt. 1600 m, *Pinetum mughi carpaticum*; IX (Mułenko et al. 2008). **SK** – Západné Tatry Mts: Zadná Tichá dolina valley at alt. 1520 m, *Pinetum mughi carpaticum*; VII (Voglmayr et al. 2006; Mułenko et al. 2008). Tichá dolina valley (tourist route to Kasprow vrch Mt.) at alt. 1265 m, meadow; VIII (Mułenko et al. 2008). Vysoké Tatry Mts: Dolina Bielych plies valley at alt. 1600 m, *Pinetum mughi carpaticum*; Zlomisková dolina valley at alt. 1640 m, herbaceous plants in *Pinetum mughi carpaticum*; VIII (Mułenko et al. 2008). Belianské Tatry Mts: Dolina Siedmich prameňov valley at alt. 1100 m; Zadné Meďodoly valley at alt. 1350 m, meadow; VII-VIII (Mułenko et al. 2008).
- *Geranium* sp. **TNP: PL** – Tatry Zachodnie Mts: Wielka Polana Małołacka glade at alt. 1161 m, meadow; VI (Mułenko et al. 2008).

Plasmopara pusilla (de Bary) J. Schröt.

- *Geranium pratense* L. **TNP: SK** – Vysoké Tatry Mts: Tatranská Lomnica town – Centre at alt. 860 m and park near hotel Morava at alt. 880 m and 900 m, roadside; Stará Lesná village – road between Academia hotel and Tatranská Lomnica town at alt. 800 m, roadside; Dolina Kežmarskej Bielej vody valley at alt. 1100 m; VII-VIII (Mułenko et al. 2008).
- *Geranium sylvaticum* L. **TNP: PL** – Tatry Zachodnie Mts: Giewont Mt. – Suchy Źleb gully under Wrótká pass at alt. 1385 m, herbaceous plants; VIII (Sałata et al. 1984). Cited by Mułenko et al. (2004). **SK** – Vysoké Tatry Mts: between Popradské pleso lake and Popradské pleso railway station at alt. 1380 m, spruce forest; VIII (Müller 1980). Cited by Bacigálová (1999).

NOTES: The herbarium specimen collected by Müller was not reidentified. The plant may have been infected by *Plasmopara geranii-sylvatici*. The data by Sałata et al. (1984: Suchy Źleb gully, see above) are doubtful. The specimen was not preserved. It is likely to be *Plasmopara geranii-sylvatici* Săvul. & O. Săvul. (Mułenko et al. 2008).

This species was also noted on *Geranium pratense* L. (Mułenko et al. 1995) and on *Geranium sylvaticum* L. (Sałata et al. 1984), and later cited by Mułenko et al. (2004). The specimens were reidentified and included in *Plasmopara geranii-sylvatici*.

PYTHIALES

Myzocyttium megastomum De Wild.

- *Closterium lunula* (Müller) Nitzsch. (Algae). TNP: PL – Tatr Zachodnie Mts: Dolina Gašienicowa valley – Toporowe Stawy lakes; IX (Kadłubowska 1999).

Acknowledgements. The study is part of two grants of the Polish Ministry of Science and Higher Education (PL): No 2/04C/089/27 and No N/N304/172436, and also by VEGA grant agency (SK): No. 2/4032/04.

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Grzyby mikroskopijne Tatr. 6. Organizmy grzybopodobne: Albuginales, Peronosporales i Pythiales

Streszczenie

Masyw Tatr, jeden z najciekawszych pod względem przyrodniczym regionów Europy Środkowej, został dość dobrze poznany pod wieloma względami, np. geologicznym, hydrologicznym, geobotanicznym, florystycznym. W dalszym ciągu jednak nie jest wystarczająco poznany pod względem mykologicznym, zwłaszcza w zakresie grzybów mikroskopijnych oraz organizmów grzybopodobnych. Trwające od kilku lat prace mające na celu podsumowanie dotychczasowego stanu zbadania tej grupy przyczyniły się do opublikowania kilku prac syntetyczno-analitycznych poświęconych kolejnym jednostkom taksonomicznym – rzędowi, rodzajowi czy gatunkowi.

W obecnej pracy przygotowano wykaz organizmów grzybopodobnych należących do trzech rzędów w obrębie typu Oomycota – Albuginales, Peronosporales oraz Pythiales, podawanych dotychczas w granicach parków narodowych obu części Tatr – polskiej i słowackiej. Zamieszczono w nim gatunki znane przede wszystkim z literatury, uzupełniając część informacji o dane szczegółowe pochodzące z kolekcji zielnikowych.

Pierwsze dane o organizmach grzybopodobnych Tatr pojawiły się pod koniec XIX wieku w pracach Krupy (1886, 1888). Do chwili obecnej, a więc przez okres ponad 120 lat, publikacje dotyczące Oomycota były jednak nieliczne, a informacje na temat ich występowania bardzo ogólne. Na całym obszarze Tatr stwierdzono dotychczas zaledwie 32 gatunki na 57 gatunkach roślin, w tym dwa gatunki z rzędu Albuginales (rodzaje: *Albugo* i *Pustula*, na 9 gatunkach roślin), 29 gatunków z rzędu Peronosporales (rodzaje: *Bremia*, *Hyaloperonospora*, *Peronospora* oraz *Plasmopara*, na 49 gatunkach roślin), a także jeden gatunek z rzędu Pythiales (rodzaj: *Mycocyttium*, na jednym gatunku glonu). Po polskiej stronie Tatr zebrano 29 gatunków, przy

czym aż 26 w Tatrach Zachodnich. Po słowackiej stronie Tatr zanotowano zaledwie 10 gatunków, z czego najwięcej – 9 w Tatrach Wysokich (Vysoké Tatry). Wszystkie zebrano na 185 stanowiskach, przy czym 135 przypada na Tatry polskie (73 %), w tym aż 126 na polskie Tatry Zachodnie. Z kolei po stronie słowackiej Tatr najwięcej danych pochodzi z Tatr Wysokich (21 stanowisk).

Stan znajomości Oomycota w Tatrach jest więc bardzo słaby, a informacje o ich rozmieszczeniu rozproszone, wręcz przypadkowe. W przyszłości niezbędne są badania znacznie bardziej intensywne, przede wszystkim systematyczne, a obecny syntetyczny wykaz może być punktem wyjścia do ich rozpoczęcia.