Dryopteris remota rediscovered for the flora of the Czech Republic

***Dryopteris remota* – nově ověřený druh květeny České republiky**

Libor E k r t[1], Martin L e p š í[2], Karel B o u b l í k[3] & Petr L e p š í[4]

[1]*Department of Botany, Faculty of Biological Sciences, University of South Bohemia, Branišovská 31, CZ-370 05 České Budějovice, Czech Republic, and Administration of the Šumava National Park, 1. máje 260, CZ-385 01 Vimperk, e-mail: libor.ekrt@atlas.cz;* [2]*South Bohemian Museum in České Budějovice, Dukelská 1, CZ-370 51 České Budějovice, Czech Republic, e-mail: lepsi@seznam.cz;* [3]*Institute of Botany, Academy of Sciences of the Czech Republic, CZ-252 43 Průhonice, Czech Republic, e-mail: boublik@ibot.cas.cz;* [4]*Administration of the Blanský les Protected Landscape Area, Vyšný 59, CZ-381 01 Český Krumlov, Czech Republic, e-mail: plepsi@seznam.cz*

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Until now, *Dryopteris remota* was only recorded in the Czech Republic from the Moravian Karst, ca 70 years ago. This record is mentioned in some studies, but references to the data's origin have always been missing. For this reason it was uncertain whether *D. remota* was still present in the Czech Republic. Recently, the records from the Moravian Karst were verified by re-examination of original herbarium specimens. In 2002 a specimen of *D. remota* was found for the first time in Bohemia, close to the village of Ktiš, on a slope of Malý Plešný hill in the foothills of the Bohemian Forest (S Bohemia). At this locality only one plant occurred on the boundary between *Lonicera nigra*-shrub and spruce-beech-fir forest, on a gneiss outcrop. Determination of the Czech specimens of *D. remota* was based on comparisons with macro- and micromorphological characters of both Alpine (Upper Austria) and Carpathian (West Ukraine) specimens, as well as descriptions in the literature. A detailed morphological description and comparison with similar taxa are included. A map of its distribution within the Czech Republic as well as a map of the distribution of *D. remota* worldwide is also presented. It is suggested that *D. remota* be designated a critically endangered plant species in the Czech Republic.

K e y w o r d s : Bohemian Forest foothills, *Dryopteridaceae*, ferns, Moravian Karst, *Pteridophyta*

Introduction

Dryopteris remota (A. Braun ex Döll) Druce is a critical member of the genus *Dryopteris* from a taxonomic point of view. It was first described from the Schwarzwald Mts, Germany, in 1843 (Druce 1908, Krause 1998). The taxon is considered to be a fixed hybridogenous species, which originated from a cross between the diploid taxa *D. affinis* subsp. *affinis* and *D. expansa* or *D. pallida* (Krause 1998).

Dryopteris remota is a strictly apogamous taxon with a triploid set of chromosomes (2n = 123), which produces both well developed and aborted spores (Manton 1950). Molecular studies (RAPDs) indicate a polymorphic origin of *D. remota* at various localities in Europe. A good dispersal ability by spores is reported in this species, which has enabled it to disperse over great geographical distances (Schneller et al. 1998).

Whether *D. remota* occurred in the Czech Republic was unclear until recently (Chrtek 1988, Kubát in Kubát et al. 2002), when records from the Moravian Karst (= Moravský

kras) (Bílý 1931, 1937) were verified, based upon an examination of F. Bílý's herbarium specimens. In the present paper this species is also reported for the first time in Bohemia.

This paper presents a description of the new locality and reviews the revised herbarium specimens from the main Czech herbarium collections confirming the historical occurrence in the region of the Moravian Karst. The taxonomic position, general distribution and distinguishing characters of this species are presented and discussed. A map of the overall distribution of *D. remota* is also presented, because it is missing from recent compendia (Meusel et al. 1965, Jalas & Suominen 1988, Fraser-Jenkins & Reichstein 1984). The last overall distribution map was published ca 70 years ago (Döpp 1939).

Material and methods

The distribution of this species within the Czech Republic and its overall distribution, are based upon examination of specimens from the following public herbaria (abbreviations follow Holmgren et al. 1990): BRNM, BRNU, CB, HOMP, KHMS, OH, PR, PRC, SOB; as well as on the literature (Fraser-Jenkins 1982, Fraser-Jenkins & Reichstein 1984, Salvo & Arrabal 1986, Boudrie & Labatut 1989, Haeupler & Schönfelder 1989, Vadam 1990, Peroni et al. 1991, Hartl et al. 1992, Boudrie & Lazare 1993, Gruber 1994, Point 1996, Prosser 1996, Page 1997, Polatschek 1997, Beck 1998, Schneller et al. 1998, Lauber & Wagner 1998, Bizot 1999, Ciocârlan 2000, Jogan et al. 2001, Krause et al. 2001, Stöhr & Strobl 2001, Marchetti 2002, Aeschimann et al. 2004, Fraser-Jenkins C. R. & Trewren K., unpublished).

Texts on the herbarium labels were abridged and translated into English. Names of phytogeographic divisional units within the Czech Republic follow Skalický (1988). For the quadrants (1/4 of basic square) of the Central European grid mapping, see Ehrendorfer & Hamann (1965). The altitude and coordinates (WGS-84) of the new locality near the village of Ktiš were measured using a Garmin Vista C instrument. The comparison of some important morphological characteristics of selected herbarium specimens from the Czech Republic, Austria and the Ukraine were made to confirm the determination of the new find in Bohemia. Specifically, exospore length, stoma length, lamina length, lamina width, and number of pairs of pinnae were measured and evaluated on specimens from the main Czech herbarium collections. Samples of 20 spores (exospore length) and 30 stomata (using nail-varnish) were measured on each specimen examined, at a magnification of 1000×, using a light microscope (Olympus CH30). The specimen of *D. remota* found near Ktiš village (S Bohemia) was revised by K. Horn and H. W. Bennert.

Names of taxa follow Kubát et al. (2002) and Kučera & Váňa (2003), only *D. pallida* follows Fraser-Jenkins (1993). A voucher herbarium specimen from the Ktiš locality is preserved at CB.

Nomenclature and description

Dryopteris remota (A. Braun ex Döll) Druce, List Brit. Pl. 87, 1908.

B a s i o n y m : *Aspidium rigidum* var. *remotum* A. Braun ex Döll, Rhein. Fl. 16, 1843.
H o l o t y p u s : Germany, Baden-Württemberg region, Schwarzwald, Geraulsauer Wasserfall, 1834 (deposited in B).
For a comprehensive list of synonyms see Fraser-Jenkins & Reichstein (1984).

Fig. 1a. – Specimen of *Dryopteris remota* from southern Bohemia.

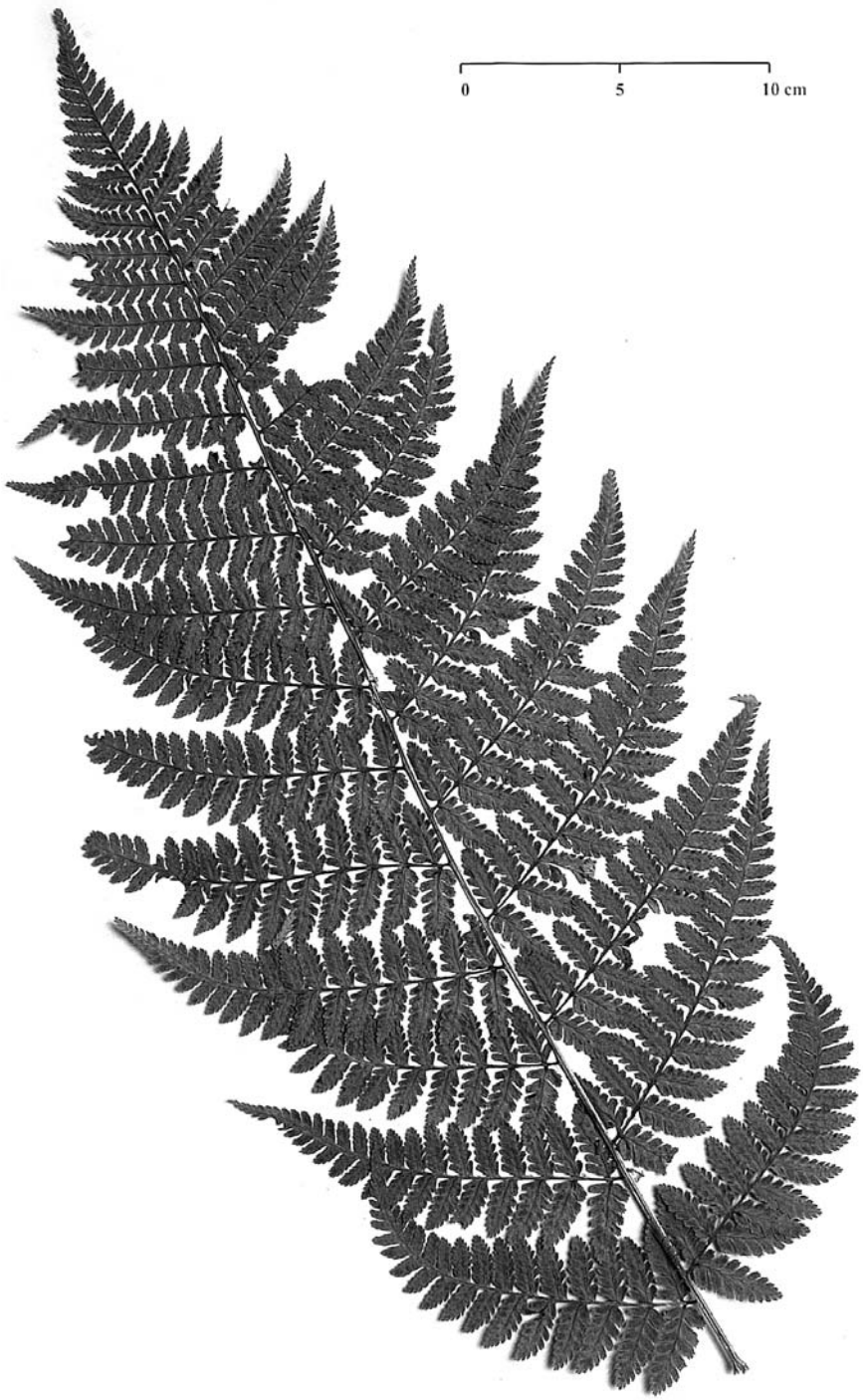

Fig. 1b. – Specimen of *Dryopteris remota* from southern Bohemia.

D e s c r i p t i o n (based on Fraser-Jenkins & Reichstein 1984, Krause et al. 2001, Fraser-Jenkins 1993) (Fig. 1): Plants perennial, usually tufted; rhizome short, ascending to erect, producing offshoots; leaves usually survive winter, 20–90 cm long and 10–25 cm wide, glabrous or slightly glandulous; stipe ca 4 mm thick, usually 1/2 (–3/4) of the total leaf length, the stipe scales lanceolate to narrowly lanceolate, bicolorous, light brown with dark base; blades thick subcoriaceous dark green, juvenile yellow-green, narrowly elliptical, 2-pinnate, with pinnae mostly opposite, 12–22 pairs; point of insertion of secondary rhachis (live plants) with ca 3–10 mm long blackish part (similar to *D. affinis*); pinnule segments oblong-ovate, shallowly pinnately lobed, with ± parallel margins, the lobes rounded or bearing long acute, often aristate teeth, mostly pinnatifid, only the lowest proximal 2–3 pairs pinnatisect; proximal pinnule segments distinctly and very shortly stalked, basiscopic basal pinnule of basal pinnae slightly or distinctly longer than the basal acroscopic pinnule; distal pinnae sessile and truncate at tips, apex acute or setaceous; stomata length 49–56 μm; sori medial, ca 1 mm in diameter; indusia thick, densely glandular, light brown, at maturity persisting or soon shrivelling, with slightly revolute margins; spores are mainly well developed (maximum 32 spores per sporangium) but some aborted, exospore length (30–) 36–48 (–54) μm; 2n = 123.

Comparison of *Dryopteris remota* with some other taxa and notes on morphometry

Of the European species of *Dryopteris*, *D. remota* is most closely similar to *D. carthusiana*, which commonly occurs in almost all of Europe. These two species are very similar morphologically (Fraser-Jenkins & Reichstein 1984, Frey et al. 1995, Kubát in Kubát et al. 2002, Fischer et al. 2005). A comparisons of the important morphological characteristics of *D. carthusiana* and *D. remota* is presented in Table 1 and drawing of the pinnae of both species in Fig. 2.

Two different taxa were considered to be *D. remota* in the past (Manton 1950, Benl & Eschelmüller 1973). A lot of confusion in the determination of *D. remota* was caused by the existence of the hybrid *D.* ×*brathaica* Fraser-Jenkins & Reichstein (*D. carthusiana* × *D. filix-mas*). This hybrid was discovered and described from England (Fraser-Jenkins & Reichstein 1977). Recently, it was also found in France and Germany (Boudrie et al. 1994, Krause et al. 2001). The general morphology of *D.* ×*brathaica* and *D. remota* is very similar, but *D.* ×*brathaica* is characterized typically by the pinnae lacking a dark purple base, aborted spores, a tetraploid chromosomal set and other characteristics (Fraser-Jenkins & Reichstein 1977, Krause et al. 2001).

A summary of the selected morphometric characteristics measured on the plants found in the Czech Republic and in the literature is presented in Table 2. For a reliable determination of *D. remota* it is essential to collect a mature leaf and ensure that the spores are not lost. By checking the sporangial content it is possible to confirm the identification. Because of the triploid origin of *D. remota*, some sporangia contain 32 normal spores and those with aborted spores may contain a few regular ones and a few aborted ones. When aborted spores occur the number of spores per sporangium may be between 32 and 64. The measurement of the exospore length of well developed spores can also confirm the identification of the species. The spore size of plants from the Czech Republic agrees with the spore size of those from the Alps, and measured by Fraser-Jenkins & Reichstein 1984 and

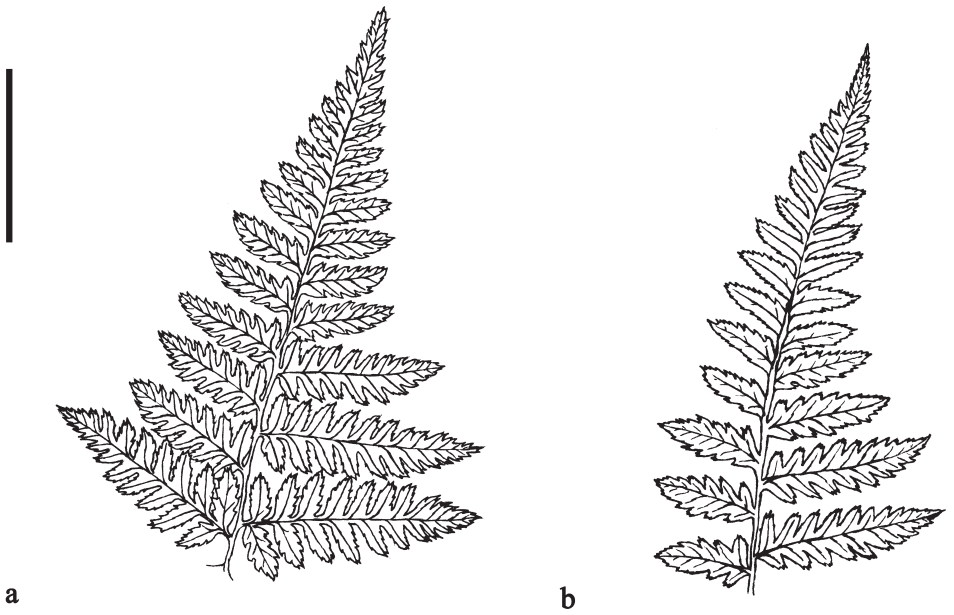

Fig. 2. – Basal pinnae of *Dryopteris carthusiana* (a) and *D. remota* (b) (del. P. Lepší). Scale bar is 3 cm.

Krause et al. 2001 (Table 2). Stomata lengths of our plants range between 43 and 46 μm (Table 2). However, this range falls within the lower values recorded by Krause et al. (2001). The values for other characters are similar to those reported in the literature.

General distribution

Dryopteris remota is a subatlantic and subalpine species. It is recorded in W Ireland, Scotland, N Spain (Pyrenees), France, Germany, Switzerland, N Italy, Austria, the Czech Republic (Moravian Karst), W Hungary, Slovenia, W Croatia, Poland (Biesczady), the Ukraine, Romania, Turkey and the W and central parts of the Caucasus (Bílý 1931, 1937, Fraser-Jenkins 1982, Fraser-Jenkins & Reichstein 1984, Prosser 1996, Page 1997, Marchetti 2002).

An overview of the overall distribution range of *D. remota* is presented in Fig. 3. The centre of its European distribution area is in the N part of the Alps and foothills of the N Alps in Austria, Germany and Switzerland, where it is a scattered and relatively frequent species. In most peripheral areas of its range *D. remota* occurs very rarely and in particular localities only a few plants occur (Fraser-Jenkins & Reichstein 1984). Because of the difficulty of identifying this plant, we consider *D. remota* to be a neglected species.

Table 1. – Comparisons of important morphological characters of *Dryopteris carthusiana* and *D. remota* (based on Fraser-Jenkins & Reichstein 1984, Krause et al. 2001).

Character	Taxon	
	Dryopteris carthusiana	*Dryopteris remota*
Petiole scales	concolorous, light brown	bicolorous, light brown with dark base
Leaves (older ones)	green to yellow-green, usually not present during winter	dark green, usually evergreen during winter
Point of insertion of secondary rhachis (live plants)	green, never blackish	with ca 3–10 mm long blackish part
Margin of the basal lobe of the basal pinnule facing the secondary rhachis	usually dentate	usually not dentate
Terminal parts of pinnules	with long spiny teeth	with short mucronate (sometimes spiny) teeth
Spores	always normally developed	partly aborted
Length of developed spores (exospore length) (μm)	(27–) 33–39 (–42)	(30–) 36–48 (–54)
Indusium	lacks glands	frequently glandular

Table 2. – Summary of some morphometric characters measured on plants of *Dryopteris remota* originated from the Czech Republic (CZ), Austria (AUS) and the Ukraine (UKR). Herbaria abbreviations refer to those in local herbaria; ST = mean of stoma length; SD_{ST} = standard deviation of stoma length; SP = mean of spore length; SD_{SP} = standard deviation of spore length; L = leave length; W = lamina width (length of two opposite pinnae); P = number of pair of pinnae.

Specimen/source	ST (μm)	SD_{ST}	SP (μm)	SD_{SP}	L (cm)	W (cm)	P (pl)
CZ, CB 39336	44.5	3.3	42.5	3.8	85	21.5	19
CZ, BRNU 285028	45.5	3.5	41.5	3.5	52	17.5	15
CZ, BRNU 285029	45.5	3.8	–	–	45	18.0	15
CZ, BRNU 218901	43.1	2.4	–	–	50	18.5	17
AUS, CB 33064	42.1	3.8	42.7	5.2	105	27.0	19
AUS, CB 33056	43.3	3.6	41.2	4.6	80	27.0	17
UKR, CB 38859	45.6	3.4	–	–	43	16.5	12
Fraser-Jenkins & Reichstein 1984	–	–	–	–	20–90	10.0–25.0	12–22
Krause et al. 2001	49–56	3.4–5.8	–	–	50–69	18.5–31.0	–

Ecological requirements in Central Europe

Dryopteris remota is reported from altitudes of (260–) 400 to 1200 m a.s.l. from ravines, steep rocky slopes and screes. It grows in mesotrophic and eutrophic mixed forests dominated by *Fagus sylvatica*, *Acer pseudoplatanus*, or *Fraxinus excelsior* (the *Fagetalia sylvaticae* order), in the submontane and montane vegetation belts. Rarely, it occurs in spruce and spruce-fir forests, young spruce plantations, in clearings or openings in the subalpine vegetation belt. Accompanying this species are other ferns and meso- and eutrophic forest species. Species of oligotrophic substrates are rare or absent.

Dryopteris remota can commonly be found on siliceous bedrocks, but its occurrence on calcareous bedrocks is also known (e.g. in the German part of the Alps, it occurs to-

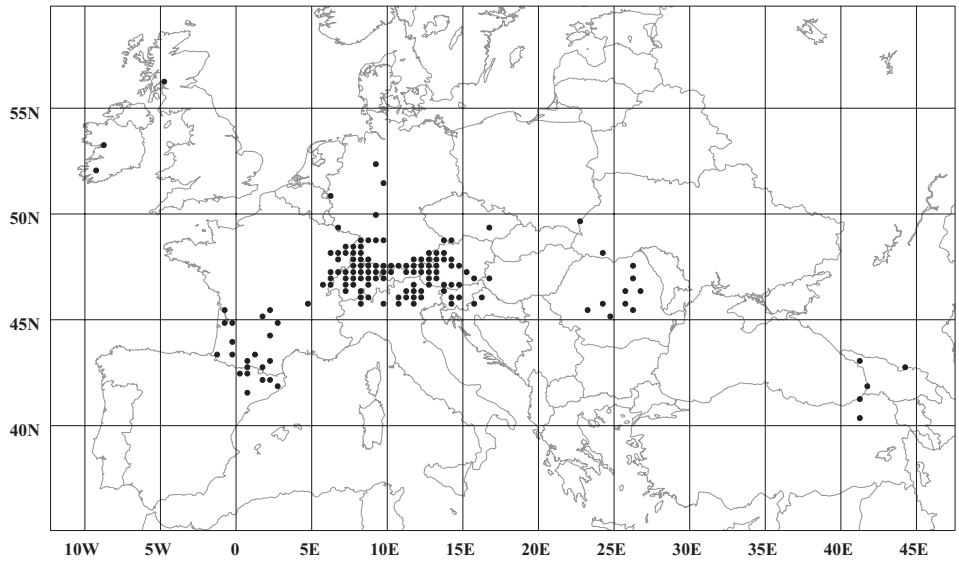

Fig. 3. – Map of the distribution of *Dryopteris remota*, based on revised herbarium specimens (Appendix 1) and Fraser-Jenkins 1982, Fraser-Jenkins & Reichstein 1984, Salvo & Arrabal 1986, Boudrie & Labatut1989, Haeupler & Schönfelder 1989, Vadam 1990, Peroni et al. 1991, Hartl et al. 1992, Boudrie & Lazare 1993, Gruber 1994, Point 1996, Prosser 1996, Page 1997, Polatschek 1997, Beck 1998, Schneller et al. 1998, Lauber & Wagner 1998, Bizot 1999, Ciocârlan 2000, Jogan et al. 2001, Krause et al. 2001, Stöhr & Strobl 2001, Marchetti 2002, Aeschimann et al. 2004, Fraser-Jenkins C. R. & Trewren K., unpublished.

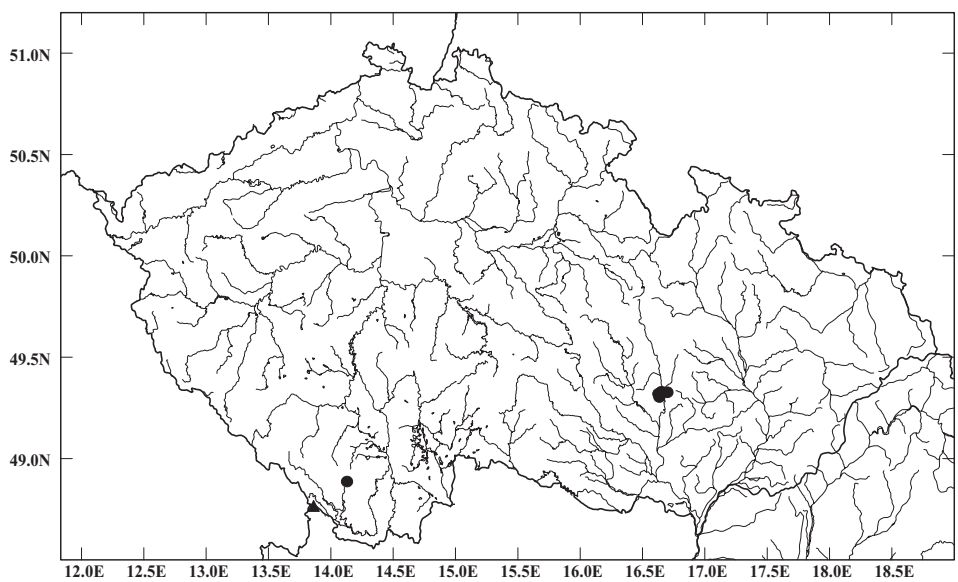

Fig. 4. – Map of the distribution of *Dryopteris remota* in the Czech Republic and border areas: ● – Czech and Moravian localities, ▲ – Austrian locality (Stöhr & Strobl 2001).

gether with the typical calcicolous fern species: *Asplenium viride*, *Polystichum lonchitis* or *Gymnocarpium robertianum*). In addition to fresh and leached soils, *D. remota* also occurs on hydromorphic soils associated with springs or streams. It is a species of shady places with high air humidity (Benl & Eschelmüller 1973, Fraser-Jenkins & Reichstein 1984, Oberdorfer 2001).

Records of *Dryopteris remota* from the Czech Republic

Historical records

Dryopteris remota is erroneously recorded from different places in the Czech Republic under the name *D.* ×*bohemica* Domin (Domin 1942). This author mistakenly synonymized *D. remota* and *D.* ×*bohemica*. From his paper and his type herbarium specimen, it is evident that *D.* ×*bohemica* is only an abnormal type of *D. filix-mas*. Dostál (1989) mentions (without other citations) that *D. remota* is wrongly reported under various names such as "*D. subaustriaca*, *D. lawalreei* and *D. subalpina*" from the Czech Republic. These names are usually considered as synonyms of *D. remota* in recent literature (Fraser-Jenkins & Reichstein 1984, Krause 1998).

Bílý (1931, 1937) reports the first reliable records of *D. remota* from the Czech Republic, from three localities close to the town of Adamov in the Moravian Karst (Fig. 4). Bílý (1931, 1937) considered *D. remota* to be a hybrid of "*D. filix-mas* and *D. spinulosa*". Our revision of his herbarium specimens in BRNU indicates that his specimens do indeed belong to *D. remota*. In PRC, we found other herbarium specimens of Bílý from two unreported localities (see Appendix 1). Records of *D. remota* from the Moravian Karst appeared in several Czech publications, but without reference to the data's origin (Dostál 1948, 1989). Later records of *D. remota* in the Czech Republic were assumed either to be uncertain (Chrtek 1988) or the species was considered as missing (Kubát in Kubát et al. 2002). There is a note on its occurrence north of Brno in Illustrierte Flora von Mitteleuropa, but again without reference to the data's origin (Fraser-Jenkins & Reichstein 1984). In 1976 Fraser-Jenkins unsuccessfully searched for *D. remota* in the Moravian Karst (Nový Hrad, Olomučany). The record in Illustrierte Flora von Mitteleuropa is based on his revision of Bílý's herbarium specimens in BRNU and PRC (Fraser-Jenkins, pers. comm.). In 2006 we revisited the recorded localities in the Moravian Karst, but did not find *D. remota*.

Description of the new locality

The new Bohemian locality is situated in the Bohemian Forest (Šumava Mts) foothills ca 3.5 km south of the village Ktiš, on the N slope of the Malý Plešný hill (N 48°53'07.6", E 14°07'48.2") at an altitude of 860 m (Fig. 4). The locality is in quadrant 7150b of the Central European grid mapping (Ehrendorfer & Hamann 1965). It is situated in the submontane vegetation belt of the phytogeographical sub-district Libínské Předšumaví, which belongs to the Šumavsko-novohradské podhůří phytogeographical district (Skalický 1988). The locality lies on the border of a cold and moderately warm climatic region (Quitt 1971). The mean annual temperature is about 6 °C and the mean annual precipitation is about 700 mm (Syrový 1958). The geological bedrock is composed of garnet-bi-

otite sillimanite gneiss. *Dryopteris remota* grew on rock on the border between the shrub community *Ribeso alpini-Rosetum pendulinae* Sádlo 2003 and open spruce-beech-fir forest with an admixture of birch (*Betula pendula*) of the association *Galio rotundifolii-Abietetum* Wraber (1955) 1959. The species *Lonicera nigra* occurred scattered there in the shrub layer and other ferns like *Dryopteris dilatata*, *D. filix-mas* and *Polypodium vulgare* were abundant. Further, *Avenella flexuosa*, *Festuca altissima*, *Galeobdolon montanum*, *Hieracium murorum*, *Moehringia trinervia*, *Oxalis acetosella*, *Rubus idaeus*, *Sambucus racemosa* and *Sorbus aucuparia* were present. The bryophytes *Dicranum scoparium*, *Hylocomium splendens*, *Hypnum cupressiforme*, *Plagiochila porelloides* and *Polytrichastrum formosum* were also present. In 2004 and 2006, the species was not found at this locality.

The closest known locality (ca 23 km) to this new locality of *D. remota* in the Bohemian Forest foothills lies in Austrian part of the Bohemian Forest (Fig. 4). *Dryopteris remota* was recorded on the SE slope of the Plöckenstein Mt (Plechý), NE of the village Schwarzenberg at an altitude of 1030 m (1999 leg. C. Schröck, herb. C. Schröck in Stöhr & Strobl 2001).

In 1999, *D. remota* was also recorded as from the Bavarian part of the Bohemian Forest (Horn et al. 1999). However, based on further examination, this identification was not confirmed; it was an aberrant form of *D. filix-mas* (Diewald & Horn 2001).

Conclusion

Dryopteris remota should be included on the list of the native species of the Czech Republic. The occurrence of *D. remota* in S Bohemia is seen as a single spore colonization from a long distance, obviously the Alps, or probably represents a typical Alpine migration element; this plant might be more common and neglected like *D. affinis*.

Considering the rarity of *D. remota* in the Czech Republic, which is outside its centre of distribution, we recommend that *D. remota* be designated a critically endangered species (CR) and put on the Red List of the Czech Republic (sensu Holub & Procházka 2000).

Acknowledgements

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Souhrn

Kapraď tuhá (*Dryopteris remota*) je považována za ustálený striktně apogamický taxon hybridogenního původu vzniklý křížením diploidních taxonů *Dryopteris affinis* subsp. *affinis* a s největší pravděpodobností *D. expansa* nebo *D. pallida*. Celkovou morfologií listu připomíná *D. remota* nejvíce druh *D. carthusiana*. Přehled nejvýznamnějších určovacích znaků mezi těmito druhy je uveden v následující tabulce:

Srovnání nejvýznamnějších morfologických znaků *Dryopteris carthusiana* a *D. remota* (zpracováno podle Fraser-Jenkins & Reichstein 1984, Krause et al. 2001).

Znak	*Dryopteris carthusiana*	*Dryopteris remota*
pleviny v dolní části řapíku	jednobarvé, světle hnědé	dvoubarvé, světlehnědé, s tmavě hnědou až černou skvrnou na bázi
charakter starších listů	žlutozelené až zelené, přes zimu obvykle nevytrvávající	tmavě zelené, obvykle přes zimu vytrvávající
báze lístků u vřetene listu (u živých rostlin)	zelená, bez tmavě fialové skvrny	s tmavou 3–10 mm dlouhou tmavě fialovou skvrnou
strana prvního úkrojku nejspodnějšího lístečku přivrácená k vřetenu lístku	většinou zřetelně zubatá	většinou nezubatá
koncové úkrojky lístků	s dlouhými ostnitě špičatými zuby	s krátkými zašpičatělými (někdy téměř ostnitě špičatými) zuby
výtrusy	vždy normálně vyvinuté	částečně abortované
délka vyvinutých výtrusů (exospor) [μm]	(27–) 33–39 (–42)	(30–) 36–48 (–54)
ostěra (indusium)	nežláznatá	hojně žláznatá

Je subatlantickým a subalpinským druhem rozšířeným v Evropě, Turecku a v západní a centrální části Kavkazu. Těžištěm jejího výskytu v Evropě je severní strana Alp a Předalpí. Ve střední Evropě je udávána především z roklin, strmých skalnatých svahů a sutí podhorských a horských smíšených lesů řádu *Fagetalia sylvaticae*. Vzácněji roste ve smrkových a smrkojedlových porostech. Vyhledává především suťovité, víceméně dusíkem bohaté a na kyselých podkladech vyvinuté půdy, vápnitým substrátům se však nevyhýbá.

Díky hybridogennímu původu, relativně obtížnému rozlišení a s tím související složité nomenklatuře byla *D. remota* považována za nedostatečně prokázaný druh flóry České republiky. V minulosti byla z území ČR mylně udávána z různých míst pod synonymy *D. subaustriaca*, *D. lawalreei* a *D. subalpina* a také pod názvem *D.* ×*bohemica* Domin, který se však vztahuje k abnormálnímu typu *D. filix-mas*. Jediné relevantní a dokladované údaje (BRNU, PRC) o výskytu *D. remota* z území ČR pocházejí od F. Bílého, který z Moravského krasu publikoval (Bílý 1931, 1937) a dále nalezl (1937, F. Bílý, PRC; 1938, F. Bílý, PRC) celkem pět lokalit, které se vztahují k širšímu okolí města Adamov (viz Appendix 1). Údaj o výskytu *D. remota* v Moravském krasu se následně objevuje v několika souborných publikacích avšak bez konkrétního literárního odkazu (Dostál 1948, 1989, Fraser-Jenkins & Reichstein 1984). Zmíněná absence konkrétní citace a neověření existujících herbářových dokladů byly zřejmě důvodem, proč je v dalších kompendiích výskyt *D. remota* v Moravském krasu zpochybňován (Chrtek 1988), popř. zcela vypuštěn (Kubát in Kubát et al. 2002). V roce 2006 byl proveden podrobný průzkum všech moravských lokalit, ověřit výskyt kapradě tuhé se však nepodařilo.

Kapraď tuhá byla zaznamenána poprvé také na území Čech. Nová lokalita byla nalezena v roce 2002 (jeden exemplář) v jihočeském Předšumaví ca 3,5 km jižně od obce Ktiš na severním svahu vrchu Malý Plešný v nadmořské výšce asi 860 m. Kapraď tuhá rostla na skalním stupni na hranici křovinného společenstva *Ribeso alpini-Rosetum pendulinae* a řídkého smrkobukojedlového lesa asociace *Galio rotundifolii-Abietetum*. V roce 2004 ani v roce 2006 se však již nepodařilo lokalitu znovu ověřit.

Kapraď tuhou lze zařadit do seznamu původních druhů flóry ČR. Jedná se o druh, který se zde vyskytuje na severním okraji svého přirozeného areálu. Výskyt *Dryopteris remota* v jižních Čechách je možné vysvětlit buď dálkovým přenosem spor zřejmě z alpského prostoru, nebo také může jít, vzhledem ke značné míře přehlížení druhu (podobně jako v případě *Dryopteris affinis*), o typický prvek alpského migrantu. Navrhujeme kapraď tuhou zařadit do červeného seznamu taxonů ČR do kategorie C1 (sensu Holub & Procházka 2000).

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Appendix 1. – Herbarium specimens of *Dryopteris remota* revised.

A u s t r i a . Upper Austria, 8146d, Unterach a. Attersee village, forests north of the village, close to coordinate 47°48'40.8" N, 13°29'33.6" E (WGS 84), 600 m a.s.l. (10 July 2002, leg. M. Lepší & P. Lepší, CB 33056, 33064). – North Tirol, forest near Rattenberg (August, 1887, leg. H. Woynar, BRNM, BRNU, PR; August, 1888, leg. H. Woynar, PR). – North Tirol, Voldöpp near Rattenberg, forest near Baselberg (2 November 1930, leg. A. Lösch, BRNM, PRC). – Raintal valley near Partenkirchen, scrub near Ferchenbach stream near the mouth of Partnach river (5 September 1931, 7 August 1932, leg. A. Lösch, BRNM).

C z e c h R e p u b l i c . **South Bohemia, 37g. Libínské Předšumaví**: 7150b, Ktiš village, N slope of the Malý Plešný hill, 860 m a.s.l. (17 November 2002, leg. M. Lepší, P. Lepší & K. Boublík, CB 39336). **South Moravia, 70. Moravský kras:** [6666c] In the Košový žlíbek valley, on limestone in beech forest between the Habrůvka and Olomučany villages (11 October 1934, leg. F. Bílý, BRNU 285029). – [6666c] Between the Habrůvka and Olomučany villages on limestone in spruce forest called "V Padouchu" above old limestone quarry (6 July 1937, leg. F. Bílý, PRC). – [6666c] Between the Habrůvka and Olomučany villages in fir forest in gorge near the Suchá louka meadow (12 August 1938, leg. F. Bílý, PRC). – [6665d] Adamov town, on syenogranite slope opposite the castle, towards the Vranov village, in bramble stand in fir forest (1 September 1936, leg. F. Bílý, BRNU 285028, PRC). – [6665d] Gorge from the Nový hrad castle to the Olomučany village, in fir-dominated mixed forest on syenogranite (7 November 1929, leg. F. Bílý, BRNU 218901).

F r a n c e . Vogesen, Hohwald (26 August 1898, leg. H. Petry, BRNM). – Dép. Corréze, Chameyrat, Pont de Cornil, de la Vialle gorge, 280 m a.s.l. (29 August 1975, leg. R. Deschatres, BRNM).

G e r m a n y . Baden, Schwarzwald Mts, St. Wilhelm near Freiburg town (September 1902–1904, leg. A. Lösch [F. Wirtgen, Pteridophyta Exsiccata, no. 217b], BRNU, PR). – [Schwarzwald Mts] in moist forest near Zastler valley (October 1934, leg. A. Lösch, PR; 1937, leg. A. Lösch, BRNM; August, 1901, leg. A. Lösch, PRC; October 1908, leg. A. Lösch, BRNU). – Aachen, only one plant near the town (1859, leg. A. Braun, PR).

R u s s i a / G e o r g i a . Caucasus, Ossetia, in forest (15 September 1898, leg. Marcowitsch, PRC). – Prov. Suchum, Tsebelda, Petskir, in forest, ca 700–800 m a.s.l. (25 September 1910, leg. G. Woronow [G. Woronow et A. Schelkownikow, Herbarium Florae Caucasicae, no. 2], BRNU).

S c h w e i z . Kanton St. Gallen, Murgtal (10 July 1909, leg. H. Petry, PR, BRNU).

U k r a i n e . Rakhiv, Bogdan village, on the slope above left bank of the Goverla brook, ca 6.5 km north-north-east from the junction of the Goverla brook and Bila Tisa river in the Goverla settlement, 925 m a.s.l. (16 August 2004, leg. K. Boublík, CB 38859, 38862, 38863).