

PARASITIC MICROFUNGI OF THE TATRA MOUNTAINS. 1. TAPHRINALES

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Abstract. A list of species and the distribution of the members of Protomycetaceae and Taphrinaceae (Taphrinales, Ascomycota) in the Tatra Mts are given. Noted in the area were 20 species of fungi parasitizing 33 species of plants, including 4 species of the genus *Protomyces* Unger on 16 host plants, 3 species of the genus *Protomycopsis* Magn. on 4 species of host plants, and 13 species of the genus *Taphrina* Fr. on 14 species of host plant.

Key words: Protomycetaceae, Taphrinaceae, Ascomycota, Western Carpathians, Tatra Mts, Slovakia, Poland

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INTRODUCTION

Members of the Taphrinales are biotrophic fungi parasitizing ferns and higher plants. They are dimorphic organisms with a saprobic yeast stage and a parasitic mycelial stage on plant hosts, causing characteristic morphological changes on infected plants: hypertrophy and hyperplasia of the infected tissues usually result in the formation of distinct galls or swellings (Protomycetaceae), ‘leaf curl,’ ‘witches brooms,’ tongue-like outgrowths from female catkins, leaf spots or deformed fruits (Taphrinaceae). While the mycelial stage is strictly parasitic, the saprobic yeast stage can be cultivated on synthetic medium *in vitro*.

These fungi occur mostly in regions of the northern temperate zone associated with their host plants (Büren 1915, 1922; Mix 1949; Sałata 1974, 1979). These include well known and well described areas such as Scotland (Henderson 1956), Norway (Gjaerum 1964), Ukraine (Zerova 1969) and Bulgaria (Najdenov 1986). In Poland, Taphrinales were studied by Sałata (1974, 1979). In Slovakia they have very rarely been examined. The first records, going back to the end of the 19th century, are from the Štavnické vrchy Mts and were collected by Andrej Kmet’ (*Protomyces mac-*

rosporus Unger on *Aegopodium podagraria* L., Prenčöv, 12 Oct. 1886, *leg. A. Kmet’*, BRA), and later from the Spiš region, collected by Viktor Greshchik [*Taphrina alni* (Berk. & Broome) Gjaerum on *Alnus incana*, Levoča, Aug. 1928, *leg. V. Greshchik*, BRA]. Intense investigations began about 20 years ago, when a series of publications on the distribution, ecology and taxonomy of these fungi in Slovakia came out (Bacigálová 1991, 1992, 1994a, b, c, 1997; Bacigálová *et al.* 2003).

The findings in these cited studies indicate that mountainous, peaty, boreal areas favor the occurrence of these fungi, so the Tatra National Park is a promising area for research on them. As well as being a protected nature area, it has ecological conditions suitable for members of the Taphrinales and their host plants. The fungi of this order growing in the Tatra National Park have not been investigated in detail. The first records of fungi in the Tatra Mts come from the late 19th century. The observations were made by Raciborski in 1890 and 1891, but the findings were published much later (Wróblewski 1925). Other reports came out in the early 20th century (Rouppert 1912; Wróblewski 1918; Husz 1921; Baudyš & Picbauer 1925; Moesz

1930; Szulczewski 1930; Picbauer 1933). The first list of this group of fungi covering the entire region of the Tatras in the period between 1880 and 1960 was provided by Starmachowa (1963), who gave six species of the genus *Taphrina* Fr., two species of the genus *Protomyces* Unger, and one species of the genus *Protomyopsis* Magn.. These fungi were recorded on nine plant species and at ca 23 localities. Some records were given in very general terms, giving the Tatras, for example, without specifying the location, site or study area, or without dividing the Tatras into their Polish and Slovak parts.

The two checklists of Taphrinales recorded in the Slovak part of the Tatra National Park by Bacigálová (1991, 1999) were more detailed contributions to studies on this interesting but somewhat neglected group of fungi. Fairly detailed data on this group of fungi in the Polish part of the Tatra National Park were given by Sałata and Mułenko (1996), and by Mułenko *et al.* (2004). The findings on the distribution of these fungi have not been published in full.

As part of two research projects, studies on mycobiota in the Tatra Mts have been continued jointly since the late 1990s by two institutions: the Institute of Botany of the Slovak Academy of Sciences in Bratislava, Slovakia; and Maria Curie-Skłodowska University in Lublin, Poland. One of the objectives has been to describe the fungi of the order Taphrinales occurring in the Tatras.

This study is the first comprehensive overview of what is known about the microscopic fungi occurring in the entire Tatras, both the Polish and Slovak parts. Paulech *et al.* (1991) provided a similar review of the occurrence of powdery mildews (Erysiptales), but covered only the High Tatras.

MATERIAL AND METHODS

The study is based on materials collected by the present authors over the last 20 years, deposited in the Mycological Herbarium of the Institute of Botany, Slovak Academy of Sciences (SAV), and in the Mycological Herbarium of the Department of Botany and Mycology, University of Maria Curie-Skłodowska (LBLM) (acronyms according to Holmgren *et al.*

1990). They are supplemented with findings published previously.

A new critical revision of the Taphrinales so far recorded in the Tatra National Park its immediate vicinity, collected *de novo* or published previously, is provided, and a list of fungi belonging to the *Protomyces*, *Protomyopsis* (Protomycetaceae), and *Taphrina* (Taphrinaceae) is given. Their host plants, distribution in the Tatra Mts, the source for their origin and determination (collection date, collector's name, name of the herbarium in which the collection is deposited), other data (e.g., habitat, plant community, altitude) and references as given in the literature published on the subject are also provided. In some cases, especially in literature, only limited data were available.

Names of fungi are given mostly according to Büren (1915, 1922), Mix (1949), Reddy and Kramer (1974) and Sałata (1974, 1979). Names of host plants are given after Marhold and Hindák (1998).

The entire Tatra Mts system is divided into regions differentiated on both sides of the Tatras: West Tatras (Západné Tatry Mts in Slovakia and Tatry Zachodnie Mts in Poland) and High Tatras (Vysoké Tatry Mts in Slovakia and Tatry Wysokie Mts in Poland). Two other ranges, the Belianské Tatry Mts and Sivy Vrch Mts, are situated in the Slovak part. 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 Vojenský kartografický ústav (Harmanec, Slovakia, 1992–1996).

RESULTS AND DISCUSSION

Four species of the genus *Protomyces* parasitizing 16 host plants, three species of the genus *Protomyopsis* parasitizing four species of host plants, and 13 species of the genus *Taphrina* parasitizing 14 species of host plants were collected in natural ecosystems of the Tatra National Park Biosphere Reserve. Twenty fungal species on 33 host plant species were documented in both parts of the Tatras (Tables 1 & 2). Eleven species occur on both sides of the Tatras. Five species were recorded only in the Slovak Tatras, and four species only in the Polish Tatras (Table 1).

Six species were new species both in the Carpathians and in the national (Slovak or Polish) mycobiota: *Protomyopsis leucanthemii* Magn. (on *Pyrethrum clusii* Fisch. ex Rchb.), *Protomyopsis leontodontis* Büren (on *Leontodon*

Table 1. Number of known Protomycetaceae and Taphrinaceae in the Tatra Mts and their host plants. ZT – Západné Tatry Mts, VT – Vysoké Tatry Mts, BT – Belianské Tatry Mts, TZ – Tatry Zachodnie Mts, TW – Tatry Wysokie Mts, *wl* – without precise localization, *onp* – outside the National Park.

Species	Host plant	Number of localities								Total number of localities	
		Slovakia					Poland				
		ZT	VT	BT	<i>wl</i>	<i>onp</i>	TZ	TW	<i>wl</i>		<i>onp</i>
PROTOMYCETACEAE											
<i>Protomyces crepidis-paludosae</i>	<i>Crepis paludosa</i>	–	–	–	–	–	1	–	–	–	1
<i>Protomyces kriegeria</i>	<i>Leontodon hispidus</i>	8	13	1	–	–	15	–	–	1	38
	<i>Leontodon hispidus</i> subsp. <i>danubialis</i>	–	1	–	–	–	–	–	–	–	1
	<i>Leontodon</i> sp.	1	–	–	–	–	2	–	–	–	3
<i>Protomyces macrosporus</i>	<i>Aegopodium podagraria</i>	2	21	1	–	–	4	–	1	1	30
	<i>Carum carvi</i>	–	–	–	–	–	1	–	–	–	1
	<i>Chaerophyllum hirsutum</i>	5	5	4	–	–	15	–	–	–	29
	<i>Heracleum sphondylium</i>	1	–	–	–	–	–	–	–	1	2
	<i>Ligusticum mutellina</i>	21	50	3	–	–	16	4	–	–	94
<i>Protomyces pachydermus</i>	<i>Taraxacum nigricans</i>	–	1	–	–	–	–	–	–	–	1
	<i>Taraxacum officinale</i>	–	11	–	–	–	3	–	–	–	14
	<i>Taraxacum</i> sect. <i>Alpestris</i>	–	–	–	–	–	1	–	–	–	1
	<i>Taraxacum</i> sect. <i>Alpina</i>	–	–	–	–	–	1	–	–	–	1
	<i>Taraxacum</i> sect. <i>Vulgaria</i>	–	–	–	–	–	4	1	–	1	6
	<i>Taraxacum tatrense</i>	1	1	–	–	–	–	–	–	–	2
<i>Protomyces</i> sp.	–	1	–	–	–	–	–	–	–	1	
<i>Protomyopsis arnoldii</i>	<i>Leontodon pseudotaraxaci</i>	–	–	–	–	–	1	–	–	–	1
<i>Protomyopsis leontodontis</i>	<i>Leontodon hispidus</i> subsp. <i>danubialis</i>	2	2	–	–	–	–	–	–	–	4
	<i>Leontodon pseudotaraxaci</i>	1	1	–	–	–	–	–	–	–	2
<i>Protomyopsis leucanthemi</i>	<i>Leucanthemum vulgare</i>	–	–	–	–	–	1	–	–	–	1
	<i>Pyrethrum clusii</i>	2	1	–	–	–	–	–	–	–	3
Total Protomycetaceae		44	108	9	–	–	65	5	1	4	236
TAPHRINACEAE											
<i>Taphrina alni</i>	<i>Alnus incana</i>	8	9	–	1	–	4	2	1	–	25
<i>Taphrina betulae</i>	<i>Betula carpatica</i>	–	1	–	–	–	–	–	–	–	1
	<i>Betula pendula</i>	10	6	–	–	–	–	–	1	–	17
<i>Taphrina betulina</i>	<i>Betula carpatica</i>	1	21	1	–	–	–	3	1	–	27
	<i>Betula pendula</i>	1	3	–	–	–	–	–	1	–	5
	<i>Betula pubescens</i>	6	28	3	–	–	1	–	–	–	38
	<i>Betula</i> sp.	2	6	–	–	–	–	–	–	–	8
<i>Taphrina epiphylla</i>	<i>Alnus incana</i>	4	21	4	–	2	6	–	–	5	42
<i>Taphrina filicina</i>	<i>Dryopteris carthusiana</i>	–	–	–	–	–	–	–	1	–	1
<i>Taphrina padi</i>	<i>Prunus padus</i>	–	–	–	–	–	–	–	–	3	3
<i>Taphrina populina</i>	<i>Populus nigra</i>	1	–	–	–	–	3	–	–	1	5
<i>Taphrina potentillae</i>	<i>Oreogalum montanum</i>	1	9	–	–	–	–	–	–	–	10
	<i>Potentilla erecta</i>	–	–	–	–	–	–	–	1	–	1
<i>Taphrina pruni</i>	<i>Prunus domestica</i>	–	–	–	–	1	–	–	–	–	1
	<i>Prunus spinosa</i>	–	1	–	–	–	–	–	–	–	1
<i>Taphrina sadebeckii</i>	<i>Alnus glutinosa</i>	1	5	–	–	1	–	–	1	–	8
<i>Taphrina tosquinetti</i>	<i>Alnus glutinosa</i>	–	7	–	–	1	–	–	–	–	8
<i>Taphrina viridis</i>	<i>Alnus alnobetula</i>	5	–	–	–	–	–	–	–	–	5
<i>Taphrina vestergerii</i>	<i>Dryopteris carthusiana</i>	1	–	–	–	–	–	–	–	–	1
Total Taphrinaceae		41	117	8	1	5	14	5	7	9	207
Number of species	Number of host plants	Number of localities									
20	33	85	225	17	1	5	79	10	8	13	443

Table 2. Host plants parasitized by the Protomycetaceae and Taphrinaceae fungi in the Tatra Mts.

Host plants	Fungus
<i>Aegopodium podagraria</i>	<i>Protomyces macrosporus</i>
<i>Alnus alnobetula</i>	<i>Taphrina viridis</i>
<i>Alnus incana</i>	<i>Taphrina alni</i> <i>Taphrina epiphylla</i>
<i>Alnus glutinosa</i>	<i>Taphrina sadebeckii</i> <i>Taphrina tosquinetii</i>
<i>Betula carpatica</i>	<i>Taphrina betulae</i> <i>Taphrina betulina</i>
<i>Betula pendula</i>	<i>Taphrina betulae</i> <i>Taphrina betulina</i>
<i>Betula pubescens</i>	<i>Taphrina betulina</i>
<i>Betula</i> sp.	<i>Taphrina betulina</i>
<i>Carum carvi</i>	<i>Protomyces macrosporus</i>
<i>Chaerophyllum hirsutum</i>	<i>Protomyces macrosporus</i>
<i>Crepis paludosa</i>	<i>Protomyces crepidis-paludosae</i>
<i>Dryopteris carthusiana</i>	<i>Taphrina filicina</i> <i>Taphrina vestergrenii</i>
<i>Heracleum sphondylium</i>	<i>Protomyces macrosporus</i>
<i>Leontodon hispidus</i>	<i>Protomyces kriegerianus</i>
<i>Leontodon hispidus</i> subsp. <i>danubialis</i>	<i>Protomyces kriegerianus</i> <i>Protomyopsis leontodontis</i>
<i>Leontodon pseudotaraxaci</i>	<i>Protomyopsis arnoldii</i> <i>Protomyopsis leontodontis</i>
<i>Leontodon</i> sp.	<i>Protomyces kriegerianus</i>
<i>Leucanthemum vulgare</i>	<i>Protomyopsis leucanthemi</i>
<i>Ligusticum mutellina</i>	<i>Protomyces macrosporus</i>
<i>Oreogeuum montanum</i>	<i>Taphrina potentillae</i>
<i>Populus nigra</i>	<i>Taphrina populina</i>
<i>Potentilla erecta</i>	<i>Taphrina potentillae</i>
<i>Prunus domestica</i>	<i>Taphrina pruni</i>
<i>Prunus padus</i>	<i>Taphrina padi</i>
<i>Prunus spinosa</i>	<i>Taphrina pruni</i>
<i>Pyrethrum clusii</i>	<i>Protomyopsis leucanthemi</i>
<i>Taraxacum nigricans</i>	<i>Protomyces pachydermus</i>
<i>Taraxacum officinale</i>	<i>Protomyces pachydermus</i>
<i>Taraxacum</i> sect. <i>Alpestris</i>	<i>Protomyces pachydermus</i>
<i>Taraxacum</i> sect. <i>Alpina</i>	<i>Protomyces pachydermus</i>
<i>Taraxacum</i> sect. <i>Vulgaris</i>	<i>Protomyces pachydermus</i>
<i>Taraxacum</i> sp.	<i>Protomyces pachydermus</i>
<i>Taraxacum tatrense</i>	<i>Protomyces pachydermus</i>

pseudotaraxaci Schur), *Protomyopsis arnoldii* Magn. (on *Leontodon pseudotaraxaci* Schur) as well as *Taphrina potentillae* (Farl.) Johanson [on *Oreogeuum montanum* (L.) E. I. Golubk.], *Ta-*

phrina viridis Maire [on *Alnus alnobetula* (Ehrh.) Hartig] and *Taphrina vestergrenii* Giesenh. [on *Dryopteris carthusiana* (Vill.) H. P. Fuchs]. This checklist, based on the authors' collections, also gives new host plants (for the Tatra National Park) for two species of fungi (*Taraxacum tatrense* R. Doll and *T. nigricans* (Kit.) Rchb. for *Protomyces pachydermus* Thüm., and *Heracleum sphondylium* L. for *Protomyces macrosporus* Unger), and specifies many new localities of these fungi in various plant communities of these mountains, unpublished so far. This provides a more accurate picture of the distribution of these fungi in the Tatra Mts.

Fungi were collected at 443 localities distributed throughout the Tatras (Table 1). The distribution of the species collected is shown on maps showing the localities of species collected both within the Tatra National Park and in adjacent areas, including localities published previously (see Figs 2–10). Localities reported only in a general way (e.g., 'Tatra Mts') are not provided. Localities reported from specific places but missing important additional data (e.g., elevation) are indicated by a question mark.

The numbers of localities in individual regions of the Tatra Mts and their uneven distribution do not fully reflect the actual distribution of these fungi in the Tatra Mts. The considerably higher number of localities (75%) in the Slovak Tatras and the lower number in the Polish Tatras (25%) result from the greater intensity and longer period of studies in the Slovak part of the Tatras. As the numbers given in Table 1 show, the High Tatras have been studied in more detail in the Slovak part, and the West Tatras in the Polish part. Unfortunately, mycological studies have not been conducted in the Sivy Vrch Mts, one of the most floristically interesting regions of the Tatras.

The presented list of Taphrinales collected in the Tatras is not complete, and further detailed mycological studies of the occurrence of these parasitic fungi on determined hosts are needed.

The ranges of the fungi generally overlap the range of their host plants, but some species of parasites definitely prefer specific habitat types

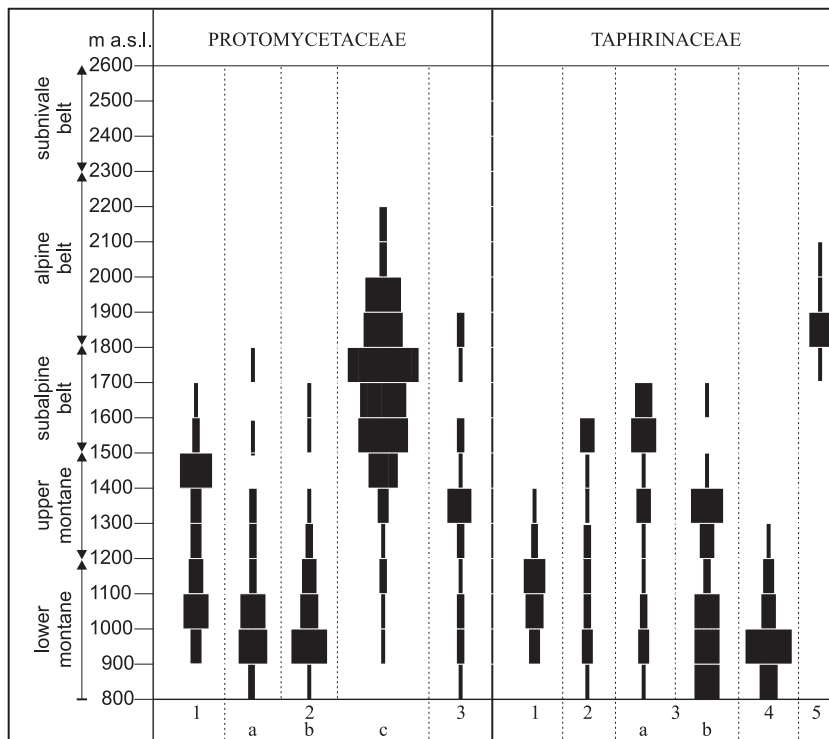


Fig. 1. Vertical distribution of some species of Taphrinales in the Tatra National Park. Protomycetaceae: 1 – *Protomyces kriegerianus* Büren on *Leontodon hispidus* L., 2 – *Protomyces macrosporus* Unger on (a) *Aegopodium podagraria* L., (b) *Chaerophyllum hirsutum* L., and (c) *Ligusticum mutellina* (L.) Crantz., 3 – *Protomyces pachydermus* Thüm. on *Taraxacum* spp. Taphrinaceae: 1 – *Taphrina alni* (Berk. & Broome) Gjaerum on *Alnus incana* (L.) Moench, 2 – *Taphrina betulae* (Fuckel) Johanson on *Betula pendula* Roth., 3 – *Taphrina betulina* Rostr. on (a) *Betula carpatica* Waldst. & Kit., (b) *Betula pubescens* Ehrh., 4 – *Taphrina epiphylla* (Sadeb.) Sacc. on *Alnus incana* (L.) Moench, 5 – *Taphrina potentillae* (Farl.) Johanson on *Oreogeuum montanum* (L.) E. I. Golubk. Single vertical line = one locality.

for their optimal development. For instance, *Protomyces macrosporus*, collected on five plant species at 156 localities, including 94 localities on *Ligusticum mutellina* (L.) Crantz. (Fig. 4), is the most frequent fungus. The maximum occurrence of the fungus on this host is at altitudes between 1700 and 1800 m a.s.l. (Fig. 1). *Taphrina potentillae* (Farl.) Johanson on *Oreogeuum montanum* (L.) E. I. Golubk., collected at altitudes between 1700 and 2010 m a.s.l., usually in the vicinity of lakes (Fig. 10), is another species typical of high altitudes (on this host), although it occurs much less frequently.

This paper does not give a more detailed analysis of the distribution of the fungi listed and relationships between the hosts and the habitats

in the Tatras. All the findings on the distribution and ecology of representatives of the Taphrinales in the Tatra National Park will be published upon completion of the present project.

LIST OF SPECIES

ABBREVIATIONS USED. SAV – Herbarium of the Institute of Botany, Slovak Academy of Sciences (unless otherwise noted, *leg. & det. K. Bacigálová*); LBLM – Herbarium of the Department of Botany and Mycology of the Maria Curie-Skłodowska University (unless otherwise noted, *leg. & det. W. Mulenko*); m – meters a.s.l.; *Pmc* – *Pinetum mughi carpaticum* (subalpine dwarf mountain pine scrub); *Alnetum incanae* – mountain alder forest near rivers and streams.

PROTOMYCETACEAE

Protomyces crepidis-paludosae Büren

On *Crepis paludosa* (L.) Moench (Fig. 2) – POLAND. TATRY ZACHODNIE MTS: Dolina Białego valley, spruce-fir forest, 910 m (Sałata *et al.* 1984).

Protomyces kriegerianus Büren

On *Leontodon hispidus* L. (Fig. 2) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Tichá dolina valley, tourist route to Kasprový vrch Mt., roadside in spruce forest, 1265 m, 4 Aug. 1999 (SAV); Tomanova dolina valley, *Pmc*, 1450 m, 5 Aug. 1998 (SAV); Úzka dolina valley, roadside in spruce forest, 950 m, 18 Aug. 2004 (SAV); Račkova dolina valley, roadside in spruce forest, 1060 m, 4 Aug. 1998 (LBLM); Žiarska dolina valley, roadside in spruce forest, 950 m, 13 Aug. 2004 (SAV); near Žiarska chata cottage, roadside in spruce forest, 1030 m, 13 Aug. 2004 (LBLM); tourist route between Žiarska chata cottage and Malé Závraty, *Pmc*, 1680 m, 16 Aug. 2004 (LBLM); between Chata Dumbier cottage and Babky Mt., calcareous grassland, 1450 m, 15 Aug. 2004 (SAV); VYSOKÉ TATRY MTS: Dolina Kežmarskej Bielej vody valley, spruce forest, 1450 m., 22 July 2001 (SAV); Štrbské pleso lake, spruce forest near the lake, 1350 m, 2 Aug. 2002 (LBLM); Starý Smokovec village, roadside, 1000 m, 30 July 2002 (LBLM); between Starý Smokovec village and Hrebienok Mt., spruce forest, 1100 m, 17 July 2000 (LBLM); Kôprová dolina valley – roadside (Bacigálová 1991); *Pmc*, 1405 m, 6 Aug. 1998 (LBLM); Rázcestie pod Hlinskou, spruce forest, 1405 m, 6 Aug. 1998 (LBLM); Tatranská magistrála, between Štrbské pleso and Jámske pleso, clearing in spruce forest, 1420 m, 13 July 2000 (LBLM); Temnosmrečinová dolina valley, roadside in spruce forest 1450 m, 6 Aug. 1998 (SAV); *Pmc*, 1580 m, 15 Aug. 1995 (SAV); Mlynská dolina valley, without precise localization (Bacigálová 1995); roadside in forest, 1400 m, 12 Aug. 1998 (SAV); spruce forest, 1410 m, 12 Aug. 1998 (LBLM); Bielowodská dolina valley, near the stream, 1050 m, 21 Aug. 2003 (SAV); BELIANSKÉ TATRY MTS: Dolina Siedmich prameňov valley, spruce forest, 1056 m, 14 July 2000 (LBLM). – POLAND. TATRA MTS: outside the National Park, Kotlina Zakopiańska basin (Sałata *et al.* 1993); TATRY ZACHODNIE MTS: Kopa Królowa Mała Mt., sward, 1500 m (Sałata *et al.* 1984); Boczań Mt., sward, 1223 m (Sałata *et al.* 1984); Dolina Jaworzynka valley, roadside, 1057 m, 1120 m (Sałata *et al.* 1984); Dolina Białego valley, sward, 1000 m (Sałata *et al.* 1984); Przełęcz Białego

saddle, spruce forest, 1300 m (Sałata *et al.* 1984); Suchy Żleb pod Wrótkami, sward, 1300 m (Sałata *et al.* 1984); Ścieżka nad Regłami tourist route, near Polana Strążyska glade, sward, 1110 m (Sałata *et al.* 1984), Ścieżka nad Regłami tourist route, roadside, 1260 m, 15 June 1998 (SAV); Dolina za Bramką valley, sward, 997 m (Sałata *et al.* 1984); Dolina Małej Łąki valley, meadow, 1260 m, 18 Aug. 1983 (LBLM), roadside, 1180 m, 13 June 1998 (SAV); Dolina Kościeliska valley, Polana Smytnia glade, 1100 m, 19 Aug. 1985 (LBLM); Dolina Miętusia near Przysłop Miętusi, roadside 1290 m, 18 June 1998 (SAV); Dolina Lejowa valley, roadside, 950 m, 12 June 1998 (SAV); Dolina Tomanowa, roadside, 1300 m, 16 June 1998 (SAV).

On *Leontodon hispidus* subsp. *damubialis* (Jacq.) Simonk. – SLOVAKIA. VYSOKÉ TATRY MTS: Štrbské pleso, turist route to vodopad Skok waterfall, 1400 m, 23 July 1990 (SAV).

REMARKS. In the paper by Bacigálová (1999) it was cited as *Protomyces pachydermus* Thüm. on *Leontodon autumnalis* L.

On *Leontodon* sp. – SLOVAKIA. ZÁPADNÉ TATRY MTS: Tichá dolina valley, without precise localization (Bacigálová 1991). – POLAND. TATRY ZACHODNIE MTS: Dolina Tomanowa valley, spruce forest, 1300 m, 16 June 1998 (LBLM); Hala Miętusia, mountain pasture, 1360 m, 18 June 1998, *leg. A. Wolczańska* (LBLM).

Protomyces macrosporus Unger

On *Aegopodium podagraria* L. (Fig. 3) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Žiarska dolina valley, without precise localization, 13 Aug. 2004 (SAV); Roháčska dolina valley, without precise localization (Bacigálová 1995); VYSOKÉ TATRY MTS: Tatranská Lomnica village, in the park (Bacigálová 1991, 1995); in the park, 22 Aug. 1985, *leg. C. Paulech* (SAV); near railway, 940 m, 17 July 2000 (SAV); in the park, 8 Aug. 2002 (SAV); roadside in spruce forest, 900 m, 30 July 2002 (LBLM); road between Tatranská Lomnica village and station Start, roadside in spruce forest, 1140 m and 1200 m, 18 July 2000 (LBLM); Tatranská Polianka village, roadside in the spruce forest (Bacigálová 1995); Starý Smokovec village, center of the village, roadside (Bacigálová 1991, 1995); roadside in spruce forest, 1050 m, 17 July 2000 (SAV); roadside, 1030 m, 30 July 2002 (LBLM); road between Starý Smokovec village and Hrebienok Mt., roadside in spruce forest, 1060 m, 16 July 2000 (SAV) and 1100 m, 17 July 2000 (LBLM); Skalnaté Pleso lake, herbaceous plants near lake, 1780 m, 20 Aug. 1999 (SAV); Popradské Pleso

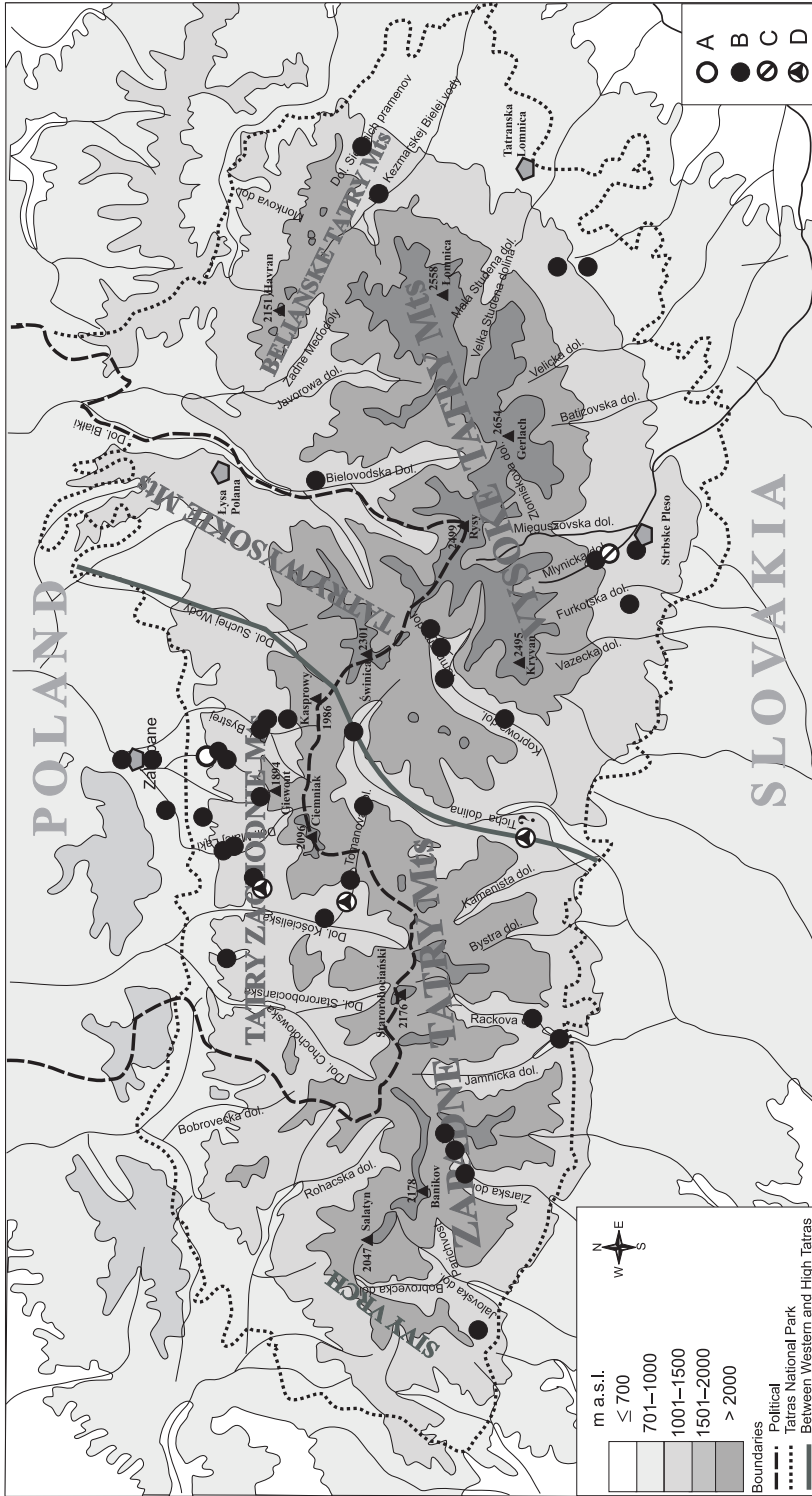


Fig. 2. Distribution of *Protomyces crepidis-paludosae* Büren and *P. kriegierianus* Büren in the Tatra National Park. *Protomyces crepidis-paludosae* Büren on (A) *Crepis paludosa* (L.) Moench; *Protomyces kriegierianus* Büren on (B) *Leontodon hispidus* L., (C) *Leontodon hispidus* subsp. *damubialis* (Jacq.) Simonk., and (D) *Leontodon* sp.

lake, 24 July 2000 (SAV); road between Popradské Pleso lake and Popradské pleso car park, roadside in spruce forest, 1350 m, 24 July 2000 (SAV); Dolina Kežmarskej Bielej vody valley, near Šlaviový prameň, herbaceous plants, 1200 m (Bacigálová 1991); 1300 m (Bacigálová 1995); roadside in spruce forest, 980 m, 22 July 2001 (SAV); 900 m, 24 July 2001 (LBLM); Cesta Slobody road, near Tri studničky bus stop, 1000 m (Bacigálová 1995); BELIANSKE TATRY MTS: Monkova dolina valley, roadside in spruce forest, 1050 m, 27 July 2000 (SAV). – POLAND. TATRA MTS: without precise localization (Wróblewski 1925; Starmachowa 1963); outside the National Park, Kotlina Zakopiańska basin (Sałata *et al.* 1993); TATRY ZACHODNIE MTS: Dolina Strażyska valley, herbaceous plants, 895 m (Sałata *et al.* 1984); Jaszczurówka village – border of National Park, beech forest, 940 m (Mułenko *et al.* 1995); Dolina Małej Łąki valley, roadside 900 m, 13 June 1998 (SAV); Kiry village, border of National Park, near Biały Domek cottage, 14 June 1998 (SAV).

On *Carum carvi* L. (Fig. 3) – POLAND. TATRY ZACHODNIE MTS: Dolina Małej Łąki valley, Mała Polanka glade, meadow, 1210 m (Mułenko *et al.* 1995).

On *Chaerophyllum hirsutum* L. (Fig. 3) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Žiarska dolina valley, spruce forest near the stream, 925 m, 17 Aug. 2004 (SAV); herbaceous plants near the stream, 950 m, 13 Aug. 2004 (SAV); Jamnická dolina valley, roadside near the stream, 950 m, 18 Aug. 2004 (SAV); roadside in the spruce forest near the stream, 1080 m, 18 Aug. 2004 (SAV); Kamenistá dolina valley, near the stream, 1250 m, 11 July 2003 (SAV); VYSOKÉ TATRY MTS: Bielovodská dolina valley, roadside near the stream, 1050 m, 21 Aug. 2003; 1080 m, 21 Aug. 2003 (SAV); Mlynická dolina valley, herbaceous plants near water spring, 1600 m, 12 Aug. 1998 (SAV); Malá Studená dolina valley, herbaceous plants near the stream, 1500 m (Bacigálová 1995); Tatranská Lomnica village, herbaceous plants near the stream (Bacigálová 1991, 1995); BELIANSKE TATRY MTS: Dolina Siedmich prameňov valley, roadside in spruce forest, 900 m, 19 Aug. 1999 (SAV); Monkova dolina valley, roadside in spruce forest, 1120 m, 11 Aug. 1999, 1100 m, 27 July 2000 (SAV); roadside 25 July 2000 (SAV). – POLAND. Tatry Zachodnie Mts: Dolina Olczyńska valley, herbaceous plants, 950 m (Sałata *et al.* 1984); Dolina Bystrej valley, herbaceous plants, 1155 m (Sałata *et al.* 1984); road between Kuźnice village and Polana Kalatówki glade, roadside, 1200 m, 9 June 1986 (LBLM); Dolina Białego valley, herbaceous plants, 908 m (Sałata *et al.* 1984); Dolina Spadowiec valley, herbaceous plants,

910 m (Sałata *et al.* 1984); Dolina ku Dziurze valley, herbaceous plants, 895 m (Sałata *et al.* 1984); Dolina Strażyska valley, herbaceous plants, 1002 m (Sałata *et al.* 1984); 950 m, 18 Aug. 1983 (LBLM); Ścieżka nad Reglami tourist route, near Polana Strażyska glade, herbaceous plants, 1092 m (Sałata *et al.* 1984); Droga pod Reglami road, near Suchy Żleb gully, herbaceous plants, 925 m (Sałata *et al.* 1984); Dolina Kościeliska valley, Stare Kościeliska glade, herbaceous plants, 945 m (Sałata *et al.* 1984); Dolina Kościeliska valley, 900 m, 19 Aug. 1983 (LBLM), 900 m, 16 June 1998 (SAV); Wąwóz Kraków gully, herbaceous plants, 1000 m, 16 June 1998, *leg. A. Wołęzańska* (LBLM); Kiry village, border of National Park, near Kościeliski Potok stream, 11 June 1998 (SAV).

On *Heracleum sphondylium* L. (Fig. 3) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Červené vrchy Mt., between Tomanova dolina valley and Javorový žľab gully, herbaceous plants near the stream, 1300 m, 18 Aug. 1995 and 5 Aug. 1999 (SAV). – POLAND. TATRA MTS: outside the National Park – Kotlina Zakopiańska basin (Sałata *et al.* 1993).

On *Ligusticum mutellina* (L.) Crantz. (Fig. 4) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Tichá dolina valley, subalpine grassland in *Pmc*, 1650m, 4 Aug. 1999 (SAV); subalpine grassland in *Pmc*, 1650 m, 4 Aug. 1999 (LBLM); Zadná Tichá dolina valley, subalpine grassland in *Pmc*, 1700 m, 6 Aug. 1987 (SAV); sedlo Závory saddle, alpine grassland, 1877 m (cited as Kôprové sedlo saddle, Bacigálová 1995); Tomanova dolina valley, subalpine grassland in *Pmc*, 1700 m, 5 Aug. 1998 (SAV); Kamenistá dolina valley, 1535 m (Bacigálová 1995); roadside, 1500 m, 3 Aug. 1999 (SAV); roadside, 1500 m, 7 Aug. 1999 (SAV); roadside 1500 m, 20 July 2004 (SAV); roadside 1440 m, 23 July 2001 (SAV); roadside in spruce forest, 985 m and 1142 m, 3 Aug. 1999 (LBLM); *Pmc*, 1410 m and 1540 m, 7 Aug. 1999 (LBLM); *Pmc* 1450 m, 26 July 2001 (LBLM); Červené vrchy Mt., Stoly, alpine grassland, 1820 m, 10 Aug. 1999 (SAV); alpine grassland, 1820 m, 10 Aug. 1999 (LBLM); Račkova dolina valley, subalpine grassland in *Pmc*, 1520 m., 4 Aug. 1998 (SAV); alpine grassland in *Pmc*, 1630 m, 4 Aug. 1998 (LBLM); Žiarska dolina valley, between Žiarska chata cottage and Malé Závraty, *Pmc*, 1640 m, 16 Aug. 2004 (LBLM); *Pmc*, 1620 m, 17 Aug. 2004 (SAV); VYSOKÉ TATRY MTS: Lomnické sedlo saddle, alpine grassland (Bacigálová 1995); alpine grassland, 2180 m, 25 July 2000 (SAV); Skalnaté pleso lake, roadside near the lake, 1750 m, 12 Aug. 2004 (SAV); between Skalnaté pleso lake and Lomnické sedlo saddle, *Pmc*, 1751 m, 26 July 1990

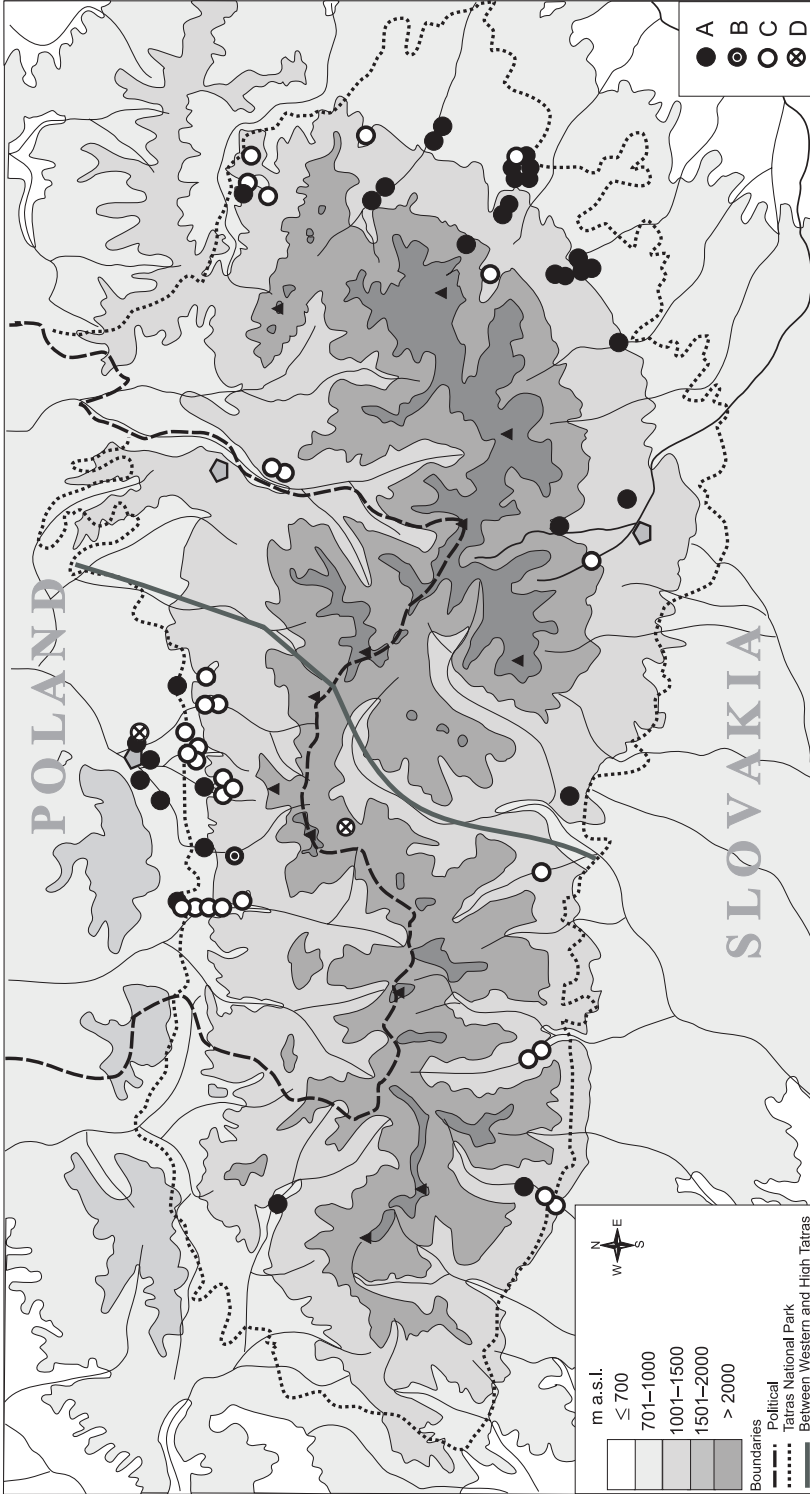


Fig. 3. Distribution of *Protomyces macrosporus* Unger on some species of plants in the Tatra National Park. *Protomyces macrosporus* Unger on (A) *Aegopodium podagraria* L., (B) *Carum carvi* L., (C) *Chaerophyllum hirsutum* L., and (D) *Heracleum sphondylium* L.

and 20 Aug. 1999 (SAV); subalpine grassland, 1800 m, 25 July 2000 (SAV); Batizovské pleso lake, alpine grassland in *Pmc*, 1879 m, 19 July 2001 and 12 July 2002 (SAV); Malá Studená dolina, Téryho chata cottage, alpine grassland around the lake, 2015 m, 20 July 2001 (SAV); Zlomisková dolina valley, subalpine grassland, 1690 m (Bacigálová 1995); near Ľadové pleso lake, alpine grassland in *Pmc*, 1700 m, 29 July 1990 (SAV); subalpine grassland in *Pmc*, 1700 m, 19 July 1991 (SAV); alpine grassland, 1920 m, 24 July 2001 (SAV); subalpine grassland in *Pmc*, 1800 m, 29 July 1990 (SAV); alpine grassland around Ľadové Pleso lake, 1900 m, 8 Aug. 1998 (SAV); Mlynická dolina valley, alpine grassland, 1950 m, 2 Aug. 1987 (SAV); subalpine grassland, 1720 m, 20 July 1991 (SAV); subalpine grassland in *Pmc*, 1700 m, 12 Aug. 1998 (SAV); *Pmc*, 27 July 1990 (SAV; Bacigálová 1991, 1995); subalpine grassland in *Pmc*, 1660 m, 12 Aug. 1998 (LBLM); Furkotská dolina valley, *Pmc*, 1610 m, 19 July 2000 (LBLM); Wahlenbergove pleso lake, alpine grassland, 2050 m (Bacigálová 1991); subalpine grassland, 1800 m (Bacigálová 1995); alpine grassland, 1820 m (Bacigálová 1995); around Wahlemborg's lakes, alpine grassland, 1950 m, 2 Aug. 1987 (SAV); Mengusovská dolina valley, tourist route between Popradské pleso and Hincové pleso lakes, *Pmc*, 1555 m, 1720 m and 1730 m, 8 Aug. 1999 (LBLM); subalpine grassland in *Pmc*, 8 Aug. 1999 (SAV); Hincové plesá lakes, alpine grassland around the lakes, 1900 m (SAV; Bacigálová 1995); tourist route between Popradské Pleso lake and Symbolický cintorín cemetery, roadside in spruce forest, 1550, 17 Aug. 1999 (SAV); Tatranská magistrála tourist route, between Popradské pleso and Štrbské Pleso, subalpine grassland in *Pmc*, 1500 m and 1550 m, 1 Aug. 2002 (LBLM); between Popradské Pleso lake and Ostrva Mt., *Pmc*, 1850 m, 22 July 1991 (SAV); 1700 m (Bacigálová 1995); Veľká Studená dolina valley, *Pmc*, 1443 m, 20 July 2000 (LBLM); subalpine grassland in *Pmc*, 12 July 2003 (SAV); Malá Studená dolina valley, herbaceous plants in *Pmc*, 1650 m, 20 July 2001 (LBLM); Temnosmrečinská dolina valley, Nižné Temnosmrečinské pleso lake, subalpine grassland in *Pmc*, 1700 m, 15 Aug. 1995 and 6 Aug. 1998 (SAV); Kôprová dolina valley, roadside, without precise localization (Bacigálová 1991, 1995); Velická dolina valley, near Velické pleso lake, 1660 m (Bacigálová 1995); subalpine grassland in *Pmc*, 1700 m, 21 Aug. 1999; 1720 m, 7 Aug. 1998 (SAV); subalpine grassland around Kvetnicové pleso lake, 1750 m, 7 Aug. 1998 (SAV); subalpine grassland near Kvetnica lake, 1750 m, 6 Sept. 1989 (Bacigálová 1995); alpine grassland around the Dlhé Pleso lake, 1950 m, 25 July 1990

(Bacigálová 1995); 1960 m, 25 July 1990 (SAV); subalpine grassland, 1797 m, 6 Aug. 1998 (LBLM); Kriváň Mt., SE wall, alpine grassland, 1900 m, 30 July 1990 (SAV); Dolina Kežmarskej Bielej vody, tourists route to Zelené Pleso lake, roadside, 1500 m (Bacigálová 1991) and 1300 m (Bacigálová 1995); Dolina Zeleného plesa, Zelené Pleso lake, subalpine grassland, 1550 m (Bacigálová 1995); BELIANSKE TATRY MTS: Zadné Meďodoly valley, subalpine grassland, 1700 m, 26 July 2000 (SAV); tourist route to Kopské sedlo, subalpine grassland, 1750 m, 7 Sept. 1989 (SAV); tourist route to Zelené Pleso lake, subalpine grassland, 1750 m, 10 Aug. 1998 (SAV). – POLAND. TATRY ZACHODNIE MTS: Krzesanica Mt., alpine grassland, 2122 m, 22 Aug. 1983 (LBLM); Kasprowy Wierch Mt., alpine grassland, 1985 m (Sałata *et al.* 1984); 22 Aug. 1983 (LBLM); Kopa Kondracka Mt., alpine grassland, 1950 m, 22 Aug. 1983 (LBLM); Hala Miętusia mountain pasture, grassland, 1240 m, 14 July 1983 (LBLM); Dolina Małej Łąki valley, Świstówka Niżnia, subalpine grassland, 1600 m, 17 Sept. 1987 (LBLM); Dolina Małej Łąki valley, Świstówka Niżnia, 1470 m, 17 Sept. 1991 (LBLM); Dolina Kondratowa valley, subalpine grassland, 1550 m, 22 Aug. 1983 (LBLM); Przełęcz Liliowe saddle, alpine grassland, 1950 m (Sałata *et al.* 1984); Hala Kalatówki mountain pasture, grassland, 1175 m (Sałata *et al.* 1984); Dolina Kondratowa valley, grassland, 1302 m (Sałata *et al.* 1984); Piekło, grassland, 1380 m (Sałata *et al.* 1984); Giewont Mt., grassland, 1820 m (Sałata *et al.* 1984); Dolina Starorobociańska valley, grassland, 1460 m and 1470 m, 17 June 1998 (LBLM, SAV); Kominiarski Wierch Mt., subalpine grassland, 1750 m, 17 Aug. 1985 (LBLM); Ścieżka nad Reglami tourist route, between Dolina Bystrej valley and Dolina Białego valley, grassland, 1300 m 15 June 1998 (SAV); TATRY WYSOKIE MTS: Morskie Oko lake, grassland, 1405 m (Sałata *et al.* 1984); subalpine grassland, 1600 m, 11 July 1982 (LBLM); Dolina Gašienicowa valley, Hala Gašienicowa, near Litworowy Staw lake, subalpine grassland, 1620 m (Sałata *et al.* 1984); near Czarny Staw lake, grassland, 1503 m (Sałata *et al.* 1984).

Protomyces pachydermus Thüm.

On *Taraxacum nigricans* (Kit.) Rchb. (Fig. 5) – SLOVAKIA. VYSOKÉ TATRY MTS: Mengusovská dolina valley, road between Popradské pleso lake and Popradské pleso car parking, roadside in spruce forest, 1400 m, 24 July 2000 (SAV).

On *Taraxacum officinale* Weber in F. H. Wigg. (Fig. 5) – SLOVAKIA. VYSOKÉ TATRY MTS: Štrbské pleso vil-

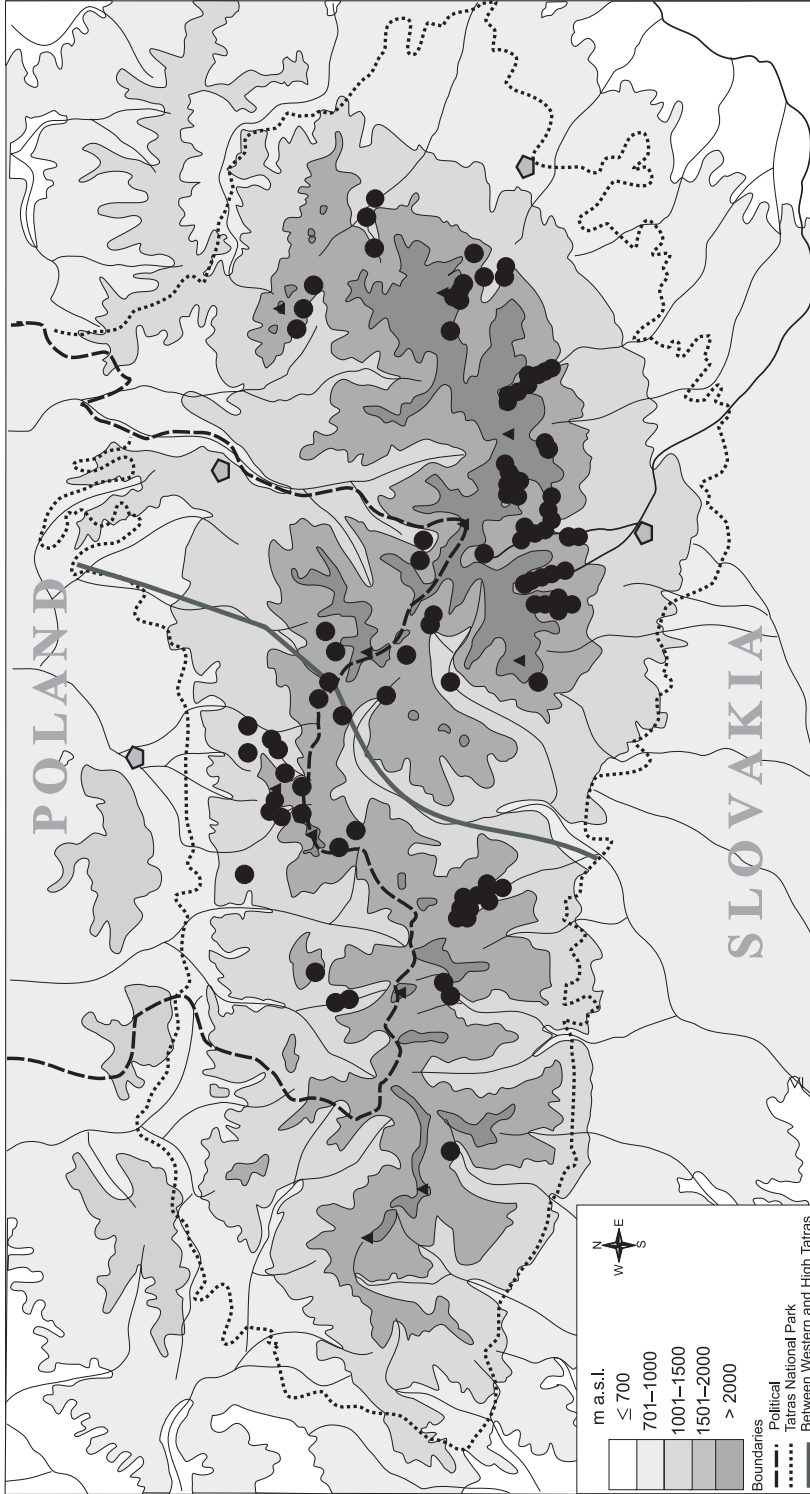


Fig. 4. Distribution of *Protomyces macrosporus* Unger on *Ligusticum mutellina* (L.) Crantz. in the Tatra National Park.

lage, in the park, 1350 m, 14 July 1990 (SAV); roadside near the lake, 1350 m, 24 July 1990 (SAV); center, roadside, 1300 m, 21 July 1991 (SAV); roadside near the car parking, 1320 m, 18 July 1991 (SAV; Bacigálová 1995); Štrbské pleso railway, roadside 1300 m, 17 Aug. 1995 (SAV); Popradské pleso lake, roadside, 1500 m, 24 July 1990 (SAV); Starý Smokovec village, in the park, roadside, 1010 m, 7 Sept. 1988 (Bacigálová 1991); without precise localization (Bacigálová 1995); Velická dolina valley, roadside in spruce forest, 1300 m, 6 Sept. 1989 (SAV; Bacigálová 1995); Zlomisková dolina valley, without precise localization (Bacigálová 1995); Ostrva Mt., without precise localization (Bacigálová 1995). – POLAND. TATRY ZACHODNIE MTS: Droga pod Reglami road, near Staników Potok stream, roadside, 980 m, 13 June 1998, *leg. B. Sałata* (LBLM, SAV); Dolina Kościeliska valley, 900 m, 11 June 1998 (SAV); Kiry village, border of National Park, near Biały Domek cottage, 14 June 1998 (SAV).

On *Taraxacum* sect. *Alpestris* (Fig. 5) – POLAND. Tatry Zachodnie Mts: Dolina Kondratowa valley, Suchy Żleb pod Wrótkami, grassland, 1325 m (Sałata *et al.* 1984).

On *Taraxacum* sect. *Alpina* (Fig. 5) – POLAND. TATRY ZACHODNIE MTS: Beskid Mt., subalpine grassland, 1750 m (Sałata *et al.* 1984).

On *Taraxacum* sect. *Vulgaris* (Fig. 5) – POLAND. TATRA MTS: outside the National Park, Kotlina Zakopiańska basin (Sałata *et al.* 1993); TATRY ZACHODNIE MTS: Dolina Jaworzynki valley, roadside, 1240 m (Sałata *et al.* 1984); Kuźnice village, roadside, 1053 m (Sałata *et al.* 1984); Droga pod Reglami road, near Spadowiec stream, roadside, 905 m (Sałata *et al.* 1984); Dolina ku Dziurze valley, roadside, 897 m (Sałata *et al.* 1984); TATRY WYSOKIE MTS: Dolina Gašienicowa valley, Hala Gašienicowa, roadside, 1500 m (Sałata *et al.* 1984).

On *Taraxacum* sp. (Fig. 5) – SLOVAKIA. VYSOKÉ TATRY MTS: Zlomisková dolina valley, near the stream, 1850 m, 19 July 1991 (SAV).

On *Taraxacum tatrense* R. Doll (Fig. 5) – SLOVAKIA. Západné Tatry Mts: Žiarska dolina valley, roadside in spruce forest, 1200 m, 16 Aug. 2004 (SAV); VYSOKÉ TATRY MTS: Batizovské pleso lake, alpine grassland, 1870 m, 12 July 2002 (SAV).

Protomycopis arnoldii Magn.

On *Leontodon pseudotaraxaci* Schur (Fig. 6) – POLAND. TATRY ZACHODNIE MTS: Małolączniak

Mt. (Czerwone Wierchy), ca 2000–2100 m, 6 Sept. 1974 *leg. A. Plocek* (SAV) (Bacigálová & Mułenko 2005).

Protomycopis leontodontis Büren

On *Leontodon hispidus* subsp. *danubialis* (Jacq.) Simonk. (Fig. 6) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Tichá dolina valley, roadside, 1120 m, 6 Sept. 1988 (Bacigálová 1995); Kamenistá dolina valley, *Pmc*, 1320 m, 11 July 2003 (SAV); VYSOKÉ TATRY MTS: Mlynická dolina valley, Vodopád Skok waterfall, roadside, 1350 m, 23 July 1990 (Bacigálová 1995); Tatranská magistrála tourist route, between Štrbské pleso and Jamské pleso lakes, 1400 m, 13 July 2000 (SAV).

On *Leontodon pseudotaraxaci* Schur (Fig. 6) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Žiarska dolina valley, Žiarske pleso lake, alpine grassland in *Pmc*, 1880 m, 19 Aug. 2004 (SAV); VYSOKÉ TATRY MTS: Skalnaté pleso lake – subalpine grassland near the stream, 1800 m, 12 Aug. 2004 (SAV).

Protomycopis leucanthemi Magn.

On *Leucanthemum vulgare* Lam. (Fig. 6) – POLAND. TATRY ZACHODNIE MTS: Jaszczurówka village, border of national park (Starmachowa 1963; Sałata 1979; Sałata *et al.* 1993).

On *Pyrethrum clusii* Fisch. ex Rchb. (Fig. 6) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Kamenistá dolina valley, without precise localization, roadside (Bacigálová 1991); grassland in *Pmc*, roadside, 1300 m, 6 Sept. 1988 (Bacigálová 1995); 8 Aug. 1993, 11 July 2003 and 20 July 2004 (SAV); VYSOKÉ TATRY MTS: Dolina Kežmarskej Bielej vody valley, roadside in the spruce forest, 1320 m, 17 Aug. 1995 (SAV).

REMARKS. In the paper by Bacigálová (1995) the fungus was cited also on *Leucanthemum vulgare*, however, it is *Pyrethrum clusii* Fisch. ex Rchb. [= *Chrysanthemum corymbosum* L., = *Tanacetum corymbosum* (L.) Sch. Bip. subsp. *corymbosum*].

TAPHRINACEAE

Taphrina alni (Berk. & Broome) Gjaerum

Ascomyces alni Berk. & Broome – *Taphrina alni-incanae* Kühn. – *Exoascus alni-incanae* (Rostr.) Sadeb. – *Taphrina amentorum* (Sadeb.) Rostr. – *Exoascus alni-incanae* (Kühn.) Magn.

On *Alnus incana* (L.) Moench (Fig. 7) – SLOVAKIA. TATRA MTS: without precise localization

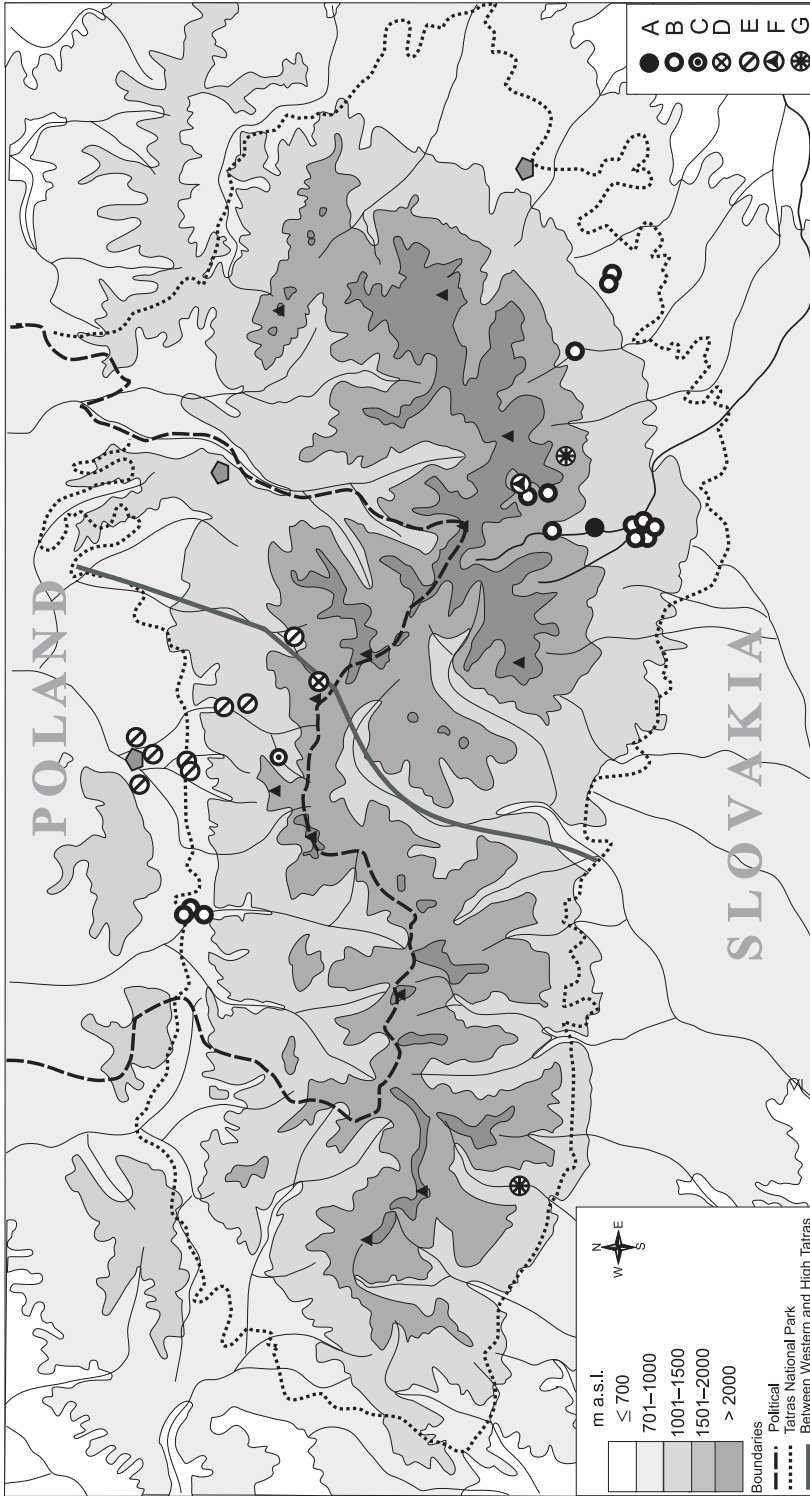


Fig. 5. Distribution of *Protomyces pachydermus* Thüm. on some species of plants in the Tatra National Park. *Protomyces pachydermus* Thüm. on (A) *Taraxacum nigriticans* (Kit.) Rechb., (B) *Taraxacum officinale* Weber in F. H. Wigg., (C) *Taraxacum* sect. *Alpestris*, (D) *Taraxacum* sect. *Alpina*, (E) *Taraxacum* sect. *Vulgaris*, (F) *Taraxacum* sp., and (G) *Taraxacum tatrense*.

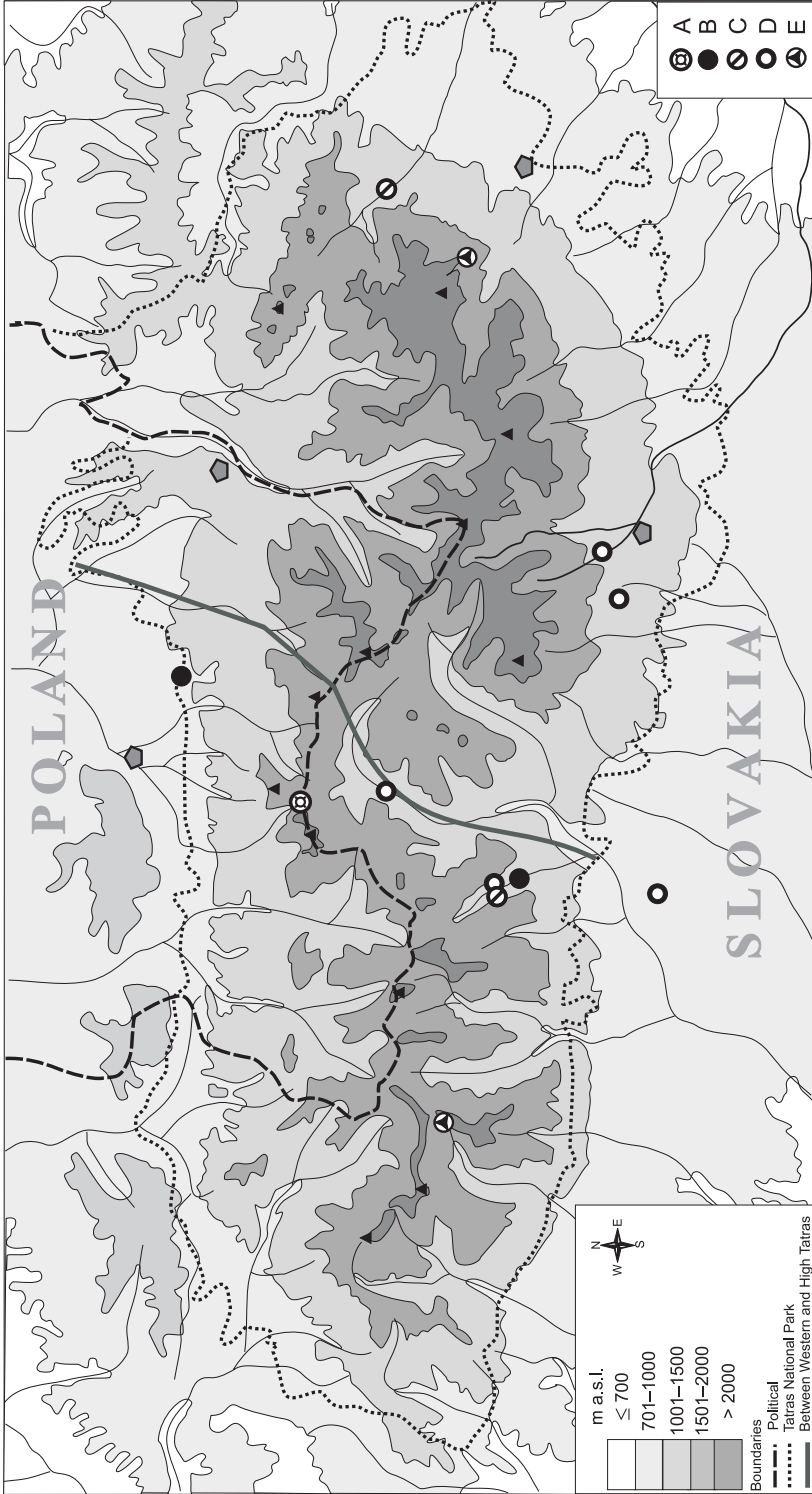


Fig. 6. Distribution of *Protomyces arnoldii* Magn., *P. leucanthemi* Magn. and *P. leontodonis* Büren in the Tatra National Park. *Protomyces arnoldii* Magn. on (A) *Leontodon pseudotaraxaci* Schur; *Protomyces leucanthemi* Magn. on (B) *Leucanthemum vulgare* Lam., (C) *Pyrethrum clusii* Fisch. ex Rehb.; *Protomyces leontodonis* Büren on (D) *Leontodon hispidus* subsp. *dambialis* (Jacq.) Simonk., and (E) *Leontodon pseudotaraxaci* Schur.

(Bacigálová 1991); ZÁPADNÉ TATRY MTS: Račkova dolina valley, without precise localization (Rouppert 1912; Starmachowa 1963); Cesta Slobody road, Podbanské village, 1000 m, 9 Sept. 1992 (SAV), Tichá dolina valley, 1150 m (Bacigálová 1991); 1200 m (Bacigálová 1994a); roadside in spruce forest, 1080 m, 6 July 1989 (SAV); 1160 m, 6 Aug. 1987 (SAV); 1160 m, 18 Aug. 1995 (SAV); Tomanova dolina valley, roadside in spruce forest, 1164 m (Bacigálová 1991, 1994a); 18 Aug. 1995 (SAV); *Pmc*, 1300 m, 5 Aug. 1999 (SAV); VYSOKÉ TATRY MTS: Tatranská Lomnica village, without precise localization (Moesz 1930; Starmachowa 1963; Bacigálová 1991, 1994a); roadside in the village, 8 Aug. 2004 (SAV); Tatranská Polianka village, road to Sliezsky dom, roadside in spruce forest, 1020 m, 25 Aug. 2003 (LBLM); Dolina Kežmarskej Bielej vody valley, roadside in spruce forest, 17 Aug. 1995 (SAV); roadside in spruce forest, 1100 m., 16 Aug. 1999 (SAV); near Šalviový prameň stream, spruce forest, 1200 m (Bacigálová 1991, 1994a); Veľký les, spruce forest, 945 m, 19 Aug. 2003 (LBLM); Cesta Slobody road, roadside near Tri studničky bus stop, 1000 m (Bacigálová 1991); Kežmarské Žlaby, without precise localization (Picbauer 1933; Starmachowa 1963; Bacigálová 1994a). – POLAND. TATRA MTS: without precise localization (Wróblewski 1925; Starmachowa 1963). TATRY ZACHODNIE MTS: Kuźnice village (Rouppert 1912; Szulczewski 1930; Starmachowa 1963); Dolina Kościeliska valley (Rouppert 1912; Wróblewski 1918; Starmachowa 1963); Polana Kalatówki glade, 1190 m, 20 June 1999, 19 July 1999, *leg. A. Wolczańska* (LBLM); Jaszczurówka village, border of national park (Szulczewski 1930; Starmachowa 1963; Sałata *et al.* 1993); TATRY WYSOKIE MTS: Dolina Roztoki valley (Rouppert 1912; Starmachowa 1963); Dolina Suchej Wody valley (Szulczewski 1930; Starmachowa 1963).

Taphrina betulae (Fuckel) Johanson

Exoascus betulae Fuckel

On *Betula carpatica* Waldst. & Kit. (Fig. 7) – SLOVAKIA. VYSOKÉ TATRY MTS: Dolina Kežmarskej Bielej vody valley, Šalviový prameň spring, 1200 m (Bacigálová 1991).

On *Betula pendula* Roth (Fig. 7) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Žiarska dolina valley, spruce forest, 1000 m, 1220 m, 13 Aug. 2004 (SAV); yellow tourist route to Holý vrch Mt., spruce forest, 1100 m, 14 Aug. 2004 (SAV); between Žiarska chata cottage and Žiarske sedlo settle 1550 m, 16 Aug. 2004 (SAV); turist route to

Jalovecké sedlo settle, Pletne miesto, *Pmc*, 1360 m and 1460 m, 17 Aug. 2004 (LBLM); yellow tourist route to Baranec Mt., Stará Stavká, spruce forest, 1170 m, 14 Aug. 2004 (LBLM); tourist route from Žiarska chata cottage to Baníkov Mt., *Pmc*, 1500 m, 17 Aug. 2004 (SAV); Jamnická dolina valley, spruce forest, 950 m, 18 Aug. 2004 (SAV, LBLM); spruce forest, 990 m, 15 July 2000 (LBLM); VYSOKÉ TATRY MTS: Dolina Kežmarskej Bielej vody valley, near Šalviový prameň spring, 1200 m (Bacigálová 1997); Mengusovská dolina valley, near Popradské Pleso lake, roadside (Bacigálová 1997); Malá Studená dolina valley, *Pmc*, 1500 m, 20 July 2001 (SAV); Tatranská Lomnica village, park, 27 July 2000 (SAV); spruce forest near rack-railway station, 17 July 2000 and 18 July 2000 (SAV); Stará Lesná village, roadside in the spruce forest, 21 July 2001 (SAV). – POLAND. TATRA MTS: without precise localization (Wróblewski 1925; Starmachowa 1963).

Taphrina betulina Rostr.

Taphrina turgida Sadeb. – *Exoascus betulinus* (Rostr.) Sadeb.

On *Betula carpatica* Waldst. & Kit. (Fig. 8) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Kamenistá dolina valley, spruce forest, 1320 m (Bacigálová 1997); 9 July 2002 (SAV); VYSOKÉ TATRY MTS: Nový Smokovec village (Bacigálová 1997); Kôprová dolina valley, near Kôprový stream (Bacigálová 1997); Dolina Zeleného plesa valley, near Zelený potok stream (Bacigálová 1991); near Zelené pleso lake, 1500 m (Bacigálová 1997); green tourist route between Skalnatá chata cottage and station Start, *Pmc*, 1500 m, 27 Feb. 2002 (LBLM); Tatranská magistrála tourist route, near Obrovský vodopád waterfall, spruce forest, 1350 m (Bacigálová 1991, 1997); under Lomnický hrebeň Mt., spruce forest, 1550 m (Bacigálová 1991, 1997); between Štrbské Pleso village and Popradské pleso lake, *Pmc*, 1535 m (LBLM); Malá Studená dolina valley, near the stream, 1640 m (Bacigálová 1997); *Pmc*, 1580 m, 10 July 2002 (SAV); 1600 m, 20 July 2001 (SAV); 1600 m, 20 July 2001 (LBLM); Veľká Studená dolina valley, *Pmc*, 1680 m, 12 July 2003 (SAV); Popradské pleso lake, spruce forest, 1500 m, 28 Aug. 1990 (SAV); Mengusovská dolina valley, between Štrbské Pleso car parking and Popradské pleso lake, roadside in spruce forest (Bacigálová 1997); Štrbské Pleso village, center of the village, near the post office (Bacigálová 1997); Dolina Kežmarskej Bielej vody, near Šalviový prameň spring, spruce forest, 1200 m (Bacigálová 1997); Tatranská Polianka village, in the park, 1000 m, 6 Sept. 1988 (SAV); Tatranská Štrba village, in the park, 900 m,

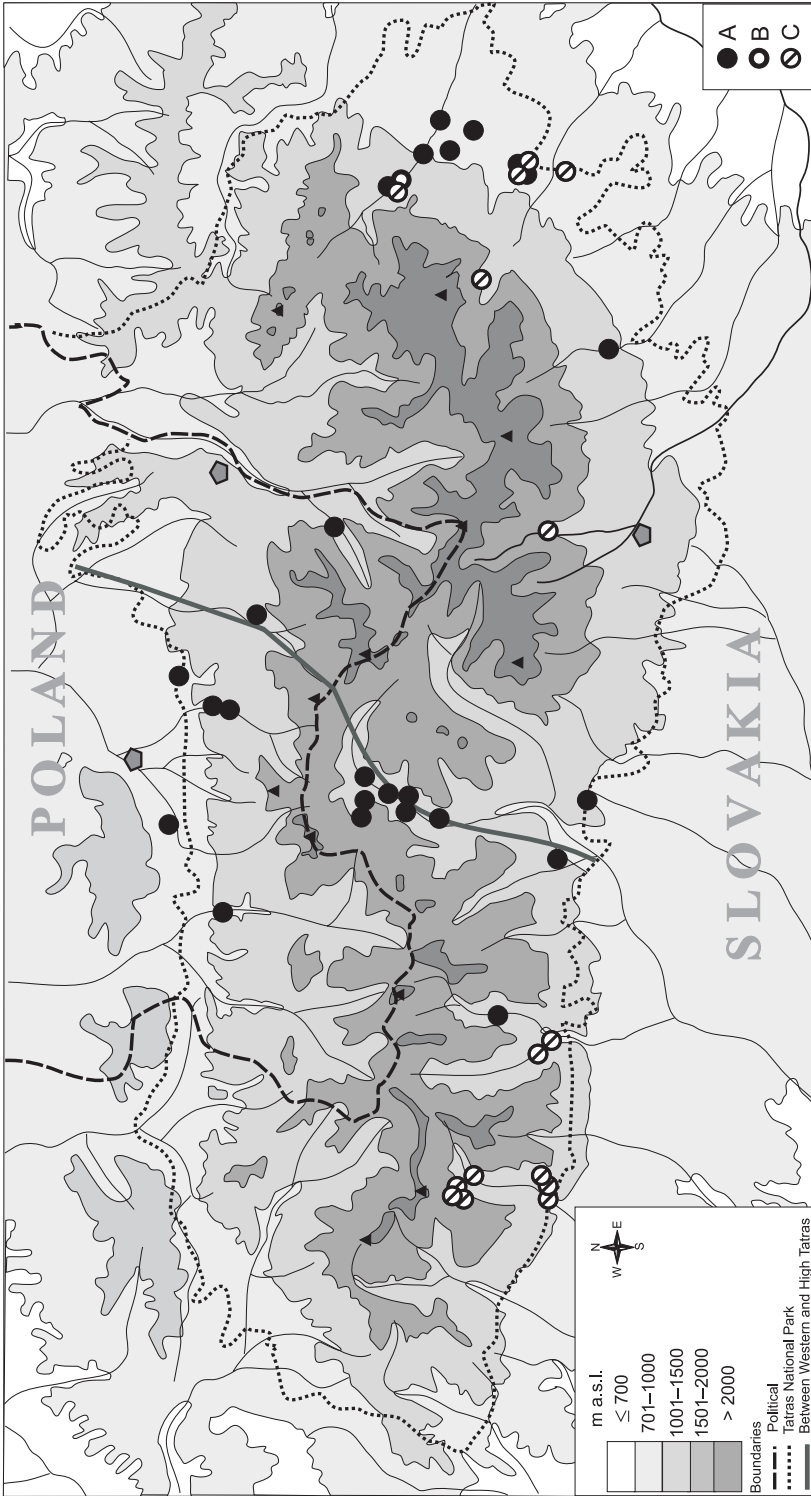


Fig. 7. Distribution of *Taphrina alni* (Berk. & Broome) Gjaerum and *T. betulae* (Fuckel) Johanson in the Tatra National Park. *Taphrina alni* (Berk. & Broome) Gjaerum on *Alnus incana* (L.) Moench (A); *Taphrina betulae* (Fuckel) Johanson on *Betula carpathica* Waldst. & Kit. (B), and *Betula pendula* Roth (C).

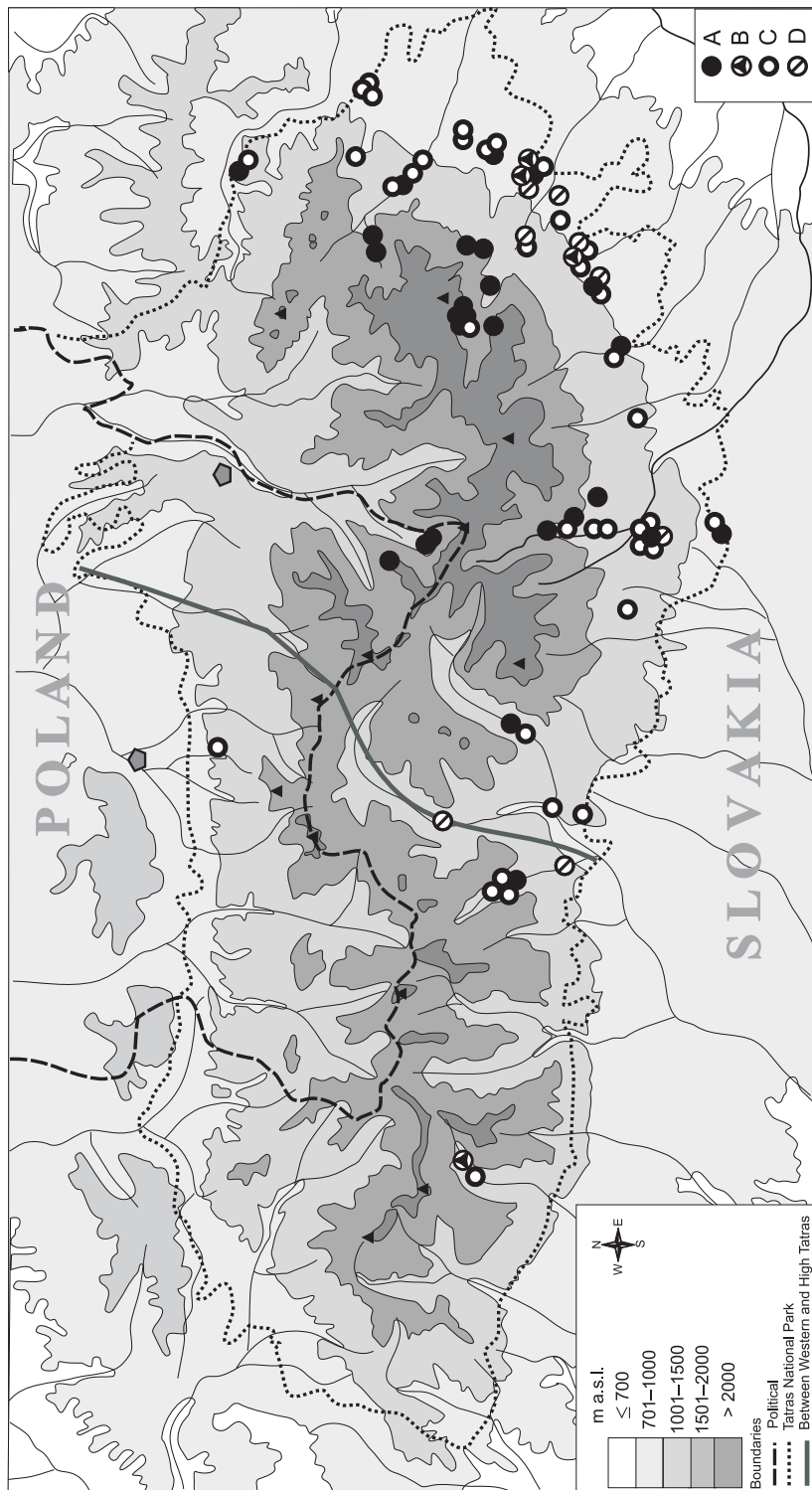


Fig. 8. Distribution of *Taphrina betulina* Rostr. in the Tatra National Park. *Taphrina betulina* Rostr. on *Betula carpatica* Waldst & Kit. (A), *Betula pendula* Roth (B), *Betula pubescens* Ehrh. (C) and *Betula* sp. (D).

3 Oct. 1986 (SAV); Tatranská Lomnica village, in the park (Bacigálová 1991, 1997); Tatranské Matliare village (Bacigálová 1997); BELIANSKE TATRY MTS: Ždiar village, roadside (Bacigálová 1991). – POLAND. TATRA MTS: without precise localization (Wróblewski 1925; Starmachowa 1963); TATRY WYSOKIE MTS: Morskie Oko lake, spruce forest, 1450 m, 11 June 1986 (Mułenko *et al.* 1995); Rybi Potok valley, Biały Żlebek gully, spruce forest, 1500 m, 7 Nov. 1996 (Chlebicki 2002); Opalony Wierch Mt., 1600 m, 1 June 1985 (LBLM).

On *Betula pendula* Roth (Fig. 8) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Žiarska dolina valley, between Žiarska chata cottage and Malé Závraty, *Pmc*, 1460 m, 16 Aug. 2004 (LBLM); VYSOKÉ TATRY MTS: Tatranská Lomnica village, spruce forest, 980 m, 2 July 2000 (SAV); Tatranská Lomnica and Smokovec villages, without precise localization (Baudyš & Picbauer 1925; Starmachowa 1963). – POLAND. TATRA MTS: without precise localization (Wróblewski 1925, Starmachowa 1963).

On *Betula pubescens* Ehrh. (Fig. 8) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Podbanské village, near the confluence of Tichý potok and Kôprovský potok streams (Bacigálová 1991); Žiarska dolina valley, near Žiarska chata cottage (Bacigálová 1997); 19 Aug. 2004 (SAV); Kamenistá dolina valley, near the stream (Bacigálová 1991); spruce forest, 1300 m, 9 July 2002 (SAV); spruce forest, 1340 m, 23 July 2001 (SAV); spruce forest, 1340 m, 26 July 2001 (LBLM); VYSOKÉ TATRY MTS: Horný Smokovec village, Pecná vyhládka, near railway station (Bacigálová 1991); Nový Smokovec (Bacigálová 1997); Starý Smokovec village, in the park and along main road (Bacigálová 1991, 1997); Hrebienok Mt., near hotel (Bacigálová 1991); Kežmarské Žľaby village, roadside (Bacigálová 1991); Štrbské Pleso village, in the park near ropeway (Bacigálová 1991, 1997); center, 1350 m, 13 July 2000 (LBLM); south part of the Štrbské pleso lake, 1347 m, 2 Aug. 2002 (LBLM); spruce forest 25 July 2000 and 21 July 2001 (SAV); Tatranská Kotlina village, roadside (Bacigálová 1991); Tatranská Lomnica village, in the park (Bacigálová 1991); Tatranská Lesná village, roadside (Bacigálová 1991); Tatranská Polianka village, roadside in the park, 960 m (Bacigálová 1991, 1997); Tatranská Štrba village, roadside in nursery of spruce (Bacigálová 1991); Tatranské Matliare village (Bacigálová 1991, 1997). Vyšné Hágy village, near railway station (Bacigálová 1997); Mengusovská dolina valley, 19 July 1991 (SAV); Tatranská magistrála tourist route, between Štrbské Pleso village and Popradské pleso lake (Bacigálová 1997); spruce forest, 1420 m, 17 Aug. 1999 and 12 July 2002

(SAV); between Štrbské Pleso village and Jamské pleso lake, 1340 m, 13 July 2000 (SAV); Dolina Kežmarskej Bielej vody valley, near Šalviový prameň spring (Bacigálová 1997) and 1200 m, 22 July 2000 (SAV); spruce forest 1050 m, 22 July 2000 (SAV); Malá Studená dolina valley, *Pmc*, 1660 m, 20 July 2001 (SAV); Cesta Slobody road, park between Tatranská Lomnica and Tatranské Matliare villages, 14 July 1990 (SAV); Tatranské Matliare village (Bacigálová 1991, 1997); Tri tudničky bus stop, roadside (Bacigálová 1991); Kôprová dolina valley, near the stream (Bacigálová 1991); BELIANSKE TATRY MTS: Ždiar village, center of the village and along the main road (Bacigálová 1997); Dolina sedmich prameňov valley, Chata Plesnivec cottage, 1320 m, 14 July 2000 (SAV); Tatranská Kotlina village, in the park and along the main road (Bacigálová 1997). – POLAND. TATRY ZACHODNIE MTS: Ścieżka nad Reglami tourist route, near Słupy (Zameczki), 1280 m, 15 June 1998 (SAV).

On *Betula* sp. (Fig. 8) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Tichá dolina valley (Bacigálová 1997); Podbanské village, near Tri studničky (Bacigálová 1997); VYSOKÉ TATRY MTS: Štrbské pleso village, in garden near rack railway (Bacigálová 1997); Horný Smokovec village, near railway (Bacigálová 1997); Starý Smokovec village, Pecná vyhládka, near railway station (Bacigálová 1997); Hrebienok Mt. (Bacigálová 1997); Stará Lesná railway station (Bacigálová 1997); Tatranská Lomnica village (Bacigálová 1997).

Taphrina epiphylla (Sadeb.) Sacc.

Exoascus epiphyllus Sadeb.

On *Alnus incana* (L.) Moench (Fig. 9) – SLOVAKIA. TATRA MTS: outside the National Park, Žiar village, near the river, 28 July 1988 (SAV); between Zuberec village and Habovka village, near Biely potok stream, 7 Aug. 1988 (SAV); ZÁPADNÉ TATRY MTS: Tichá dolina valley, near Tichý potok stream, 1080 m (Bacigálová 1991, 1994a); Tomanová dolina valley, spruce forest, 1164 m (Bacigálová 1991, 1994a); roadside, 1200 m, 18 Aug. 1995 (SAV); Roháčska dolina valley, near stream, 17 Aug. 1988 (SAV); VYSOKÉ TATRY MTS: Kôprová dolina valley, roadside, 1104 m (Bacigálová 1991, 1994a); Tatranská Polianka village (Bacigálová 1991); Tatranské Matliare village (Bacigálová 1991); Dolina Kežmarskej Bielej vody valley, spruce forest near Šalviový prameň spring, 1200 m (Bacigálová 1991, 1994a); spruce forest 1160 m, 16 Aug. 1999 (SAV); spruce forest, 950 m, 17 Aug. 1995 (SAV); Kežmarské Žľaby village (Bacigálová 1991, 1994a);

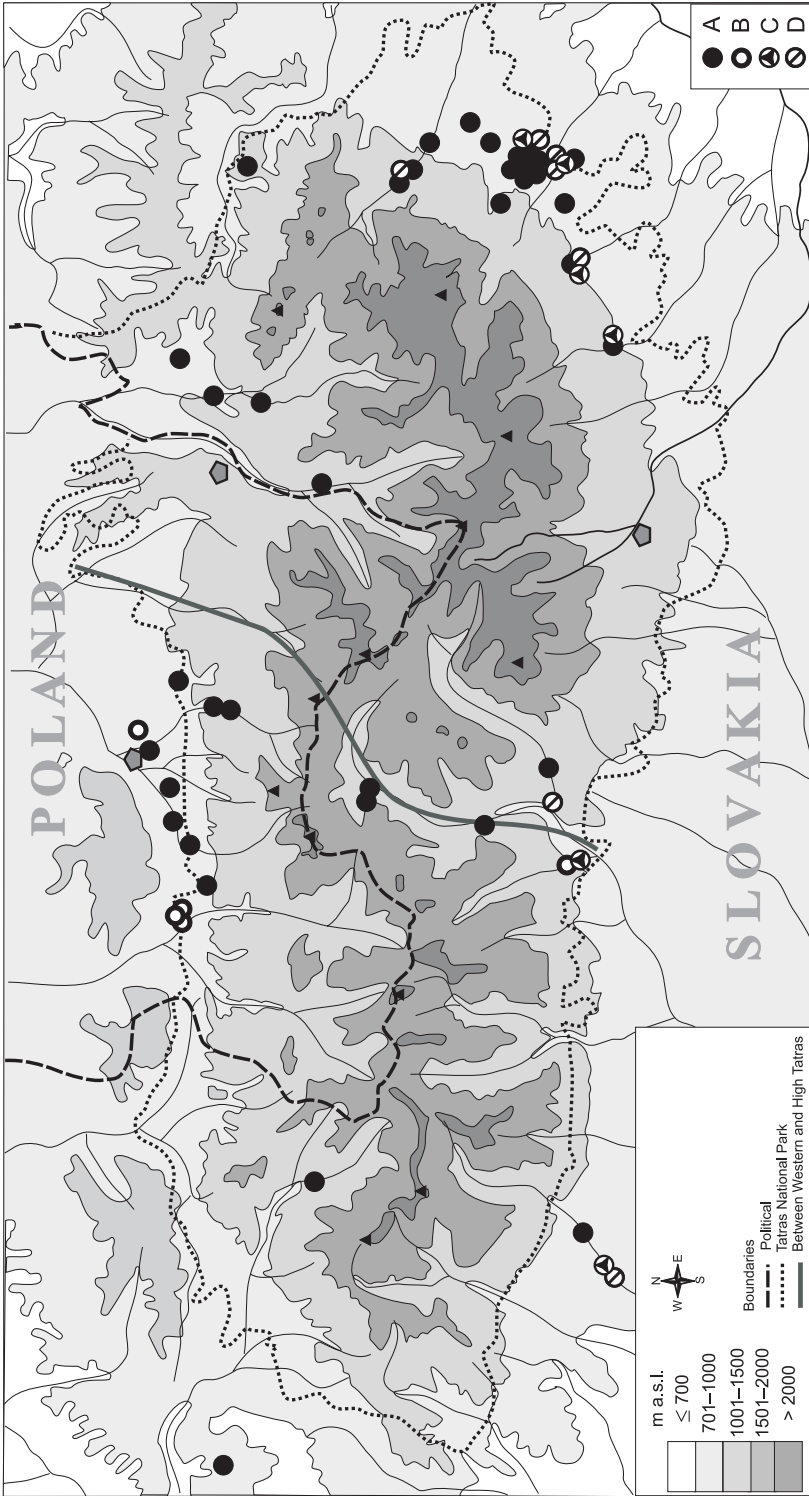


Fig. 9. Distribution of *Taphrina epiphylla* (Sadeb.) Sacc., *T. populina* Fr., *T. sadebeckii* Johanson and *T. tosquinetii* (Westend.) Magn. in the Tatra National Park. *Taphrina epiphylla* (Sadeb.) Sacc. on *Alnus incana* (L.) Moench (A); *Taphrina populina* Fr. on *Populus nigra* L. (B); *Taphrina sadebeckii* Johanson on *Alnus glutinosa* (L.) Gaertn. (C); *Taphrina tosquinetii* (Westend.) Magn. on *Alnus glutinosa* (L.) Gaertn. (D).

Starý Smokovec village, roadside in the park (Bacigálová 1991, 1994a); Bielowodská dolina valley, without precise localization (Bacigálová 1991, 1994a); Stará Lesná railway station (Bacigálová 1991); Stará Lesná village (Bacigálová 1994a); roadside in spruce forest, 17 Aug. 1995 and 21 July 2001 (SAV); Tatranská Lomnica village, without precise localization (Bacigálová 1994a); in park, 22 Aug. 1985, *leg. C. Paulech* (SAV); near railway, 27 July 2000 (SAV); near hotel Morava, 24 July 2000 (SAV); near TANAP museum, 9 Sept. 1992 (SAV); near hotel Slovan, 18 July 2000 (SAV); roadside near Jamy, 8 Aug. 2002 (SAV); roadside, 8 Aug. 2004 (SAV); road between Tatranská Lomnica village and Štart station, roadside, 21 July 2001 (SAV); BELIANSKE TATRY MTS: Ždiar village, near Ždiarsky potok stream, 17 Aug. 1995 (SAV); Javorová dolina valley, along Javorinka stream, 26 July 2000 (SAV); Podspády village (Bacigálová 1991, 1994a); Tatranská Javorina village, near Javorinka river, 940 m (Bacigálová 1991, 1994a). – POLAND. TATRA MTS: outside the National Park, Kotlina Zakopiańska basin (Sałata *et al.* 1993); Krzeptówki village (Szulczewski 1930; Starmachowa 1963; Sałata *et al.* 1993); Skibówki village (Szulczewski 1930; Starmachowa 1963; Sałata *et al.* 1993); Zakopane, Chałubińskiego street, 2 June 1998, *leg. A. Wolczańska* (LBLM); Zakopane, near railway line, 15 June 1998 (SAV). TATRY ZACHODNIE MTS: Dolina Bystrej valley, near Kuźnice village, roadside in *Alnetum incanae*, 1109 m (Sałata *et al.* 1984); Dolina Bystrej valley, Polana Kalatówki glade, roadside, 1135 m, 20 June 1999, *leg. A. Wolczańska* (LBLM); Droga pod Regłami road, Hruby Regiel Mt., N slope, streamside, 980 m, 13 June 1998, *leg. B. Sałata* (LBLM); Dolina Kościeliska valley, near stream, 16 June 1998 (SAV); Kiry, border of National Park, near Biathlon stadion, 19 June 1998 (SAV), near Biały Domek cottage, 12 June 1998 (SAV).

Taphrina filicina Rostr. *ex* Johans

On *Dryopteris carthusiana* (Vill.) H. P. Fuchs – POLAND. TATRA MTS: without precise localization (Wróblewski 1925; Starmachowa 1963; Sałata 1974).

Taphrina padi (Jacz.) Mix

Taphrina pruni (Fuckel) Tul. var. *padi* Jacz.

On *Prunus padus* L. (Fig. 10) – POLAND. TATRA MTS: outside the National Park, Kotlina Zakopiańska basin (Sałata *et al.* 1993); Nędzówka village, garden, 950 m, 13 June 1998, *leg. B. Sałata* (LBLM), 13 June 1998 (SAV); Zakopane town, Piłsudskiego street, 12 June 1998, *leg. A. Wolczańska* (LBLM).

Taphrina populina Fr.

On *Populus nigra* L. (Fig. 9) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Cesta slobody road, near Podbanské village, roadside, ca 950 m, 26 June 1992 (Bacigálová 1994b). – POLAND. TATRA MTS: outside National Park, Kotlina Zakopiańska basin (Sałata *et al.* 1993); TATRY ZACHODNIE MTS: Kiry village, border of National Park, roadside, 950 m, 13 June 1998, *leg. B. Sałata* (LBLM), near Biały Domek cottage, 950 m 14 June 1998 (SAV), near Biathlon stadion, 19 June 1998 (SAV).

Taphrina potentillae (Farl.) Johanson

Exoascus deformans (Berk.) Fuckel var. *potentillae* Farl. – *Exoascus potentillae* (Farl.) Sadeb.

On *Oreogeum montanum* (L.) E. I. Golubk. (Fig. 10) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Žiarska dolina valley, small lake under Žiarske sedlo settle, alpine grassland, 1825 m, 16 Aug. 2004 (SAV); VYSOKÉ TATRY MTS: Mlynická dolina valley, Pleso nad Skokom lake, 1801 m, 20 July 1991 (Bacigálová 1992); 25 June 1992 (SAV); Mengusovská dolina valley, Hincove pleso lake, alpine grassland, 1946 m, 8 Aug. 1999 and 20 July 2001 (SAV); Malá Studená dolina valley, Teryho chata cottage, alpine grassland near Prostredné Spišské pleso lake, 2010 m, 22 July 1991 and 10 July 2002 (SAV); Batizovská dolina valley, NE side of Batizovské pleso lake, alpine grassland, 1898 m (Bacigálová 1992); 1890 m., 19 July 2001, 12 July 2002 (SAV, LBLM); Zlomisková dolina valley, subalpine grassland near Ľadový potok stream, 1700 m (Bacigálová 1992); 8 Aug. 1998 (SAV); alpine grassland near Ľadové pleso lake, 1925 m (Bacigálová 1992); 24 July 2001 (SAV); Velická dolina valley, Kvetnica, alpine grassland under Kvetnicová Veža Mt., 1850 m, 7 Aug. 1998 (SAV); Tatranska Magistrála tourist route, between Popradské pleso lake and Ostrva Mt., subalpine grassland, 1800 m (Bacigálová 1992).

On *Potentilla erecta* (L.) Rauschel – POLAND. TATRA MTS: without precise localization (Wróblewski 1925; Starmachowa 1963; Sałata 1974).

Taphrina pruni (Fuckel) Tul.

Exoascus pruni Fuckel

On *Prunus domestica* L. (Fig. 10) – SLOVAKIA. TATRA MTS: outside the National Park, Habovka village, in garden, 17 Aug. 1988 (SAV).

On *Prunus spinosa* L. (Fig. 10) – SLOVAKIA. VYSOKÉ TATRY MTS: Velická dolina valley, Kvetnica (Husz 1921; Starmachowa 1963).

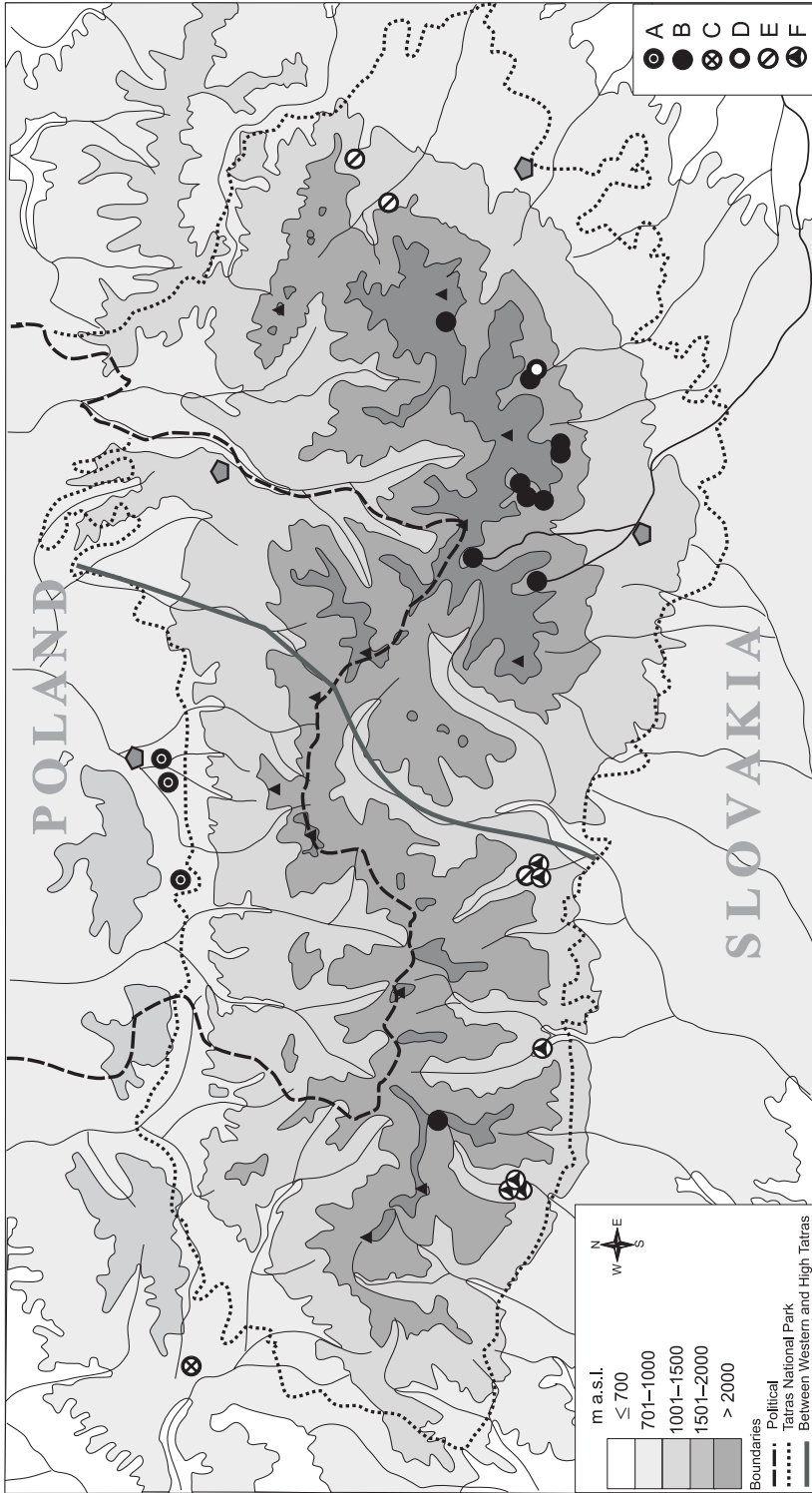


Fig. 10. Distribution of *Taphrina padi* (Jacz.) Mix, *T. potentillae* (Farl.) Johanson, *T. pruni* (Fuckel) Tul., *T. vestergrenii* Giesenh., and *T. viridis* Maire in the Tatra National Park. *Taphrina padi* (Jacz.) Mix on *Prunus padus* L. (A); *Taphrina potentillae* (Farl.) Johanson on *Oreogalum montanum* (L.) E. I. Golubik. (B); *Taphrina pruni* (Fuckel) Tul. on *Prunus domestica* L. (C); *Prunus spinosa* L. (D); *Taphrina vestergrenii* Giesenh. on *Dryopteris carthusiana* (Vill.) H. P. Fuchs (E); *Taphrina viridis* Maire on *Alnus alnobetula* (Ehrh.) Hartig (F).

Taphrina sadebeckii Johanson*Taphrina flava* (Sadeb.) Magn.

On *Alnus glutinosa* (L.) Gaertn. (Fig. 9) – SLOVAKIA. TATRA MTS: outside the National Park, Smrečany village, near Smrečianka stream (Bacigálová 1994a); ZÁPADNÉ TATRY MTS: Kamenistá dolina valley, in spruce forest 980 m, 6 Sept. 1988 (SAV); VYSOKÉ TATRY MTS: Tatranská Polianka village, roadside (Bacigálová 1991); Tatranská Lomnica village, roadside in spruce forest, 975 m, 18 July 2000 (LBLM); roadside in spruce forest, 18 July 2000 and 22 July 2000 (SAV); Starý Smokovec village, roadside in the park (Bacigálová 1991, 1994a); Stará Lesná village, roadside in spruce forest (Bacigálová 1994a); 28 Aug. 1990 (SAV). – POLAND. TATRA MTS: without precise localization (Wróblewski 1925; Starmachowa 1963).

Taphrina tosquinetii (Westend.) Magn.*Ascomyces tosquinetii* Westend.

On *Alnus glutinosa* (L.) Gaertn. (Fig. 9) – SLOVAKIA. TATRY MTS: outside the National Park, Smrečany village, near Žiarsky potok stream (Bacigálová 1994a); VYSOKÉ TATRY MTS: Kôprová dolina valley, near the stream, 950 m, 6 Aug. 1998 (SAV); road between Tatranská Lomnica and Stará Lesná villages, roadside, 20 Aug. 1999 (SAV); Stará Lesná village, near hotel Academia, 17 July 2001 (SAV); border of spruce forest, 21 July 2001 (SAV); Starý Smokovec village, near railway in park (Bacigálová 1991, 1994a); Tatranská Lomnica village, in park, 2 July 2000 (SAV); Dolina Kežmarskej Bielej vody valley, near Šalviový prameň spring 1180 m (Bacigálová 1991, 1994a).

Taphrina vestergrenii Giesenh.

On *Dryopteris carthusiana* (Vill.) H. P. Fuchs (Fig. 10) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Kamenistá dolina valley, spruce forest, 1260 m (LBLM, SAV; Bacigálová *et al.* 2002); 9 July 2002 and 10 July 2003 (SAV).

Taphrina viridis Maire

On *Alnus alnobetula* (Ehrh.) Hartig (Fig. 10) – SLOVAKIA. ZÁPADNÉ TATRY MTS: Jamnická dolina valley, spruce forest, 950 m, 18 Aug. 2004 (SAV); Žiarska dolina valley, roadside in spruce forest, 1100 m, 13 Aug. 2004 (SAV); roadside in spruce forest, 1110 m and 1130 m, 13 Aug. 2004 (LBLM); Kamenistá dolina valley, roadside, 1200–1250 m, 6 Sept. 1988,

and 8 Aug. 1993 (Bacigálová 1994c); 23 July 2001 and 9 July 2002 (SAV, LBLM).

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REFERENCES

- BACIGÁLOVÁ K. 1991. Príspevok k poznaniu druhov rodu *Taphrinales* vo Vysokých Tatrách. *Zborník TANAP* 31: 35–43.
- BACIGÁLOVÁ K. 1992. *Taphrina potentillae* (Farl.) Johans. on *Parageum montanum* (L.) Hara – a new species in Slovakia. *Czech Mycol.* 46: 138–142.
- BACIGÁLOVÁ K. 1994a. Species of *Taphrina* on *Alnus* in Slovakia. *Czech Mycol.* 47: 223–236.
- BACIGÁLOVÁ K. 1994b. Species of *Taphrina* on *Populus* in Slovakia. *Czech Mycol.* 47: 277–284.
- BACIGÁLOVÁ K. 1994c. *Taphrina viridis* – a new species for the Karpaty Mts. *Czech Mycol.* 47: 285–288.
- BACIGÁLOVÁ K. 1995. Rozšírenie zástupcov čeľade Protomycetaceae na Slovensku. *Bull. Slov. Bot. Spoločn. Bratislava* 17: 39–43.
- BACIGÁLOVÁ K. 1997. Species of *Taphrina* on *Betula* in Slovakia. *Czech Mycol.* 50: 107–118.
- BACIGÁLOVÁ K. 1999. Fytopatogénne mikroskopické huby Vysokých Tatier I. *Štúdie o Tatranskom Národnom Parku* 4(37): 41–70.
- BACIGÁLOVÁ K., LOPANDIC K., RODRIGUES M. G., FONSECA A., HERZBERG M., PINSKER W. & PRILLINGER H. 2003. Phenotypic and genotypic identification and phylogenetic characterisation of *Taphrina* fungi on alder. *Mycol. Progr.* 2(3): 179–196.
- BACIGÁLOVÁ K. & MULENKO W. 2005. *Protomycopsis arnoldii* – a new species for the Carpathians. *Biologia (Bratislava)* 60(4): 1–4.
- BACIGÁLOVÁ K., MULENKO W. & PRILLINGER H. 2002. A *Taphrina* on *Dryopteris carthusiana* in Slovakia. *Mycotaxon* 84: 387–390.

- BAUDYŠ E. & PICBAUER R. 1925. Addenda ad fl. Čechosl. mycologicam II. *Prace Moravské Privodovodecké Společnosti* 2(7): 177–194.
- BÜREN G. 1915. Die schweizerischen Protomycetaceen mit besonderer Berücksichtigung ihrer Entwicklungsgeschichte und Biologie. *Beitr. Kryptogamenfl. Schweiz* 5(1): 1–95.
- BÜREN G. 1922. Weitere Untersuchungen über die Entwicklungsgeschichte und Biologie der Protomycetaceen. *Beitr. Kryptogamenfl. Schweiz* 5(3): 1–94.
- CHLEBICKI A. 2002. Biogeographic relationships between fungi and selected relict plants. *Monogr. Bot.* 90: 1–230.
- GJAERUM H. B. 1964. The genus *Taphrina* Fr. in Norway. *Nytt. Mag. Bot.* 11: 5–26.
- HENDERSON D. M. 1956. The genus *Taphrina* in Scotland. *Notes Roy. Bot. Gard. Edinburgh* 21: 165–180.
- HOLMGREN P. K., HOLMGREN N. H. & BARNETT L. C. 1990. Index herbariorum. Part I: The herbaria of the world. Ed. 8. *Regnum Veg.* 120: 1–693.
- HUSZ B. 1921. Beiträge zur Kenntnis d. mikroskopischen Pilzflora d. Hohen Tatra u. d. Zips. *Bot. Közlem.* 19(1–6): 96–105.
- MARHOLD K. & HINDÁK F. (eds) 1998. Checklist of non-vascular and vascular plants of Slovakia. Veda, Bratislava.
- MIX A. J. 1949. A monograph of the genus *Taphrina*. *Univ. Kansas Sci. Bull.* 33: 3–167.
- MOESZ G. 1930. Pilze aus dem Norden Ungarns, Zeitsch. zur Erforsch. der Ungar. *Kryptogamenflora* 1(7): 795–815.
- MULENKO W., SALATA B. & WOLCZAŃSKA A. 1995. Mycological notes from the Tatra National Park. II. *Acta Mycol.* 30(1): 65–79.
- MULENKO W., KOZŁOWSKA M. & SALATA B. 2004. Microfungi of the Tatra National Park. A checklist. Biodiversity of the Tatra National Park 1: 1–72. W. Szafer Institute of Botany, Polish Academy of Science, Kraków.
- NAJĐENOV J. 1986. Distribution of certain species from *Taphrina* Sadeb. genus on the forest vegetation in this country. *Gorskostopanska Nauka* 5: 35–40.
- PAULECH C., ROMASZEWSKA-SALATA J. & SALATA B. 1991. Phytopathogenous micromycetes of the family Erysiphaceae in Vysoké Tatry Mountains. *Zbornik Prác o TANAPe (Tatranská Lomnica)* 31: 63–71 (in Slovak with English, German, Polish and Russian summaries).
- PICBAUER R. 1933. Addenda ad fl. Čechosl. mycologicam VII. *Prace Moravské Privodovodecké Společnosti* 8: 1–20.
- REDDY M. S. & KRAMER C. H. L. 1975. A taxonomic revision of the Protomycetales. *Mycotaxon* 3(1): 1–50.
- ROUPPERT K. 1912. Grzyby zebrane w Tatrach, Beskidzie Zachodnim i na Pogórzu. *Spraw. Komis. Fizjogr.* 46: 80–100.
- SALATA B. 1974. Szpetkowe (Taphrinales). In: J. KOCHMAN & A. SKIRGIEŁŁO (eds), *Flora Polska. Rośliny Zarodnikowe Polski i ziem ościennych. Grzyby*, 6. Państwowe Wydawnictwo Naukowe, Warszawa–Kraków.
- SALATA B. 1979. Pierwogrzybowe (Protomycetales). In: J. KOCHMAN & A. SKIRGIEŁŁO (eds), *Flora Polska. Rośliny Zarodnikowe Polski i ziem ościennych. Grzyby*, 12. Państwowe Wydawnictwo Naukowe, Warszawa–Kraków.
- SALATA B., ROMASZEWSKA-SALATA J. & MULENKO W. 1984. Mycological notes from the Polish Tatra National Park. *Acta Mycol.* 20: 13–21 (in Polish with English summary).
- SALATA B., ROMASZEWSKA-SALATA J. & MULENKO W. 1993. Microscopic phytopathogenic fungi. In: Z. MIREK & H. PIEKOŚ-MIRKOWA (eds), *Nature of the Kotlina Zakopiańska Basin. Tatry i Podtatrze* 2: 183–207 (in Polish with English summary).
- SALATA B. & MULENKO W. 1996. Microscopic phytopathogenic fungi. In: Z. MIREK, Z. GŁOWACIŃSKI, K. KLIMEK, H. PIEKOŚ-MIRKOWA (eds), *Nature of the Tatra National Park. Tatry i Podtatrze* 3: 393–404 (in Polish with English summary).
- STARMACHOWA B. 1963. Les champignons parasites des Tatras. *Monogr. Bot.* 15: 153–294 (in Polish with French summary).
- SZULCZEWSKI J. W. 1930. Die Gallen des polnischen Tatra-gebirges. *Spraw. Komis. Fizjogr.* 64: 1–11 (in Polish with German summary).
- WRÓBLEWSKI A. 1918. Beitrag zur Kenntnis der Pilzflora Westgaliziens. *Spraw. Komis. Fizjogr.* 52: 122–127 (in Polish with German summary).
- WRÓBLEWSKI A. 1925. Champignons recueillis par M. Raciborski dans des environs de Cracovie et dans le Tatra en 1883 et 1890. *Acta Soc. Bot. Poloniae* 3(1): 29–41 (in Polish).
- ZEROVA M. J. 1969. Vznachnik gribov Ukrainy, 2. Askomicety. *Naukova Dumka*, Kiev.

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