

Biodiversity of Rust Fungi in the Šumava (Bohemian Forest) and in the Krkonoše (Giant Mountains), Czech Republic

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Abstract

The occurrence and seasonal dynamics of rust fungi (*Uredinales*) on wild growing plants was investigated on eleven localities in the Bohemian Forest (Šumava Mts.) and on three localities in the Giant Mountains (Krkonoše Mts.). All studied localities are situated in the most strictly protected areas of the Czech National Parks (ecosystems of the mires, the glacial corries, and the arctic alpine tundra) that are considered the primary centres of biodiversity. The frequency of occurrence of the rust species is linked with the host plant diversity. It is also influenced by the human activity in specific places. The occurrence and the distribution of rusts are compared with available historical data. Several rust species are regular inhabitants of the natural ecosystems. The others follow the invasive host plant species.

Keywords: rust fungi; *Uredinales*; biodiversity; Czech National Parks Šumava and Krkonoše

INTRODUCTION

The National Parks Šumava (Bohemian Forest Mts.) and Krkonoše (Giant Mts.) represent the most important natural parts of the Czech Republic. The strictly protected areas of these National Parks as glacial corries, mires and arctic-alpine tundra are considered the centres of biodiversity. The examination of the present-day level of biodiversity of these areas is an important aim of several research programmes. A recent mycological research has concentrated on selected groups of microscopic fungi including rusts (*Uredinales*).

Microfungi have been studied a long time ago and the current biodiversity is poorly known. A comparison of the historical and present data could serve as information on changes in fungal diversity. In the case of parasitic fungi their presence could also reflect the changes in host plant communities. The dynamics of occurrence of rust species both in natural and in human activity influenced ecosystems is evaluated.

An review of historical data on the distribution of rusts in central Šumava is given in MARKOVÁ (2001).

The main information concerning Krkonoše was published by BUBÁK (1906) and SCHRÖTER (1887). The data on the distribution of grass rusts (also in both National Parks) were elaborated by URBAN (1966).

MATERIAL AND METHODS

The rusts were collected on eleven localities of Šumava, namely on Svaroh and Jezerní hora (mountains), Černé jezero (a lake corrie), Špičácké sedlo (a mountain pass), Čertovo jezero (a lake corrie), Laka (a lake corrie), Ždánidla (a mountain), Roklanská smrčina (a spruce forest), Mlynářská slat (a mire), Vydra (river surroundings), Plešné jezero (a lake corrie) and Houska (a mire). Geographically, these localities are ordered from west to east. Rusts were collected mainly between 1994 and 2001.

In Krkonoše, most of the rusts were collected on the localities Kotelní jámy (a glacial corrie), Pančavská louka (a mire) and Úpská jáma (a glacial corrie) between 1999 and 2002.

The books by GÄUMANN (1959), URBAN (1966), POELT and ZWETKO (1997) and ZWETKO (2000) were

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used to determine rust species and their nomenclature. The usual symbols are presented for the stages of the rust life cycle (0 – spermogonia, I – aecia, II – uredia, III – telia). The names of host plants are used according to DOSTÁL (1989).

RESULTS

During the investigation, the following 39 rust species were found in Šumava:

Melampsora cf. caprearum Thüm. II on *Salix aurita* L. and *Salix caprea* L.

Melampsora laricis Hartig ex Kleb. II on *Populus tremula* L.

Melampsorium betulinum (Pers.) Kleb. II (III) on *Betula pendula* Roth

Naohidemyces vaccinii (Wint.) Sato, Katsuya et Y. Hiratsuka (= *Thecopsora vaccinii* (Wint.) Hiratsuka fil.) II on *Vaccinium uliginosum* L. and *Vaccinium myrtillus* L.

Phragmidium fusiforme Schroet. II, III on *Rosa pendulina* L.

Puccinia bistortae DC. II, III on *Bistorta major* S.F.Gray

Puccinia pimpinellae (Str.) Röhl. II, III on *Pimpinella major* (L.) Huds.

Puccinia aegopodii (Schum.) Röhl. III on *Aegopodium podagraria* L.

Puccinia asarina Kunze III on *Asarum europaeum* L.

Puccinia cf. senecionis Lib. I on *Senecio ovatus* (Gaertn., Meyer et Scherb.) Willd.

Puccinia cf. silvatica Schroet. I on *Taraxacum officinale* Weber in Wiggers and *Senecio ovatus* (Gaertn., Meyer et Scherb.) Willd.

Puccinia cnici-oleracei Pers. ex Desm. III on *Cirsium heterophyllum* (L.) Hill, 24 July 1996

Puccinia coronata Cda. I on *Frangula alnus* Miller and var. *coronata* II on *Alopecurus pratensis* L., II, III on *Holcus mollis* L.

Puccinia deschampsiae Arth. II on *Deschampsia caespitosa* (L.) Beauv.

Puccinia festucae Plowr. II, III on *Festuca cf. ovina* L.

Puccinia graminis Pers. subsp. *graminicola* Urban, II on *Deschampsia caespitosa* (L.) Beauv.

Puccinia hieracii (Schum.) Mart. II, III on *Hieracium argillaceum* Jord.

Puccinia hypochoeridis Oud. II on *Hypochoeris radicata* L.

Puccinia chondrillae Cda II, III on *Mycelis muralis* (L.) Dumort.

Puccinia laschii Lagerh. II, III on *Cirsium heterophyllum* (L.) Hill

Puccinia leontodontis Jacky II, III on *Scorzoneroide autumnalis* (L.) Moench

Puccinia luzulae-maximae Diet. II on *Luzula sylvatica* (Huds.) Gaud.

Puccinia maculosa (Str.) Röhl. II on *Prenanthes purpurea* L.

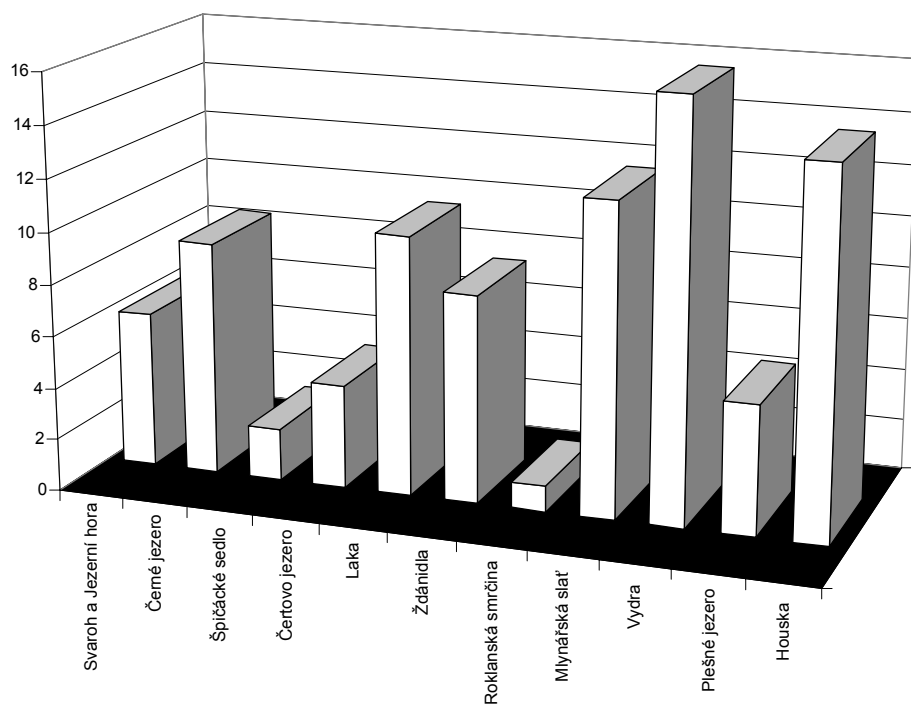


Figure 1. Numbers of rust species at particular localities of Šumava

Puccinia obscura Schroet. II, III on *Luzula multiflora* (Ehrh. ex Retz.) Lej.
Puccinia perplexans Plow. II, III on *Alopecurus pratensis* L. and cf. 0, I on *Ranunculus acris* L.
Puccinia poae-nemoralis Otth II on *Poa annua* L., *Poa chaixii* Vill. in L., *Poa nemoralis* L.
Puccinia poarum Niels. I on *Tussilago farfara* L., II on *Poa angustifolia* L., *Poa pratensis* L. and *Poa trivialis* L.
Puccinia pygmaea Erikss. II (III) on *Calamagrostis villosa* (Chaix) J.F. Gmel.
Puccinia retifera Lindr. II, III on *Chaerophyllum aureum* L.
Puccinia sessilis W. G. Schneid. in Schroet. 0 on *Maianthemum bifolium* (L.) F. W. Schmidt
Puccinia silvatica Schroet. II on *Vigna brizoides* (L.) Reichenb.
Puccinia willemetiae Bub. II on *Calyocorsus stipitatus* (Jacq.) Rauschert
Trachyspora intrusa (Grev.) Arth. II on *Alchemilla* sp. div.
Triphragmium ulmariae (Hedw. f. ex DC.) Link II on *Filipendula ulmaria* (L.) Maxim.
Uredinopsis filicina (Niesel) Magnus II on *Phegopteris connectilis* (Michx. fil.) Watt
Uredo festucae DC. II on *Festuca rubra* L.
Uromyces airae-flexuosae Ferd. et Winge II on *Avenella flexuosa* (L.) Drejer
Uromyces dactylidis Otth II, III on *Dactylis glomerata* L.
Uromyces trifolii (Hedw. f. ex DC.) Fckl. III on *Trifolium repens* L.

Twelve species known from literature were not found (MARKOVÁ 2001). At present, the species *Puccinia luzulae-maximae*, *Uromyces airae-flexuosae* and *Melampsora* cf. *caprearum* appear to be the most frequent ones. The numbers of rust species found at particular localities are given in Figure 1. The high number of rusts at the localities Vydra, Houska and Mlynářská slat reflects the high diversity of host plant species. In contrast, the plant and consequently the rust diversity of Roklanská smrčina are both very low.

The following list presents 39 rust species found in Krkonoše:

Coleosporium campanulae (Strauss) Tul. II on *Campanula rapunculoides* L. and on *Campanula rotundifolia* L.
Coleosporium senecionis Fr. et Kicks. on *Senecio ovatus* (Gaertn., Meyer et Scherb.) Willd. and cf. I on *Pinus mugo* Turra
Melampsora cf. *caprearum* Thüm. II on *Salix caprea* L.

Melampsorium betulinum (Fr.) Kleb. II (III) on *Betula pubescens* Ehrh.
Mylesina blechni (P. & H. Syd.) P. & H. Syd. II on *Blechnum spicant* (L.) Roth
Phragmidium potentillae (Pers.) Karst. II, III on *Potentilla aurea* L.
Puccinia bistortae DC. II, III on *Bistorta major* S.F. Gray
Puccinia arenariae (Schum.) Wint. III on *Stellaria nemorum* L.
Puccinia carduorum Jacky II, III on *Carduus personata* (L.) Jacq.
Puccinia cf. *senecionis* Lib. I on *Senecio ovatus* (Gaertn., Meyer et Scherb.) Willd
Puccinia conglomerata (Strauss) Röhl. III on *Homo-gyne alpina* (L.) Cass.
Puccinia coronata Cda. var. *coronata* II, III on *Holcus mollis* L.
Puccinia deschampsiae Arth. II on *Deschampsia caespitosa* (L.) Beauv.
Puccinia graminis Pers. subsp. *graminicola* Urban II on *Anthoxanthum odoratum* L., *Dactylis glomerata* L. and *Deschampsia caespitosa* (L.) Beauv.
Puccinia hieracii (Schum.) Mart. II on *Hieracium murorum* L.
Puccinia chaerophylli Purt. II, III on *Myrrhis odorata* (L.) Scop.
Puccinia chondrillae Cda. I on *Mycelis muralis* (L.) Dumort.
Puccinia leontodontis Jacky II, III on *Scorzoneroide autumnalis* (L.) Moench
Puccinia maculosa (Str.) Röhl. II, III on *Prenanthes purpurea* L.
Puccinia major (Diet.) Diet. 0, I on *Crepis paludosa* (L.) Moench.
Puccinia mulgedii P. & H. Syd. II, III on *Cicerbita alpina* (L.) Wallr.
Puccinia perplexans Plow. II, III on *Alopecurus pratensis* L. and cf. 0, I on *Ranunculus acris* L.
Puccinia poae-nemoralis Otth II on *Anthoxanthum odoratum* L., *Poa chaixii* Vill. in L. and *Poa nemoralis* L.
Puccinia poarum Niels. I on *Tussilago farfara* L. and II on *Poa* sp.
Puccinia pozzii Semadeni III on *Chaerophyllum hirsutum* L.
Puccinia punctiformis (Str.) Röhl. 0, II, III on *Cirsium arvense* (L.) Scop.
Puccinia pygmaea Erikss. II (III) on *Calamagrostis arundinacea* (L.) Roth. and *C. villosa* (Chaix) J.F. Gmel.
Puccinia taraxaci (Rebent.) Plow. II on *Taraxacum officinale* Weber in Wiggers

Puccinia urticata Kern. I on *Urtica dioica* L.
Schroeteriaster alpinus (Schroet.) Magn. II, III on
Rumex alpinus L.
Thecopsora symphyti (DC.) Berndt II on *Symphytum*
officinale L.
Trachyspora intrusa (Grev.) Arth. II on *Alchemilla*
sp. div.
Triphragmium ulmariae (Hedw. f. ex DC.) Link I,
 II, III on *Filipendula ulmaria* (L.) Maxim.
Uredinopsis filicina (Niesel) Magnus II on *Phegopteris*
connectilis (Michx. fil.) Watt
Uromyces airae-flexuosae Ferd. et Winge II, III on
Avenella flexuosa (L.) Drejer
Uromyces dactylidis Oth II on *Dactylis glomerata* L.
Uromyces geranii (DC.) Fr. I, II, III on *Geranium*
pratense L.
Uromyces trifolii (Hedw. f. ex DC.) Fckl. III on
Trifolium repens L.
Uromyces trifolii-repentis (Cast.) Liro II, III on *Tri-*
folium repens L.

Most species were found in corries; on the local-
 ity Pančavská louka, only five species of rusts were
 found. According to historical data from Krkonoše,
 about 50 species of rusts were collected. Recently,
 20 of these species were found but the investigation
 has not yet been completed. Preliminary results did not
 confirm the occurrence of rusts on rare host species
 in natural ecosystems. Regarding the preservation of
 the diversity (genofond) of organisms this would be a
 negative information. At the same time, intensive hu-
 man activity in the region causes undesirable changes
 in the host plant diversity. The input of invasive plants
 is followed by their pathogenes (*Puccinia taraxaci*,
P. punctiformis, *P. poarum* and so on).

The results confirm the parallel occurrence of
 21 rust species in both National Parks.

The climatic conditions dependent, intensive
 occurrence of several rusts can be viewed as a phy-
 topathological problem, as for example *Melampsora*
sp. div., *Melampsoridium betulinum* and *Coleosporium*
sp. div.

References

- BUBÁK F. (1906): Houby české. I. Rezy (*Uredinales*).
 Archiv přírodovědného výzkumu Čech, 13/5: 1–228
 DOSTÁL J. (1989): Nová květena ČSSR 1–2. Academia,
 Praha.
 GÄUMANN E. (1959): Die Rostpilze Mitteleuropas mit
 besonderer Berücksichtigung der Schweiz. Beitrag Kryp-
 togamen – Flora Schweiz, 12: 1–1407.
 MÁLKOVÁ J., KŮLOVÁ A. (1995): Vliv dolomitického
 vápence na změny druhové diverzity vegetace podél
 cest v hřebenových partiích východních Krkonoš. Opera
 Concor., 32: 115–130.
 MARKOVÁ J. (2001): Contribution to the biodiversity of
 rust fungi (*Uredinales*) in the Bohemian Forest (Šumava
 Mts.). Silva Gabreta, Vimperk, 7: 211–222.
 POELT J., ZWETKO P. (1997): Die Rostpilze Österreichs.
 2., revidierte und erweiterte Auflage des Catalogus Florae
 Austriae, III Teil, Heft 1, *Uredinales*. Biosystematics
 and Ecology Series, No. 12, Wien.
 SCHRÖTER J. (1887): Uredinei. In: Krypt.-fl. Schlesiens,
 3/1: 291–381.
 URBAN Z. (1966): Československé travní rzi. [Habilitační
 práce.] Karlova univerzita, Praha.
 ZWETKO P. (2000): Die Rostpilze Österreichs. Supple-
 ment und Wirt-Parasit-Verzeichnis zur 2. Auflage des
 Catalogus Florae Austriae, III. Teil, Heft 1, *Uredinales*.
 Biosystematics and Ecology Series, No. 16, Wien.