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OCCURRENCE OF *WOODSIA ALPINA* (ATHYRIACEAE) IN THE TATRA MTS

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Abstract: The distribution of the very rare and threatened fern *Woodsia alpina* in the Polish and Slovakian Tatras is reviewed and mapped. The species is scattered between 1100 and 2600 m a.s.l. It occurs in the Western Tatras on dolomite rocks and in the High Tatras on mylonitized granites, growing mainly in crevices of very steep rock walls. The populations are very small, usually comprising a few plants. The threat to them and conservation measures are discussed.

Key words: Pteridophyta, *Woodsia alpina*, distribution, habitats, the Carpathians, Poland, Slovakia

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INTRODUCTION

Woodsia alpina (Bolton) S. F. Gray is a rare and threatened species through its whole European range. It is included in the red data books and red lists of several countries (Procházka & Paclová 1999). In Poland and Slovakia it is among the rarest ferns, classified in Poland as a critically endangered (CR) species (Fabiszewski & Piękoś-Mirkowa 2001) and in Slovakia as an endangered (EN) species (Feráková *et al.* 2001).

In Poland *W. alpina* has been reported from the Karkonosze Mts (Fabiszewski & Piękoś-Mirkowa 2001) and from two stations in the Tatra Mts (Szafer & Sokołowski 1927; Pawłowski 1956; Piękoś-Mirkowa 1982). In the course of floristic studies carried out in the Tatra Mts in recent years by the present authors, this species was found on three separate rocks in Koński Żleb gully above the Dolina Strążyska valley.

In Slovakia *W. alpina* is restricted exclusively to the Tatra Mts, where it has been recorded from a few stations (Schidlay 1966; Procházka & Paclová 1999).

This paper deals with the occurrence of *W. alpina* in the Polish and Slovakian Tatra Mts, giving a full list of localities including newly found ones. Habitat conditions and population size are characterized, threats to this species are considered, and conservation measures to maintain existing populations are suggested.

MATERIAL AND METHODS

A distribution map and diagram of *Woodsia alpina* in the Polish and Slovakian Tatras were elaborated on the basis of literature and the authors' field records. Only two specimens of this rare fern have been preserved in the five herbaria we have seen in Kraków (KRAM, KRA), Zakopane (ZTS) and Bratislava (SAV, BRA). Schidlay (1966) cited data on another five specimens from PRC, BRNM, BRNU and TPN.

Some soil properties were determined in one soil sample collected from a newly found station in Koński Żleb gully. Active acidity (pH H_2O) and exchangeable acidity (pH KCl) were determinated potentiometrically, organic carbon content using Tiurin's method, and total nitrogen content by Kjeldahl's method.

GENERAL DISTRIBUTION

Woodsia alpina is a circumpolar species restricted to arctic areas and high mountains (Dostál 1984; Hultén 1958). In Europe it occurs in Scandinavia, northern Russia and Great Britain, and the Alps, Pyrenees, Apennines, Sudety Mts and Carpa-

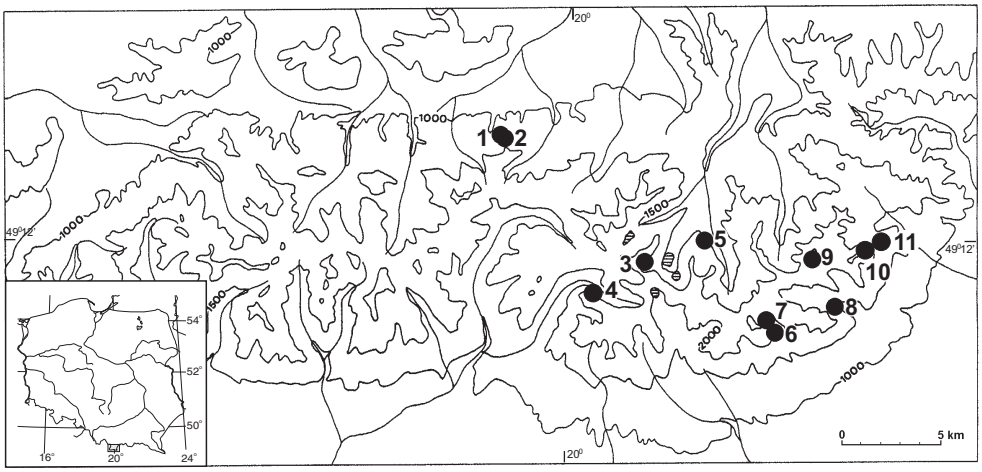

Fig. 1. Distribution of *Woodsia alpina* (Bolton) S. F. Gray in the Tatra Mts.

thians. It is also found in the Caucasus and scattered in the Urals, Siberia, Altai, Kamchatka, the Western Himalayas, North America and Greenland.

DISTRIBUTION IN THE TATRA MTS

Woodsia alpina is a very rare glacial relic species in the Tatra Mts. The map (Fig. 1) shows its distribution, and the diagram (Fig. 2) its altitudinal range. The stands are scattered between 1100 m and 2600 m a.s.l. The lower localities (1100–1200 m) in Koński Żleb gully are within the lower montane belt. The highest station (2600 m) on Malý L'adový Mt. is in the subnival belt (Resner 1967).

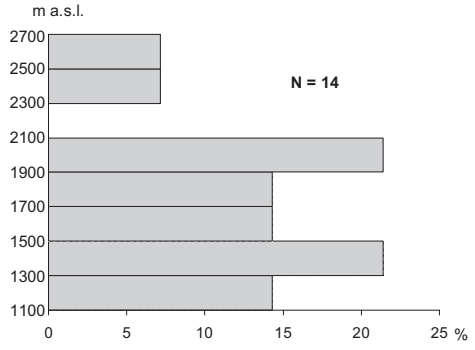

Fig. 2. Vertical distribution of localities of *Woodsia alpina* (Bolton) S. F. Gray in the Tatra Mts.

LIST OF STATIONS

POLAND. WESTERN TATRAS (Tatry Zachodnie): 1 – Koński Żleb 1100 m and 1105 m (Delimat & Piękoś-Mirkowa); alt. 1200 m, 18 July 1998, *leg. A. Nedorub* (ZTS); 2 – Suchy Wierch Mt. 1480 m (Szafer & Sokołowski 1927; Pawłowski 1956), crevices of calcareous rocks, 29 August 1924, *leg. M. Sokołowski* (KRA 79347); High Tatras (Tatry Wysokie): 3 – between Morskie Oko lake and Szpiglasowa Przełęcz pass, *ca* 1900 m (Piękoś-Mirkowa 1982).

SLOVAKIA. HIGH TATRAS (Vysoké Tatry): 4 – Kriváň Mt., N slope (Resner 1967); 5 – Bielovodská dolina valley near Českе pleso lake between Mlynár and Ganek Mts. 1425–1555 m (Domin 1925); between Bielovodská and Česka dolina valley 1400 m (Paclová 1964) – according to Paclová (l.c.), this locality may be identical with that given by Domin (1925); 6 – Kvetnicová veža Mt. above Velická dolina valley 1790–1810 m (Radwańska-Paryska 1981); 7 – Gerlach Mt., E slope *ca* 1900 m (Šmarda 1955); 8 – Slavkovský Mt. above Veľká Studená dolina valley 1550–1575 m (Radwańska-Paryska 1981); 9 – Malý Ľadový Mt., SE slope *ca* 2600 m (Resner 1967); 10 – Kežmarský Mt. 2450 m (Resner 1967); 11 – Veľká Svišťovka 1700–2000 m (Resner 1967).

Woodsia alpina has also been reported without a precise location from the Studenovodská dolina valley (Hazslinszky 1872).

HABITATS

Woodsia alpina grows in open places. It is a moderately calciphilous species occurring on very steep walls of dolomite Triassic rocks in Koński Żleb gully and on Suchy Wierch Mt. in the Western Tatras. In the High Tatras it occur mainly on mylonitized granites (Schidlay 1966; Procházka & Paclová 1999). The species is found on initial soils (lithosols). In the stand in Koński Żleb gully the soil sample exhibits a neutral reaction (pH in H_2O 7.3 and pH in KCl 7.15). Organic carbon content reaches 13.03% and total nitrogen content 1.29%. The C/N ratio is 10.

Table 1. The species accompanying *Woodsia alpina* (Bolton) S. F. Gray in three localities in the Tatra Mts. 1–3 – localities.

No.	1	2	3
Woodsia alpina (Bolton) S. F. Gray	x	x	x
Asplenium viride Huds.	x		
Asplenium trichomanes L.		x	
Cystopteris fragilis (L.) Bernh.			x
Gentiana verna L.	x		x
Gentiana clusii J. O. E. Perrier & Songeon		x	
Gypsophila repens L.			x
Carex capillaris L.	x		
Crepis jacquinii Tausch	x	x	
Leontopodium alpinum Cass.	x	x	
Campanula cochleariifolia Lam.		x	
Primula auricula L.	x	x	
Saxifraga oppositifolia L.			x
Saxifraga caesia L.			x
Saxifraga paniculata Mill.			x
Saxifraga aizoides L.			x
Salix reticulata L.			x
Trisetum alpestre (Host) P. Beauv.	x		x
Draba aizoides L.			x
Hedysarum hedysaroides (L.) Schinz & Thell.			x
Scabiosa lucida Vill.		x	x
Artemisia eriantha Ten.			x
Festuca versicolor Tausch			x

Localities and sources: 1. Koński Żleb, 1105 m, S, 90°, surface: 5 m^2, date: 15.06.2000 (Piękoś-Mirkowa & Delimat); 2. Koński Żleb, 1100 m, S, 60°, surface: 6 m^2, date: 30.05.2001 (Delimat); 3. Velká Svištovka, 1700–2000 m (Resner 1967).

The occurrence of *W. alpina* is restricted to rock crevices with minimum soils. It is connected with communities representing the order *Potentilletalia caulescentis* Br.-Bl. in Br.-Bl. & Jenny 1926. The vegetation of rock crevices in the Tatra Mts is very poor, with species numbering a few or in the teens. The floristic composition of phytocoenoses with *W. alpina* is presented in Table 1. In the Slovakian Tatras this species also occurs in scree communities representing the alliance *Androsacion alpinae caulescentis* Br.-Bl. in Br.-Bl. & Jenny 1926 (Procházka & Paclová 1999).

POPULATION SIZE AND THREAT

Woodsia alpina populations are very small, comprising usually a few plants. For example, at one site in Koński Żleb gully only six clumps were found, and at another site there were thirteen individuals with spores and two juvenile plants. Resner (1967) observed two clumps on the northeastern slope of Kežmarský Mt. Two sites on the eastern slope of Mt. Slavkovský support one and two small clumps (Radwańska-Paryska 1981). On the southeastern slope of Kvetnicová veža Mt. within the Gerlach massif a few clumps were found (Radwańska-Paryska 1981). *W. alpina* populations cover small areas a few meters square or somewhat larger.

In Poland *Woodsia alpina* is considered a critically endangered species (Fabiszewski & Piękoś-Mirkowa 2001) and in Slovakia an endangered species (Feráková *et al*. 2001). It is potentially threatened due to its very rare and isolated occurrence, as well as stochastic genetic events found in extremely small populations. Generally the sites of *W. alpina* are not exposed to damage by man because they are difficult to access. Only the locality between Morskie Oko Lake and Szpiglasowa Przełęcz pass, situated close to a very popular hiking trail, appears to be in danger. Some sites

of *W. alpina* in the Slovakian Tatras are exposed to destruction by rock falls (Procházka & Paclová 1999).

All localities of *W. alpina* in the Tatras are within national parks, both Polish and Slovakian. National park status and legal protection cannot, however, ensure effective conservation of this species. Continuous monitoring to determine appropriate protection measures is needed if existing populations are to be maintained. Detailed research on the biology, ecology and dynamics of populations should be carried out *in situ* as a basis for successful conservation. Additionally, this extremely rare fern should be propagated *ex situ* in botanical gardens, and its spores stored in spore banks. In Poland, so far *W. alpina* is preserved only in the Mountain Botanical Garden of the Polish Academy of Sciences in Zakopane.

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