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Bryoflora of the Žofínský Prales nature reserve (Novohradské hory Mts., South Bohemia)

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Abstract
Bryofloristic inventory of the Žofín primeval forest reserve was realized in 2004–2005 based on 6 whole-day recording trips covering the majority of area and the habitat spectrum. 176 species and 2 additional infraspecific taxa were recorded, bringing thus the total of recently known taxa to 195 species, the highest known number from any of the forest reserves in the Czech Republic. The importance of the reserve is illustrated by several facts: 3 of the recorded species (*Hypnum fertile, Hypnum imponens, Rhynchostegiella tenuicaulis*) are known only from this reserve, for several other threatened taxa the reserve is regarded as probably the most important refuge given the size of the local population (*Dicranum viride, Neckera pennata, Anacamptodon splachnoides*). The bryophytes have above-average sporophyte production ratio, which can be interpreted as a manifestation of good vitality. The species diversity is distributed very evenly in terms of both spatial distribution and substrate preferences.

Key words: Bryophyta, floristic analysis, Czech Republic, Red List

Introduction

The Žofín primeval forest (Žofínský Prales) is a forest reserve in the South Bohemian Novohradské Hory Mts. It is located at approximately 48°40'N and 14°42'E on the northern slopes of the Stříbrný Vrch Mt. in the altitude 735–825 m a.s.l., covering the area of 98 ha. The Žofínský Prales nature reserve is the oldest protected area in the Czech Republic, established in 1838 on a part of the contemporary area (perhaps some 40 ha) for the protection of a typical mixed montane forest, then having been dominated by very old (>350–400 yrs) silver firs (*Abies alba*), nowadays naturally shifted towards a mostly broad-leaved forest dominated by beech (*Fagus sylvatica*, ca. 80%) with a second commonest tree species the Norwegian spruce (*Picea abies*, 15%), and a smaller proportion of sycamore (*Acer pseudoplatanus*), Norway maple (*Acer platanoides*), Wych elm (*Ulmus glabra*) and others; the originally dominating firs nowadays account for less than 5% (Průša 1985). The soils on the acidic bedrock (granites of the Bohemian Massif) include cambisols, crypto-podsols and gleys. The climate is temperate, with the mean annual temperature of 4.3°C, average annual precipitation of 915 mm, falling mostly during the growing season (67% in April–September), the snow cover occurs mostly between November and April (Průša 1985).

History of the bryofloristic survey

Given the unusually long history of site protection and the general botanical knowledge about the biodiversity value of the Žofín primeval forest in our country, one may find it surprising that the first attempt at bryofloristic enumeration (and still only for the epiphytic and epixylic bryophytes) was published not earlier than in the late 1990s (Vacínová & Soldán 1997). We must consider, however, that the nature reserve laid in the inaccessible border zone from the late 1940s and before this period unfortunately had not attract the attention of the prominent Czech bryologists of those times from Prague and Brno. Thus the bryofloristic data untill the 1990s include only a handful of casual records. Vacínová (1998) was able to find the historical records of 20 species, all of them rather common forest bryophytes, mostly published from phytosociological relevés or forest-typological characterisations. The preliminary enumeration of epiphytic and epixylic bryophytes (Vacínová & Soldán 1997) and the unpublished diploma thesis of Vacínová (Vacínová 1998) are thus the first important milestones in recognition of the bryological exceptionality of the reserve. Vacínová listed the total of 150 species, all having been recorded in the period 1995–1998. It has to be stressed that the thesis was not aimed at the bryofloristic inventory but rather at describing the ecological factors affecting the composition and dynamics of epixylic bryophyte communities (the results of this study were later published in Jansová 2006 and Jansová & Soldán 2006). A part of my bryofloristic results from the first year of this inventory was published in 2004 (Kučera 2004b) and at the same time the bryoflora of the Novohradské Hory Mts. was independently summarized by Soldán (2004). I also published a short popular outline of the bryoflora of the Novohradské Hory Mts. in a book chapter (Kučera 2006).

Methods of survey

The bryofloristic inventory of the Žofín primeval forest (Žofínský Prales) was realized by the author in 2004 and 2005 on behalf of the Agency for Nature Conservation and Landscape Protection of the Czech Republic. Rather than having been organized as a full-scale detailed survey, the inventory was realized as an attempt to assess the bryophyte species diversity upon an approximation based on a limited number of excursions. The Žofín reserve has an area of nearly 98 ha, with the dimensions of ca. 1.4 km in the longer NNE–SSW direction and 0.5–1.0 km in the shorter WNW–ESE direction. Given the relative homogeneity of the reserve (in the sense of spatial distribution of sites that were expected to be promising from the bryological point of view), it was decided to realize 6 whole-day recording trips through the segments of the reserve, each one measuring between 1.8 and 2.8 km and having been focused to one quarter of the reserve (Fig. 1). This survey pattern assured that all parts of the reserve were kind of evenly explored – the farthest distance between two recording tracks did not exceed some 150 m, a distance that can be reasonably overviewed in order not to miss a bryofloristically obviously promising spot.

On each day, the bryophytes recognizable in the field were recorded into the ready-printed recording sheets, and for each taxon the substrate condition(s) were noted – 9 group-conditions were recognized (epiphytic, epiphytic-tree bases, epixylic, epilithic, hygro-epilithic (i.e. aquatic and semiaquatic conditions in and around brooklets and spring sites), terrestrial, hygro-terrestrial, "grass" (living among vascular plants on or decaying remnants of them), and artificial substrate (disused concrete pieces and mortar remnants among stones). The relative frequency of occurrence were recorded at the end of each track on a 5-step scale (1 for 1 or 2 very close (< 10 m apart) occurrences, 2 for 2–3 occurrences, 3 for 4 to ca. 7 occurrences, 4 for the regular though not very common occurrences, and 5 for the common, fre-

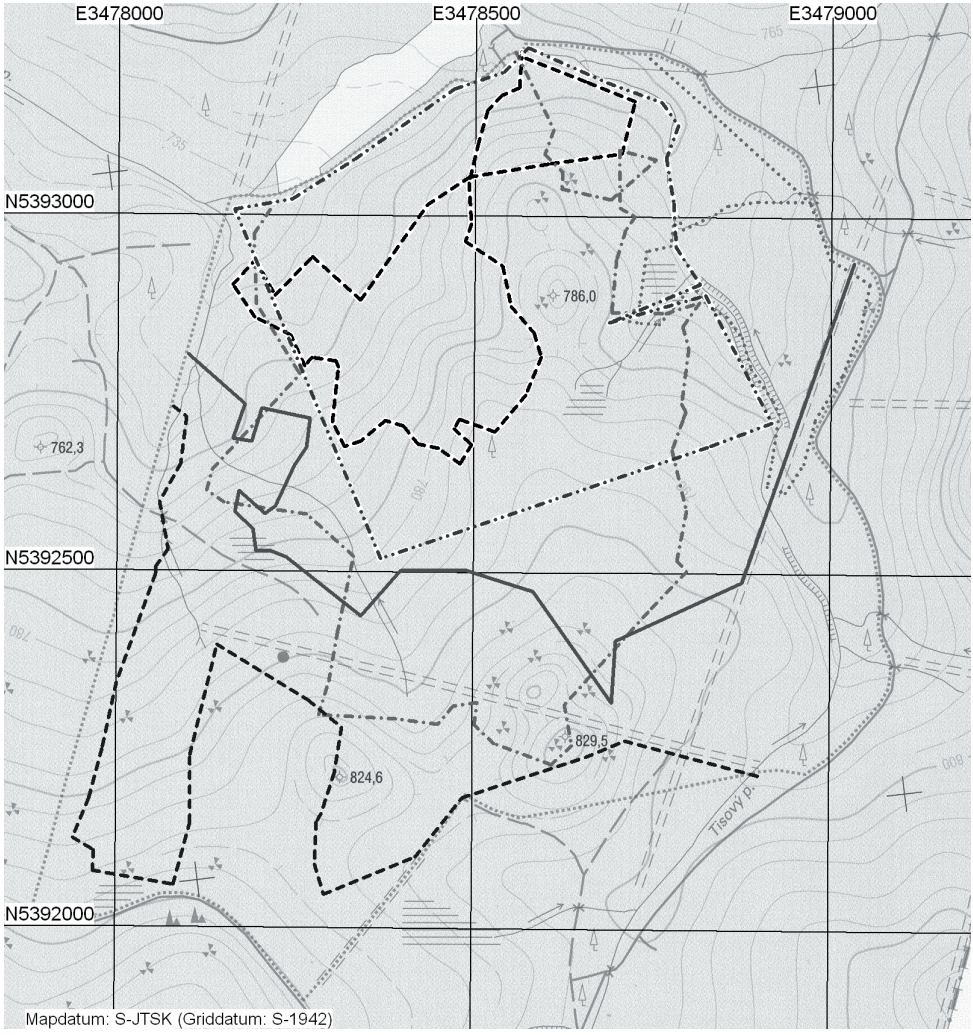

Fig. 1. Map of the recording tracks in the Žofín reserve.

quent occurrences (however vague the limits especially in the higher categories may look, they may present a reasonable approximation to the frequency estimate). Occurrence of sporophytes on each track (+/–) was recorded as well. Fertility of bryophytes expressed as the ratio of sporophyte-producing species can serve as an indirect measure of vitality of the local populations. The production of sporophytes is clearly associated with the humidity, which is essential for the successful transport of sperm to the egg in archegonia. In case of hepatics, the production of sporophytes is somewhat difficult to record due to its ephemeral nature and therefore it might be useful to record the presence of perianths, which growth may precede the growth of sporophyte and also lasts after the sporophytes have decayed. Of course we must take into consideration that not always the production of perianths signals the earlier or later production of sporophytes and not all liverwort species produce perianths. The day's track was controlled and recorded with the handheld GPS receiver (Garmin GPS-

MAP60 CSx) in order to stay in the a priori determined segment of the reserve and allowing the possibly even surveillance of the segment. Bryophytes not identifiable in the field or those, which were considered important to be supplied with the herbarium specimen, were collected in a quantity that allowed the later laboratory identification and did not threaten the population at the site, noticing the site collection details. All herbarium specimens are kept in the herbarium of the Department of Botany, Faculty of Science, University of South Bohemia (CBFS).

Results

176 species and 2 additional infraspecific taxa according to the checklist of Kučera & Váňa (2005) (the nomenclature and threat categories of bryophytes follow this source) have been found during the survey in 2004–2005. 48 species and two previously unrecognized varieties have been found for the first time in the reserve but at the same time 21 species, reported by Vacínová (1998), could not be retrieved (however, four of the reported and unretrieved taxa are probably based on erroneous identifications, see below). The sum of the bryophyte species recorded in the reserve so far thus reaches at the moment 195 species. The list of taxa found in the reserve follows in the Table 1, together with the information on frequency of occurrence, substratum preferences and presence of sporophytes (in liverworts also of perianths).

Doubtful or uncertain species

Cephalozia connivens – reported by Vacínová (1998) as "rare" from the Žofín reserve, which probably means a single collection (Vacínová-Jansová pers. comm.). Unfortunately the specimen could not be found in PRC. The occurrence of *C. connivens* is regarded not very probable due to the absence of suitable habitats.

Ptilidium ciliare – reported by Vacínová (1998) as "rare" from the Žofín reserve, which probably meant a single collection and subsequently again reported from ground flora by Jansová & Soldán (2006). The revision of the single (epixylic) specimen filed in PRC proved however the misidentification for *P. pulcherrimum*. The occurrence of *P. ciliare* in the reserve is thus to be verified.

Dicranella varia – reported by Vacínová & Soldán (1997) and Vacínová (1998) as "less common" from the Žofín reserve. Unfortunately no herbarium specimen could be found in PRC but there seems to be no place in the reserve where this basiphilous species could be found. On the other hand, several places were found in the reserve where a similar *Dicranella rufescens* occurs, not reported by Vacínová. The misidentification of these two species thus seems probable.

Leucobryum glaucum – reported by Vacínová (1998) as "less common" from the Žofín reserve. The revision of the only available specimen in PRC proved the misidentification for *L. juniperoideum*. The occurrence of *L. glaucum* seems to be probable, however, even the author's only record of *Leucobryum* from the reserve belongs to *L. juniperoideum*.

Sphagnum teres – reported by Vacínová & Soldán (1997) and Vacínová (1998) as "less common" from the Žofín reserve. The revision of the only available specimen in PRC proved the misidentification for *S. girgensohnii*. The occurrence of *S. teres* is regarded not very probable due to the absence of suitable habitats.

Excluded species

Calypogeia neesiana – reported by Vacínová (1998) as "less common" from the Žofín reserve. The revision of two specimens filed in the herbarium PRC proved the misidentification

Table 1. List of bryophyte taxa found or reported from the Žofín primeval forest from 1995 onwards. Red List = threat evaluation according to KUČERA & VÁŇA (2005). Sporophytes, perianths = presence (+) /absence (–) thereof (blank if not applicable). Frq(V) = frequency of occurrence according to VACÍNOVÁ (1998)[1]. Frq(JK) = frequency of occurrence (average of the 6 recording tours). Count = number of tours on which the respective taxon was recorded. Substrate categories: L – epilithic, Lh – hygro-epilithic, T – terrestrial, Th – hygro-terrestrial, E – epiphytic, Eb – epiphytic/bases, X – epixylic, G – grass, A – artificial.

Species name	Red List	Sporophytes	Perianths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Anastrophyllum hellerianum	CR	–	–	1	0	0	0	0	0	0	0	0	0	0	0
Aneura maxima[2]	DD	–		5	1	5	0	0	0	5	0	0	0	0	0
Bazzania trilobata var. *trilobata*	LC	–	–	5	4.7	6	1	0	5	0	1	0	3	0	0
Blasia pusilla	LC	–		0	0.3	1	0	1	0	0	0	0	1	0	0
Blepharostoma trichophyllum	LC	+	+	3	4	6	1	1	1	0	0	2	6	0	0
Calypogeia azurea	LC	–		5	2.7	5	1	0	3	0	0	0	3	0	0
Calypogeia integristipula	LC	–		5	2.3	5	0	0	1	1	0	0	3	0	0
Calypogeia muelleriana	LC	–		3	0.3	1	0	0	0	1	0	0	0	0	0
Calypogeia suecica	LR-nt	–		5	2.3	6	0	0	0	0	0	0	6	1	0
Cephalozia bicuspidata	LC	+	+	5	4.5	6	2	2	1	3	0	0	5	0	0
Cephalozia catenulata	VU	–	+	1	3.2	5	0	0	0	0	0	0	5	0	0
Cephalozia leucantha	VU	–	–	0	0.3	1	0	0	0	0	0	0	1	0	0
Cephalozia lunulifolia	LC	–	–	5	0.2	1	0	0	0	0	0	0	1	0	0
Chiloscyphus coadunatus	LC	–	–	5	4	6	1	0	1	4	0	0	0	1	0
Chiloscyphus polyanthos var. *pallescens*	LC-att	–	–	0	0.2	1	0	0	0	1	0	0	0	1	0
Chiloscyphus polyanthos var. *polyanthos*	LC	–	–	5	1.7	4	0	3	0	2	0	0	0	0	0
Chiloscyphus profundus	LC	+	+	5	4.8	6	0	0	0	0	1	0	6	0	0

[1] VACÍNOVÁ (1998) distinguished only 3 frequency categories – 1 for "common", 2 for "less common", and 3 for "rare"; these were transformed to approximately match the author's categories as 5, 3, and 1, respectively (see above for explanation) to facilitate the comparison.
[2] VACÍNOVÁ (1998) reported *Aneura pinguis*, not *A. maxima*, but *A. pinguis* probably cannot occur in the reserve. Unfortunately no specimen of *Aneura* collected by Vacínová was found to check the identification.

Table 1. Continued.

Species name	Red List	Sporophytes	Perianths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Conocephalum conicum	LC	–		5	4.3	6	0	0	1	6	0	0	0	0	0
Diplophyllum albicans	LC	–	–	0	1.2	3	0	2	1	0	0	0	0	0	0
Diplophyllum obtusifolium	LC	–	–	1	0	0	0	0	0	0	0	0	0	0	0
Frullania dilatata	LC	–	+	5	2.2	5	0	0	0	0	5	0	0	0	0
Frullania tamarisci	VU	–	–	1	0.3	1	0	0	0	0	1	0	0	0	0
Geocalyx graveolens	EN	–		1	0	0	0	0	0	0	0	0	0	0	0
Harpanthus scutatus	EN	–	+	0	0.8	4	2	1	0	0	0	0	3	0	0
Jamesoniella autumnalis	VU	–	–	0	0.2	1	0	0	0	0	0	0	1	0	0
Jungermannia leiantha	LR-nt	+	+	3	2	5	0	4	0	3	0	0	3	0	0
Jungermannia sphaerocarpa	LC	–	+	0	0.5	2	0	2	0	0	0	0	0	0	0
Lejeunea cavifolia	LC	–	–	0	0.2	1	0	0	0	0	1	0	0	0	0
Lepidozia reptans	LC	–	–	5	4.2	5	1	0	1	0	0	1	5	0	0
Lophozia attenuata	LC	–	–	0	0.3	1	0	0	0	0	0	0	1	0	0
Lophozia incisa	LC-att	+	+	1	3.7	6	1	2	1	1	0	0	6	0	0
Lophozia longiflora[3]	LC	–	–	3	0	0	0	0	0	0	0	0	0	0	0
Lophozia ventricosa s.l.[4]	–	+	–	3	0.7	1	1	0	0	0	0	1	1	0	0
Lophozia ventricosa var. *silvicola*	LC-att	–	+	0	0.8	3	0	0	2	0	0	1	3	0	0
Lophozia ventricosa var. *ventricosa*	LC	–	+	0	0.5	2	0	1	0	0	0	0	2	0	0
Marchantia polymorpha subsp. *polymorpha*[5]	LC	–		5	1	2	0	1	1	1	0	0	0	0	0

[3] The occurrence of this species is not fully certain. Two specimens, collected by Vacínová in 1996 (herb. PRC) were revised by the author and found not in the condition that would without doubt allow the identification with respect to *Lophozia ventricosa* s.l.

[4] Vacínová (1998) did not distinguish among the varieties of *L. ventricosa*. During the survey in 2004–2005, most specimens were checked for the oil bodies, *Lophozia ventricosa* s.l. was noted in remaining cases.

[5] Vacínová (1998) did not distinguish among the subspecies of *M. polymorpha*. However, subsp. *polymorpha* seems to be the most probable as the conditions for the other subspecies probably do not occur throughout the reserve.

Table 1. Continued.

Species name	Red List	Sporophytes	Perianths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Metzgeria furcata	LC	–		5	4.7	6	0	0	0	0	6	0	0	0	0
Metzgeria violacea[6]	EN	–		1	0.2	1	0	0	0	0	1	0	0	0	0
Nardia geoscyphus	LC-att	–	–	1	0	0	0	0	0	0	0	0	0	0	0
Nardia scalaris	LC	–	–	1	0	0	0	0	0	0	0	0	0	0	0
Nowellia curvifolia	LC-att	–	+	5	5	6	1	0	0	0	0	0	6	0	0
Odontoschisma denudatum	LC-att	–	–	0	0.3	1	0	0	0	0	0	0	1	0	0
Pellia neesiana	LC	–		5	1.3	3	0	0	1	2	0	0	0	0	0
Pellia sp.	–	–		0	1.7	3	0	0	1	2	0	0	0	1	0
Plagiochila asplenioides	LC	–	–	5	3.7	6	0	0	3	1	0	0	1	2	0
Plagiochila porelloides	LC	–	–	5	4.8	6	3	1	0	0	2	5	3	0	0
Porella platyphylla	LC	–	–	1	1	3	0	0	0	0	3	0	1	0	0
Ptilidium pulcherrimum	LC	–	+	5	2.8	6	0	0	0	0	5	0	4	0	0
Radula complanata	LC	+	+	5	3.7	6	0	0	0	0	6	0	0	0	0
Riccardia latifrons	LC-att	–		3	4.2	6	0	0	0	0	0	0	6	0	0
Riccardia multifida	LC-att	+		0	0.3	2	0	0	0	2	0	0	0	0	0
Riccardia palmata	LC-att	+		3	3.7	6	0	0	0	0	0	0	6	0	0
Scapania nemorea	LC	–	–	5	4	6	6	2	0	0	0	0	4	0	0
Scapania umbrosa	LC	–	–	3	1.3	4	2	1	0	0	0	0	3	0	0
Scapania undulata	LC	–	–	5	2	4	0	4	0	0	0	0	1	0	0
Trichocolea tomentella	LR-nt	–		1	3.3	6	0	1	1	6	0	0	0	1	0
Tritomaria exsecta	LC	–	–	0	0.8	3	0	1	0	0	0	0	3	0	0
Tritomaria quinquedentata	LC	–	–	3	0	0	0	0	0	0	0	0	0	0	0

[6] *Metzgeria violacea* was not reported by Vacínová (1998) but firstly by Soldán & Buryová (2001).

Table 1. Continued.

Species name	Red List	Sporo-phytes	Peri-anths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Amblystegium serpens	LC	+		5	4.3	6	1	0	0	0	6	2	1	0	1
Anacamptodon splachnoides	EN	+		0	0.7	3	0	0	0	0	2	1	0	0	0
Andreaea rupestris	LC	–		3	0	0	0	0	0	0	0	0	0	0	0
Anomodon longifolius	LC-att	–		0	1.2	3	0	0	0	0	3	3	0	0	0
Antitrichia curtipendula	LC-att	–		1	0.7	2	0	0	0	0	2	1	1	0	0
Atrichum undulatum var. *undulatum*	LC	+		5	4.7	6	1	0	6	0	0	0	1	0	0
Aulacomnium androgynum	LC	–		5	0.5	2	0	0	1	0	0	0	1	0	0
Aulacomnium palustre	LC	–		3	0	0	0	0	0	0	0	0	0	0	0
Brachythecium oedipodium	LC-att	+		1	2.5	6	1	0	0	2	0	0	2	2	0
Brachythecium plumosum	LC	+		3	1.5	2	0	2	0	0	0	0	0	0	0
Brachythecium populeum	LC	+		5	1.3	3	1	0	0	0	2	1	0	0	0
Brachythecium reflexum	LC	+		5	1.8	4	0	0	0	0	0	3	2	0	0
Brachythecium rivulare	LC	+		5	4	6	0	2	0	6	0	0	0	0	0
Brachythecium rutabulum	LC	+		5	4.8	6	2	1	1	2	0	2	6	0	0
Brachythecium salebrosum	LC	+		5	4.3	6	1	0	1	0	1	2	4	0	0
Brachythecium starkei	LC-att	+		3	2.7	5	1	0	2	0	0	1	2	0	0
Brachythecium velutinum	LC	+		5	3.8	6	0	0	0	0	4	3	1	0	0
Bryum capillare	LC	–		3	0	0	0	0	0	0	0	0	0	0	0
Bryum creberrimum	DD	+		0	0.2	1	0	0	0	0	0	0	0	0	1
Bryum moravicum	LC	–		5	3.2	6	0	0	0	0	5	2	1	0	0
Calliergon cordifolium	LC	–		5	1.8	5	0	0	0	5	0	0	0	0	0
Calliergonella cuspidata	LC	–		3	0.5	2	0	0	0	2	0	0	0	0	0
Campylostelium saxicola	LR-nt	+		0	0.5	3	0	3	0	0	0	0	0	0	0

Table 1. Continued.

Species name	Red List	Sporo-phytes	Peri-anths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Ceratodon purpureus	LC	+		5	0.3	2	1	0	0	0	0	0	1	0	0
Cirriphyllum piliferum	LC	+		0	2.5	5	1	0	1	4	0	0	2	2	0
Dichodontium pellucidum	LC	–		0	1	4	0	3	0	0	0	0	0	0	1
Dicranella heteromalla	LC	+		5	3.8	6	0	0	6	1	0	0	1	0	0
Dicranella rufescens	LC	+		0	1.2	2	0	0	2	0	0	0	0	0	0
Dicranodontium denudatum	LC	+		5	5	6	4	0	0	0	0	0	6	0	0
Dicranoweisia crispula	LC	+		0	0.2	1	0	1	0	0	0	0	0	0	0
Dicranum flagellare	LC-att	–		0	0.2	1	0	0	0	0	0	0	1	0	0
Dicranum fuscescens	LC-att	–		0	0.2	1	1	0	0	0	0	0	0	0	0
Dicranum montanum	LC	–		5	4.8	6	2	0	0	0	6	3	4	0	0
Dicranum scoparium	LC	+		5	5	6	5	0	3	0	3	2	5	0	0
Dicranum viride	EN	–		0	4	6	0	0	0	0	6	0	1	0	0
Ditrichum heteromallum	LC	+		3	0.5	1	0	0	1	0	0	0	0	0	0
Encalypta streptocarpa	LC	–		0	0.2	1	0	0	0	0	0	0	0	0	1
Eurhynchium angustirete	LC	+		5	3.5	6	3	1	1	0	0	2	1	0	0
Eurhynchium hians	LC	–		3	1.2	2	0	2	0	1	0	0	0	0	0
Fissidens pusillus	LC-att	+		0	0.8	4	0	4	0	0	0	0	0	0	0
Fontinalis antipyretica	LC	–		5	0.5	2	0	2	0	0	0	0	0	0	0
Grimmia hartmanii	LC	–		5	0.7	2	2	1	0	0	0	0	0	0	0
Hedwigia ciliata	LC	–		3	0.3	2	2	0	0	0	0	0	0	0	0
Herzogiella seligeri	LC	+		5	5	6	0	0	1	0	0	0	6	0	0
Heterocladium heteropterum	LC	–		3	3.8	6	5	3	0	0	0	0	0	0	0
Homalia trichomanoides	LC	+		0	1.2	3	0	0	0	0	1	3	0	0	0

Table 1. Continued.

Species name	Red List	Sporo-phytes	Peri-anths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Homalothecium sericeum	LC	+		5	3	6	0	0	0	0	6	1	0	0	0
Hygrohypnum ochraceum	LC	–		1	1.7	2	0	2	0	0	0	0	1	0	0
Hylocomium splendens	LC	–		5	2.7	6	2	0	2	1	0	2	2	0	0
Hypnum andoi	LC	+		5	5	6	4	0	0	0	5	2	2	0	0
Hypnum cupressiforme s.l.[7]	–	–		5	0	0	0	0	0	0	0	0	0	0	0
Hypnum cupressiforme var. cupressiforme	LC	+		0	2.2	5	4	0	0	0	1	0	2	0	0
Hypnum cupressiforme var. filiforme	LC	–		0	0.3	1	0	0	0	0	1	0	0	0	0
Hypnum fertile	CR	+		0	0.2	1	0	0	0	0	0	0	1	0	0
Hypnum imponens	DD	–		0	0.2	1	0	0	0	0	0	1	1	0	0
Hypnum jutlandicum	LC	+		3	0.2	1	0	0	0	0	0	0	1	0	0
Hypnum pallescens	LC	+		0	0.8	2	0	0	0	0	0	1	1	0	0
Isothecium alopecuroides	LC	+		5	5	6	3	0	0	0	5	5	1	0	0
Leucobryum juniperoideum[8]	LC	–		3	0.2	1	1	0	1	0	0	0	0	0	0
Leucodon sciuroides	LC	–		3	2.5	5	0	0	0	0	5	0	0	0	0
Mnium hornum	LC	+		5	3.2	6	3	2	1	3	0	2	2	0	0
Mnium spinosum	LC	–		3	0.5	1	0	0	0	0	1	1	0	0	0
Mnium spinulosum	LC	–		0	0.3	2	0	0	0	0	0	0	2	0	0
Mnium stellare	LC	–		0	0.5	2	0	0	0	0	0	1	1	0	0
Neckera complanata	LC	–		5	4.5	6	0	0	0	0	6	1	0	0	0
Neckera crispa	LC	–		1	1	4	0	0	0	0	4	0	0	0	0
Neckera pennata	EN	+		1	1.8	5	0	0	0	0	5	1	0	0	0

[7] The varieties of *Hypnum cupressiforme* were not distinguished by Vacínová (1998).
[8] Vacínová (1998) reported only *L. glaucum* from the reserve. However, the revision of the only available specimen in PRC proved the misidentification for *L. juniperoideum*, hence I adopted the frequency report for the latter species (see also a note above).

Table 1. Continued.

Species name	Red List	Sporophytes	Perianths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Oligotrichum hercynicum	LC	–		3	0	0	0	0	0	0	0	0	0	0	0
Orthotrichum affine	LC	–		3	0	0	0	0	0	0	0	0	0	0	0
Orthotrichum lyellii	LC-att	–		3	0	0	0	0	0	0	0	0	0	0	0
Orthotrichum obtusifolium[9]	LC	–		1	0.2	1	0	0	0	0	1	0	0	0	0
Orthotrichum pallens	LC	–		1	0	0	0	0	0	0	0	0	0	0	0
Orthotrichum patens	VU	+		1	0.3	2	0	0	0	0	2	0	0	0	0
Orthotrichum speciosum	LC	+		3	0.7	3	0	0	0	0	3	0	0	0	0
Orthotrichum stramineum	LC	+		5	2.2	5	0	0	0	0	4	0	1	1	0
Paraleucobryum longifolium	LC	+		5	4.5	6	4	0	0	0	3	5	0	0	0
Plagiomnium affine	LC	+		5	4.8	6	0	0	5	3	0	3	1	1	0
Plagiomnium cuspidatum	LC	+		5	3.8	6	1	0	0	0	2	3	3	0	0
Plagiomnium elatum	LC-att	+		5	0.7	2	0	0	1	2	0	0	0	0	0
Plagiomnium ellipticum	LC-att	–		0	1	3	0	0	0	3	0	0	0	0	0
Plagiomnium medium	LR-nt	+		0	0.8	2	0	0	0	2	0	0	0	1	0
Plagiomnium undulatum	LC	–		5	4	6	0	0	6	3	0	2	0	0	0
Plagiothecium curvifolium	LC	+		5	3	5	3	0	3	0	0	1	3	0	0
Plagiothecium denticulatum var. *denticulatum*	LC	+		5	3.3	6	3	0	3	0	0	2	1	0	0
Plagiothecium laetum	LC	+		5	3.8	6	4	0	1	0	0	1	2	0	0
Plagiothecium nemorale	LC	+		5	4.2	6	6	0	2	0	3	3	2	0	0
Plagiothecium undulatum	LC	–		3	1	3	0	0	2	1	0	0	0	0	0
Platygyrium repens	LC	+		3	3.5	6	0	0	0	0	6	0	2	0	0
Platyhypnidium riparioides	LC	+		5	0.8	2	0	2	0	0	0	0	0	0	0

[9] Reported from a single relevé accompanying *Metzgeria violacea* by Soldán & Buryová (2001).

Table 1. Continued.

Species name	Red List	Sporo-phytes	Peri-anths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Pleurozium schreberi	LC	+		5	4.7	6	2	0	3	0	0	1	6	0	0
Pogonatum aloides	LC	+		3	1.3	4	0	0	4	0	0	0	0	0	0
Pogonatum urnigerum	LC	+		5	0.8	2	0	0	2	0	0	0	2	0	0
Pohlia lescuriana	DD	–		0	0.2	1	0	0	1	0	0	0	0	0	0
Pohlia nutans subsp. nutans	LC	+		5	3.5	6	1	0	6	0	0	1	2	0	0
Pohlia proligera	LC	–		0	0.5	1	0	0	1	0	0	0	0	0	0
Pohlia sp.	–	–		0	1	4	0	0	4	0	0	0	0	0	0
Pohlia wahlenbergii var. *wahlenbergii*	LC	–		0	0.2	1	0	0	1	0	0	0	0	0	1
Polytrichastrum formosum	LC	+		5	5	6	5	0	5	0	0	2	2	0	0
Polytrichum commune	LC	+		5	4.3	6	1	1	3	2	0	0	3	1	0
Polytrichum juniperinum	LC	–		0	0.3	1	0	0	1	0	0	0	0	0	0
Pseudoleskeella nervosa	LC	–		0	0.5	1	0	0	0	0	1	0	0	0	0
Pseudotaxiphyllum elegans	LC	–		3	1	4	1	2	2	0	0	0	0	0	0
Pterigynandrum filiforme	LC	–		3	1	3	0	0	0	0	2	1	0	0	0
Ptilium crista-castrensis	LC	–		3	0.7	3	0	0	0	0	0	0	2	1	0
Pylaisia polyantha	LC	+		0	0.8	2	0	0	0	0	2	0	0	0	0
Racomitrium aciculare	LC	+		5	1.5	2	0	2	0	0	0	0	0	0	0
Racomitrium fasciculare	LC	+		0	0.8	2	1	1	0	0	0	0	0	0	0
Racomitrium heterostichum	LC	–		5	0.3	1	1	1	0	0	0	0	0	0	0
Racomitrium microcarpon	LC	–		3	0	0	0	0	0	0	0	0	0	0	0
Racomitrium sudeticum	LC	–		0	0.2	1	1	1	0	0	0	0	0	0	0
Rhizomnium magnifolium	LC-att	–		1	2.5	6	0	0	0	5	0	0	0	1	0
Rhizomnium punctatum	LC	+		5	4.8	6	5	1	2	1	0	1	6	1	0

Table 1. Continued.

Species name	Red List	Sporo-phytes	Peri-anths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Rhodobryum roseum	LC	–		5	2.5	5	0	0	1	4	0	0	0	1	0
Rhynchostegiella tenuicaulis	CR	–		0	0.3	2	0	0	0	0	2	0	0	0	0
Rhynchostegium confertum	LC-att	+		0	1.8	5	0	5	0	0	0	0	0	0	0
Rhytidiadelphus loreus	LC	–		5	2.8	6	0	0	2	1	0	0	4	0	0
Rhytidiadelphus squarrosus	LC	–		5	1.5	4	0	0	0	0	0	0	2	3	0
Rhytidiadelphus subpinnatus	LC-att	–		3	3.3	6	0	0	2	1	0	0	4	1	0
Rhytidiadelphus triquetrus	LC	–		5	1.3	3	1	0	0	1	0	0	3	0	0
Sanionia uncinata	LC	+		5	4.3	6	2	1	0	0	0	0	6	0	0
Schistidium robustum	LC	+		0	0.2	1	0	0	0	0	0	0	0	0	1
Schistostega pennata	LC	+		5	2.5	6	0	0	6	0	0	0	0	0	0
Serpoleskea subtilis	LR-nt	+		3	2.3	6	0	0	0	0	6	4	0	0	0
Sphagnum capillifolium	LC	–		3	1.7	4	0	0	3	1	0	0	0	0	0
Sphagnum centrale	LC-att	–		3	1.7	3	0	0	2	2	0	0	1	1	0
Sphagnum fallax[10]	LC	–		1	0	0	0	0	0	0	0	0	0	0	0
Sphagnum flexuosum	LC	–		5	1.7	3	0	0	0	3	0	0	0	0	0
Sphagnum girgensohnii	LC	–		5	5	6	0	0	3	4	0	0	2	0	0
Sphagnum magellanicum	LC	–		5	0.3	1	0	0	0	1	0	0	0	0	0
Sphagnum palustre[11]	LC	–		5	1.2	2	0	0	0	2	0	0	0	0	0
Sphagnum palustre s.l.	–	–		0	1.3	2	0	0	2	1	0	0	0	0	0

[10] *Sphagnum fallax* was not reported by VACÍNOVÁ (1998) but the revision of the single specimen of *S. russowii*, collected by Vacínová in PRC proved the misidentification for that species. Hence the frequency reports for *S. fallax* and *S. russowii* by Vacínová were interchanged.

[11] The field identification of *S. palustre* with respect to *S. centrale* is difficult and virtually impossible for the author. Based on a selective checking of several specimens of *S. palustre* s.l. it seems that both species occur with a similar frequency in the reserve. VACÍNOVÁ (1998) did not distinguish between *S. palustre* s.str. and *S. palustre* s.l., hence her reports on frequency of *S. palustre* should probably rather be assigned to *S. palustre* s.l., because the respective herbarium specimens were not found in herbarium PRC, which means that they were not always checked.

Table 1. Continued.

Species name	Red List	Sporo-phytes	Peri-anths	Frq(V)	Frq(JK)	Count	Number of records for the individual substrate categories								
							L	Lh	T	Th	E	Eb	X	G	A
Sphagnum quinquefarium	LC	+		5	1	3	0	0	0	3	0	0	1	0	0
Sphagnum russowii[10]	LC	–		0	0.7	2	0	0	1	0	0	0	2	0	0
Sphagnum squarrosum	LC	+		5	4	6	0	0	1	5	0	0	2	3	0
Straminergon stramineum	LC	–		5	0	0	0	0	0	0	0	0	0	0	0
Syntrichia ruralis	LC	–		1	0	0	0	0	0	0	0	0	0	0	0
Tetraphis pellucida	LC	+		5	5	6	3	0	1	0	0	0	6	0	0
Thuidium tamariscinum	LC	–		3	4.7	6	3	0	4	4	0	0	2	0	0
Tortula muralis var. aestiva	LC	+		0	0.2	1	0	0	0	0	0	0	0	0	1
Trichodon cylindricus	LC	–		0	0.3	2	0	0	2	0	0	0	0	0	0
Ulota bruchii	LC	+		1	0.5	2	0	0	0	0	2	0	0	0	0
Ulota crispa	LC	+		0	0.5	3	0	0	0	0	3	0	1	0	0
Ulota sp.[12]	–	+		0	0.2	1	0	0	0	0	1	0	0	0	0
Warnstorfia exannulata	LC	–		0	0.2	1	0	0	0	1	0	0	0	1	0
Zygodon dentatus[13]	EN	–		1	0	0	0	0	0	0	0	0	0	0	0

[12] sterile plants
[13] Found by B. Buryová during an excursion on 22 May 1998, first reported by Kučera (2004).

for *C. integristipula*. The occurrence of *C. neesiana* is regarded improbable.

Chiloscyphus minor – reported by Vacínová & Soldán (1997) and Vacínová (1998) as "less common" from the Žofín reserve. The revision of one specimen deposited in the herbarium PRC and another specimen collected on a common excursion of Vacínová and Kučerová (herb. CBFS) proved the misidentification for *C. profundus*. The occurrence of *C. minor* is regarded improbable.

Collection details and remarks for the most interesting taxa

Anastrophyllum hellerianum

The critically endangered species of our flora was found by Vacínová on a single site (location given only as a dot in a sketch of the reserve) in the valley of the Tisový Potok stream. Despite a repeated search the species could not be retrieved during my survey. Nevertheless, Eva Holá (University of South Bohemia) was able to re-find the species (probably at its original location) during an excursion on 13 October 2007. The site details are as follows:

– NE part of the reserve at the Tisový Potok stream 500 m SE of the entrance to the reserve [S-1942, M33: E3478.6–N5392.85], 760 m a.s.l., on decaying spruce stem over the brook, a colony of 8 cm^2, 13 Oct 2007 not. E. Holá.

Hypnum fertile

Another critically endangered species was found on a single place during my first visit to the reserve (Kučera 2004b):

– N part of the reserve, old-growth forest ca. 110 m above the left bank of the Tisový Potok stream, 400 m SSE from the entrance to the reserve, [E3478.69–N5392.85], 770 m a.s.l., on decaying beech stem in a spring site, a colony of ca. 20×30 cm, 28 Sep 2004 coll. J. Kučera (11720, 11821); teste Z. Hradílek.

Despite much effort, no other additional locality was recorded. The state of the single colony seemed much as unchanged during a visit at the locality on 18 October 2008. *H. fertile* might represent one of the rarest and most threatened mosses of Europe (and potentially also of the world as there is no verified record of this moss outside Europe) that nevertheless has escaped the attention of international threat evaluations. The Žofín locality is the only one recently known and the second verified record in the Czech Republic.

Rhynchostegiella tenuicaulis

Critically endangered species found on two close sites in the NE part of the reserve (Kučera 2004b) as the first and only record from the Czech Republic:

– N part of the reserve, along the Tisový Potok stream, left bank, 440 m SE from the entrance to the reserve, [E3478.82–N5392.87], 760 m a.s.l., epiphytically on old beech (*Fagus sylvatica*), half-shaded, 28 Sep 2004 coll. J. Kučera, herb. J. Kučera (11692), teste H. Greven; dtto, 470 m SSE from the entrance to the reserve and 200 m ESE of the elev. pt. 786.0, [E3478.80–N5392.82], 770 m a.s.l., on bark of a big beech, half-shaded, 2 Nov 2004 coll. J. Kučera, herb. J. Kučera (11823).

Similarly as in the preceding case, no other occurrence of this species was recorded in the reserve.

Harpanthus scutatus

In addition to the sites published in 2004 (Kučera 2004b), 3 additional sites of occurrence were found – thus the complete list follows:

– NW part of the reserve, a small clearing ca. 270 m SW of the elev. pt. 786.0 and 550 m SSW from the entrance to the reserve [E3478.43–N5392.68], ca. 775 m a.s.l., on half-shaded granitic stone at the ground level in the upper part of a spring site, with *Scapania nemorea*, 7 Oct 2004 coll. J. Kučera (11760)

– E part of the reserve, 270 m SE of the elev. pt. 786.0 [E3478.78–N5392.67], 785-790 m a.s.l., on half-shaded decaying log, 2 Nov 2004 coll. J. Kučera (11830).

– S part of the reserve ca. 160 m S of the elev. pt. 824.6 E3478.289 N5392.043], 810-815 m a.s.l., decaying spruce log in a spring site, half-shaded, mossy, vertical side, 7 Sep 2005 coll. J. Kučera (12189).

– W part of the reserve ca. 140 m from the fencing, 720 m SSW of the entrance to reserve [E3478.18 N5392.59], 765 m a.s.l., shaded wet base of a granitic stone in a spring-site, 23 Oct 2005 coll. J. Kučera (12287-8).
– W part of the reserve ca. 160 m from the fencing, 760 m SSW of the entrance to reserve, around a small stream [E3478.19 N5392.549], ca. 770 m a.s.l., on shaded wet decaying branch at the stream, 23 Oct 2005 coll. J. Kučera (12293)

The species is recently known from epixylic habitat only from the Žofín reserve and the other primeval forest of South Bohemia – Boubín in the Šumava Mts. The other rare recent occurrences of this species from our country are reported from the North- and East-Bohemian sandstones (Košnar 2003, 2005).

Metzgeria violacea

Reported from a single place in the reserve (Kučera 2004b):
– E part of the reserve, 240 m SE of the elev. pt. 786.0, [E3478.80–N5392.73], 780 m a.s.l., on bark of a smaller beech, half-shaded, 2 Nov 2004 coll. J. Kučera (11826).

No other occurrence of the species was found. The first record of *M. violacea* from the Žofín reserve (Soldán & Buryová 2001) was from another site in the NE part of the reserve, where it has not been re-found despite a repeated search.

Anacamptodon splachnoides

Reported first by Kučera (2004) from a single place and later found on 3 other sites in the reserve. The complete list of records follows:
– N part of the reserve, ca. 150 m NW of the elev. pt. 786.0 and 240 m SSW from the entrance to the reserve [E3478.49–N5392.98], 770 m a.s.l., on wet base of an older beech, 7 Oct 2004 coll. J. Kučera (11738).
– W part, 250 m NW from the elev. pt. 824.6, ca. 150 m from the W fencing [E3478.14 N5392.39], 790 m a.s.l., on shaded bark of a beech, knothole, 7 Sep 2005 coll. J. Kučera (12172).
– S part ca. 40 m SE of the elev. pt. 824.6 [E3478.34 N5392.18], 820 m a.s.l., half-shaded bark of a beech, in a scar, 7 Sep 2005 coll. J. Kučera (12180).
– central part of the reserve ca. 250 m NNW from the elev. pt. 829.5 [E3478.525 N5392.491], 795 m a.s.l., montane beechwood, in a wet scar of a beech, 23 Oct 2005 coll. J. Kučera (12305).

The population in the Žofín forest represents the largest one in the Czech Republic of this rare species, which otherwise is known from only 4 other recent localities in South Bohemia and one in Northern Moravia (Kučera 2004a, 2006; Hradílek 2004).

Dicranum viride, *Neckera pennata*

More than 30 trees with the occurrence of the endangered and NATURA 2000-monitored *Dicranum viride* and 13 trees with the occurrence of *Neckera pennata* have been recorded (mostly *Fagus sylvatica*, rarely *Acer pseudoplatanus*, Fig. 2) and this very probably still does not represent the whole population. One colony of *Neckera pennata* was found with the sporophytes, which is the second recent record of sporophytes in this species from the Czech Republic (the other record of sporophyte-bearing plants was made in the Hrubý Jeseník Mts. (Hradílek, pers. comm.).

Zygodon dentatus

The species was recorded once during the visit of B. Buryová on 22 May 1998, on an old *Acer pseudoplatanus* tree close to the entrance to the reserve (Kučera 2004b).

Aneura maxima

The species occurs quite regularly on the forest spring sites throughout the reserve; not all of the occurrences were recorded. In addition to the 3 localities published earlier from the NW and E part of the reserve (Kučera 2004b), 2 other collections were made:
– SW part of the reserve, a spring site ca. 30 m from the fencing, 350 m W from the elev. pt. 824.6, 190 m

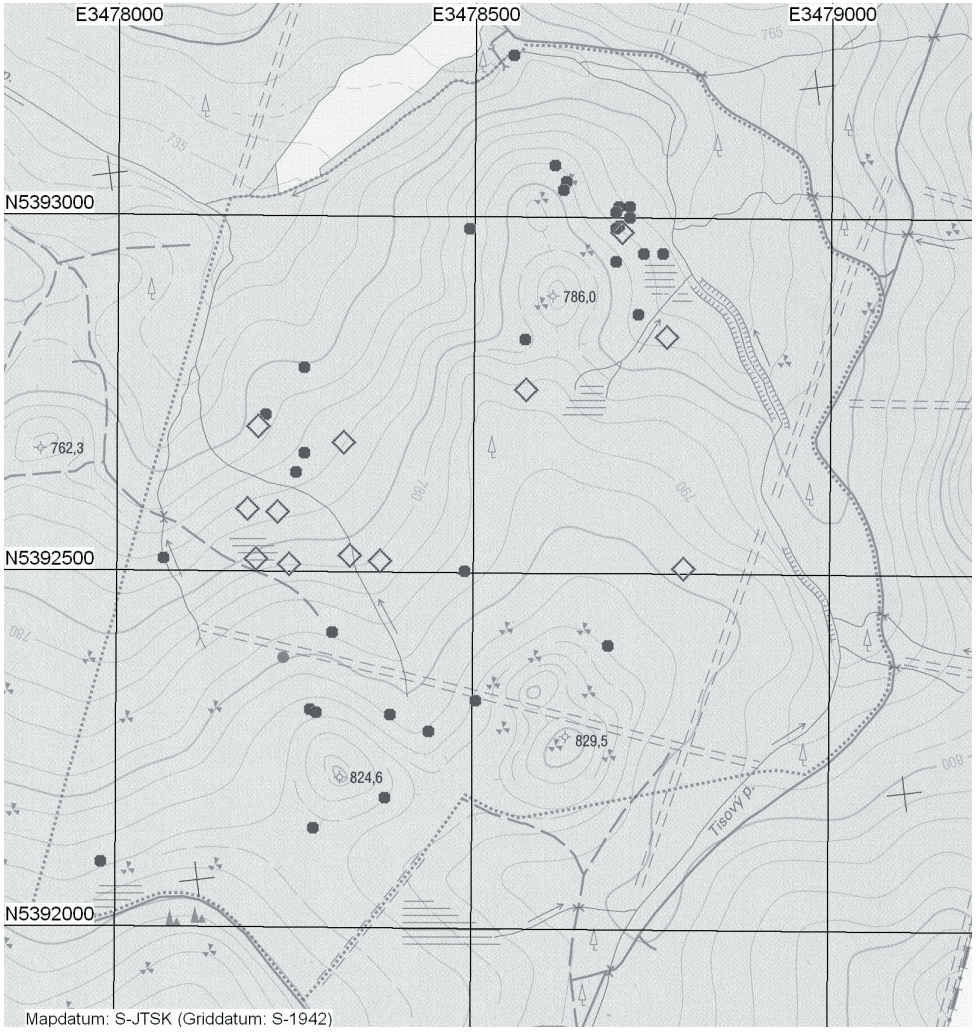

Fig. 2. Recorded occurrences of *Dicranum viride* (full dots) and *Neckera pennata* (empty diamonds) in the Žofín reserve.

NNE of the SW corner of the reserve [E3477.96 N5392.18], 800 m a.s.l., forest spring site, wet shaded humus-rich soil, 7 Sep 2005 coll. J. Kučera (12164).
– central part of the reserve ca. 330 m WNW from the elev. pt. 829.5 [E3478.35 N5392.433 and E3478.402 N5392.502], 790 m a.s.l., in a forest spring site, half-shaded by the vegetation, on wet soil, 23 Oct 2005 coll. J. Kučera (12298, 12300)

After the publication of the first records from the Žofín forest, Loskotová (2006) also reported the occurrence of *A. maxima* in the neighbouring Šumava Mts. but no occurrence from other regions of our country has been reported so far.

Hypnum imponens

Found on a single place in the NW part of the reserve (Kučera 2004b):
– 500 m SW from the entrance to the reserve, [E3478.20–N5392.86], 740–745 m a.s.l., on roots of a bigger

spruce, 7 Oct 2004 coll. J. Kučera (11734), teste Z. Hradílek.

This record represents the only recent collection in the Czech Republic. Despite an intensive search during the later visits of the reserve and of other suitable localities in South Bohemia, the species has not yet been re-found. The same unfortunately applies to the yet unsuccessful search at other suitable localities in the Czech Republic, hence it seems that the species is indeed extremely rare and probably also highly threatened in our country and deserves the highest, Critically Endangered status.

Campylostelium saxicola

– NW part of the reserve, along a brooklet ca. 260 m SW of the elev. pt. 786.0 and 550 m S–SSW from the entrance to the reserve [E3478.45–N5392.68], 785 m a.s.l., on shaded, moist granitic stone at the brooklet bank, 7 Oct 2004 coll. J. Kučera (11753).

– SW part at a stream ca. 30 m from the fencing, 340 m W from the elev. pt. 824.6 [S-1942 M33 E3477.977 N5392.245], 790 m a.s.l., wet shaded siliceous stone in the stream 7 Sep 2005 coll. J. Kučera (12160).

– N part of the reserve at the Tisový Potok stream, ca. 260 m ESE of the entrance to the reserve [E3478.77 N5393.093], 750 m a.s.l., on wet half-shaded granitic stone on the right brook bank, vertical face, 6 Nov 2005 coll. J. Kučera (12329).

The species is generally regarded as quite rare throughout our country (Soldán 1991) but especially in the Moravian Beskydy Mts. it is regularly scattered and therefore evaluated only as a Lower Risk in the Czech Red List. Nevertheless, the 3 microsites in the Žofín reserve are the only records in South Bohemia, where it is obviously very rare.

Fertility and production of perianths

The sporophyte was recorded in 80 taxa of those recorded by the author (9 liverworts and 71 mosses; Vacínová (1998) does not quote this information), this represents 43.7% of recorded taxa (17.6% of liverworts and 53.8% of mosses). The perianths were produced in 40.0% of perianth-producing liverworts.

Frequency of occurrence in individual species

The usual distribution of frequency categories is progressively decreasing towards the commoner species. However, in case of the Žofín forest, we can see the typical decrease only between the rarest and moderately common species, than the curve increases again towards the commonest species (Fig. 3). Nevertheless, this pattern can perhaps be partly explained rather by the nature of recording scale (see Discussion).

On the other hand, there exists definitely a numerous set of "core taxa", which occur very regularly throughout the reserve, and mostly in a higher abundance. This can be seen from the simple analysis of spatial distribution of species, plotting the counts of species presences on the recording tracks (Fig. 4). The most common category here was 6, i.e. the taxa that were recorded on each track; the mean recorded frequency of these taxa on individual tracks was 4.0, meaning that they also belonged to the most frequent ones. The smallest proportion on the total number had the species recorded at 4 or 5 tracks, whereas the numbers for the rarer (or unevenly distributed) taxa than rises again with the increasing unevenness.

Substrate preferences

The distribution of substrate preferences among recorded bryophytes in the Žofín reserve is extraordinarily even, except for the relatively uncommon bryophytes growing in the grass and, of course, the bryophytes found on anthropogenic substrates. Note that the epilithic, epiphytic and terrestrial substrate categories are each divided in two subcategories (the sum for epilithic substrates makes 23%, that for terrestrial substrates 26%, epiphytic 22%). There are, however, different proportions between the data for mosses and liverworts evaluated

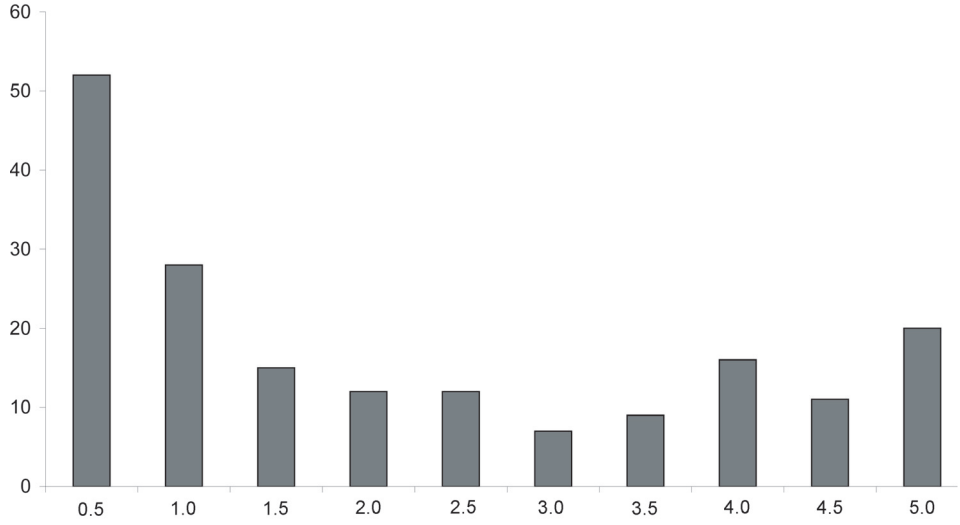

Fig. 3. Numbers of taxa in individual frequency classes. The description of classes (0.5, 1.0…) refers to the classes $0<x\leq0.5$, $0.5<x\leq1.0$…, respectively, the bars show the number of cases (the case being the average recorded frequency for the respective taxon on the six recording tracks through the reserve) in those classes.

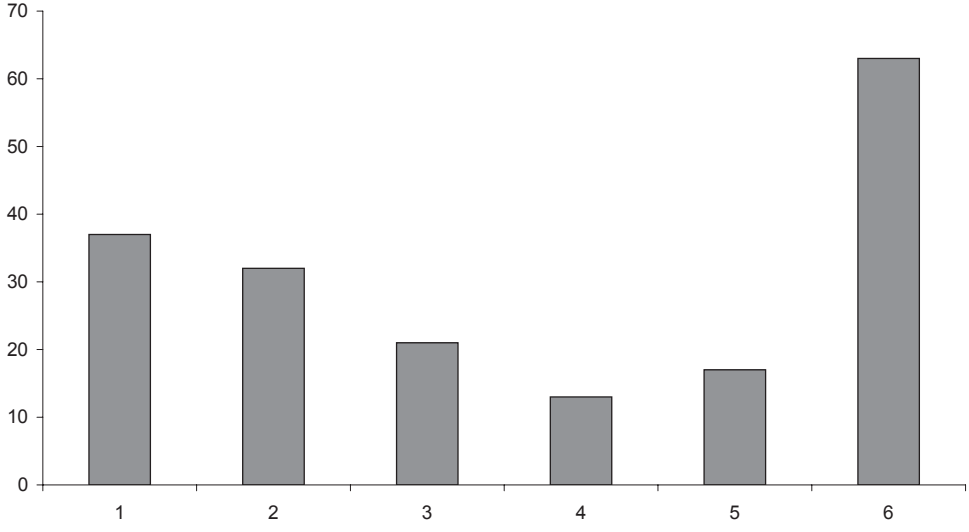

Fig. 4. Spatial distribution of the recorded species expressed as the count of species presences on individual recording tracks.

separately – mosses showing essentially the same pattern as all bryophytes together (data not shown), but liverworts having a substantially larger proportion of hygrophilous (mostly hygro-epilithic) and epixylic taxa and a substantially smaller proportion of epiphytic species of the tree bases (Fig. 5).

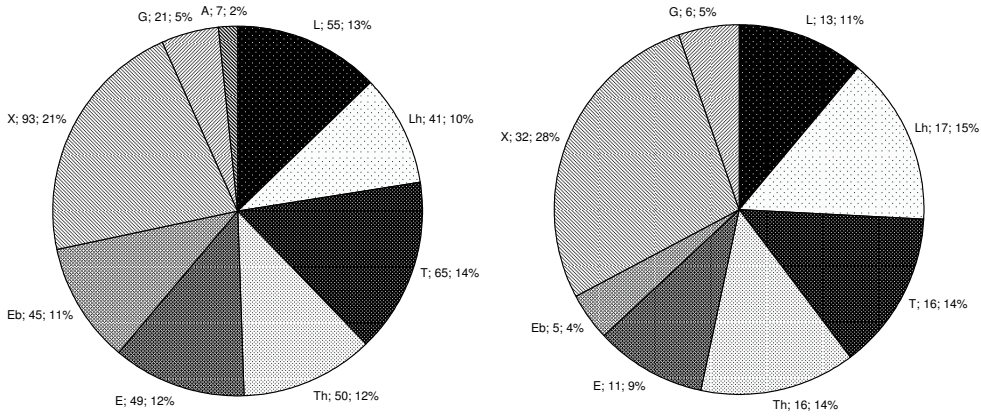

Fig. 5. Left: Percentages of substrate records for individual taxa of bryophytes. The occurrence of a bryophyte on multiple substrates was coded as separate records. See the caption to Table 1 for the substrate codes. Right: Percentages of substrate records for individual taxa of liverworts.

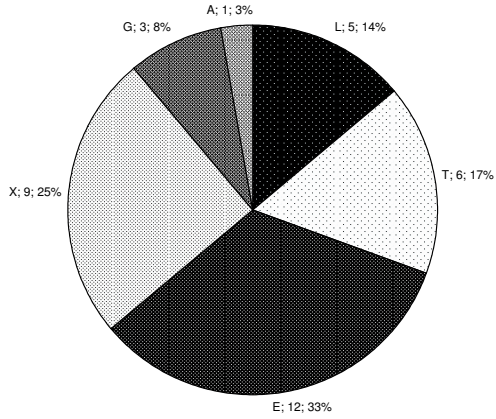

Fig. 6. Substrate records for red-listed bryophytes (sum of CR, EN, VU, LR-nt and DD categories). The occurrences on multiple substrates were coded as separate records. See the caption to Table 1 for the substrate codes.

Red-listed taxa

12.7% of the recorded taxa (including the records of Vacínová (1998) except for the excluded taxa) are listed in some of the threatened categories of the Czech Red List (Kučera & Váňa 2005). These records include 3 critically endangered, 7 endangered, 5 vulnerable, 6 near threatened, and 4 data deficient taxa; 23 of the recorded least concern taxa are on the "attention list". There is a higher percentage of threatened liverwort taxa than of the mosses, with 21.4% of red-listed liverwort taxa and only 9.3% of red-listed mosses.

The red-listed bryophytes generally belong to the less common taxa in the reserve. The analysis of own records showed the average value for recorded frequency equalling 1.1, with the median even lower, 0.58, and the 8 of the 22 red-listed taxa recorded only once (remaining 3 red-listed taxa have not been recorded by the author). On the other hand, 7 of the red-listed taxa were recorded during 5 or all 6 collecting trips, although mostly only sparsely.

Dicranum viride (Endangered in the Czech Republic) was recorded during each of the collecting trips with the average frequency of 4 and represents thus somewhat paradoxically the commonest of the red-listed taxa in the Žofín reserve. The substrate preferences of the red-listed taxa differ to a larger extent from the preferences for all taxa (Fig. 6). Most of the threatened taxa have been found epiphytically, followed by the epixylic occurrences, accounting together for nearly two-thirds of the whole spectrum.

Discussion

There are very few possibilities for comparisons of the bryofloristic data from the Žofín reserve with other comparable reserves. Unfortunately in no other primeval forest reserve of the Czech Republic, the exhausting floristic inventory has ever been made. Hradílek (1999) recorded 71 bryophytes in the 12-ha large lowland old-growth forest Cahnov in Southern Moravia, of which 61 were recorded on epixylic habitat, Gutzerová (1999) reported very similar numbers (70 bryophytes, of which 28 were liverworts) from the montane mixed forest Polom in the ŽeleznéHory Mts. of Eastern Bohemia. Váňa & Soldán (1998) surveyed two montane old-growth forests in the Bohemian Forest (= Šumava Mts.) and found 97 species in a 15–20 ha large beechwood on the Ždanidla Mt. (1080–1250 m a.s.l.) and 71 species in a similarly large spruce forest at ca. 1100 m a.s.l. Unpublished preliminary data for the old-growth mixed forest Jelení Bučina in the Hrubý Jeseník Mts. of Northern Moravia (ca. 25 ha., 800–930 m a.s.l.) account for 97 bryophyte species (Hradílek in litt.). Significantly smaller areas of those surveyed forests, however, preclude direct comparison of species numbers, although it is evident that the Žofín forest is richer in species (195 species in total with 95 epixylic species, and at each of the 6 recording tracks that mostly covered an area smaller than 20 ha was recorded between 107 and 121 species).

In the absence of comparable floristic data from habitats similar to the Žofín forest, we can try to compare the floristic richness of the montane forest to surveys made by the collective including the author of this article in the glacier cirques of the Giant Mts. (= Krkonoše Mts.) and Hrubý Jeseník Mts. The glacier cirques are generally regarded as extremely rich localities (Jeník 1961), especially in terms of the bryophytes, due to the variety of micro-sites and favourable, relatively stable conditions in parts of the cirques combined with the disturbing forces of avalanches that do not allow for the growth of closed forest. The cirques at the Kotel Mt., the cirques of the Labský Důl valley and the Úpská Jáma cirques have a comparable area with the Žofín reserve (ca. 60, ca. 100 and ca. 80 ha, respectively) and have been surveyed by means of similar methods (Kučera et al. 2004a,b,c), yet much more intensively (30–40 man-days spent at each locality during three years of the survey compared with the 6 man-days at the Žofín reserve. The number of bryophyte species reported from each of the localities oscillated between 240 and 270, which seems to be fully comparable with the 195 known species of the Žofín reserve. If the cumulated number of known species after each of the visits to the Žofín reserve is extrapolated by means of a logarithmic curve (Fig. 7), we can theoretically expect some 230 species in the Žofín reserve after 30 additional visits, i.e. with a similar degree of exploration as it was the case in the cirques of the High Sudetes. This means that the Žofín primeval forest belongs to the absolutely richest bryophyte localities in our country, which may seem quite unexpected for a forest with a limited diversity of microsites, compared to the glacial cirques.

The unexpectedly high number of recorded bryophytes can probably be explained by three factors. The first is the higher diversity of microhabitats and relatively even distribution there compared to other old-growth forests of the Czech Republic. Especially important here might be the good representation of hygric habitats, which can particularly support the

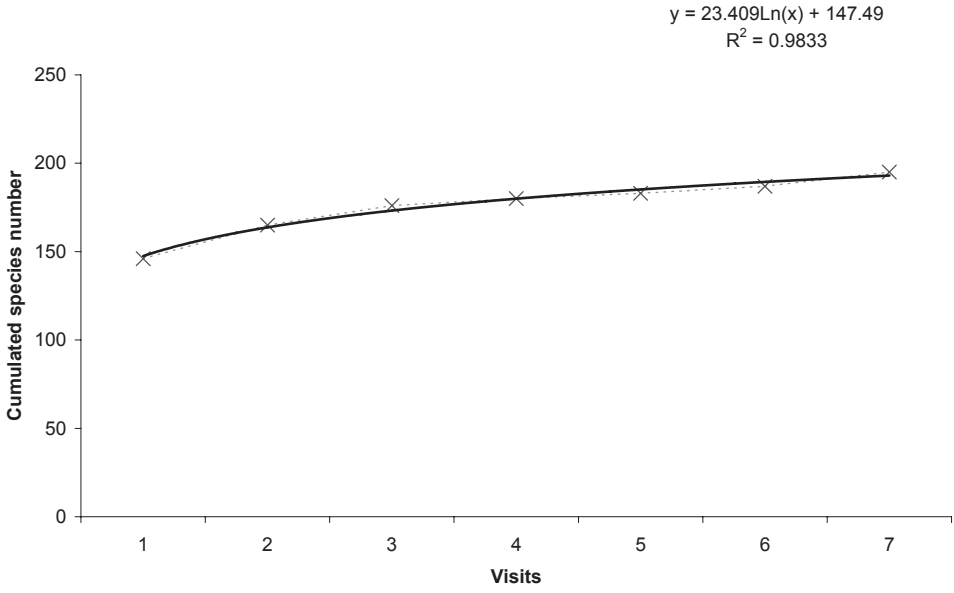

Fig. 7. Cumulated known species number after inclusion of records from the individual recording tracks.

wide spectrum of liverworts. The second reason is definitely the generally high and stable air humidity, both in the surface layer and higher up in the forest. This can be documented by the extremely high proportion of sporulating species (the numbers documented here exceed, though not by much, the highest documented numbers from the glacial cirques of the High Sudetes: 40–49% for mosses, 3–17% for liverworts, cf. Kučera et al. 2004a). The third reason is logically the minimum number of anthropogenic disturbances, namely the uninterrupted supply of fallen trees that can support the development of epixylic bryophyte communities, for a time period extending at places probably much more than the 170 years of the official site protection.

With regard to frequency and spatial distribution of the species in the reserve, unfortunately there are no bryofloristic data for comparison at hand. Nevertheless, the expected gradual decline of species belonging to the higher frequency ranks does not seem to be true for the Žofín reserve. In fact I recorded higher frequencies of occurrence for the given species sets at each recording track more often than lower frequencies and the typical look of the average frequency records for the lower ranks (Fig. 3) is only caused by the relatively high proportion of species that were not recorded at all at the individual tracks. This reflects the high evenness of the species distribution in the reserve and would definitely account for high values of biodiversity indices if these were calculated on a legitimate way in the reserve.

The even distribution of substrate preferences for the recorded taxa was quite surprising for me. There is a certain paucity of epilithic habitat due to the absence of larger rocks and boulders and the terrestrial communities seem to be dominated by a few common ubiquitous species. Nevertheless the reality after the evaluation of all available data looks different. The relative richness of epiphytic and epixylic bryoflora is probably outstanding in comparison to other forest reserves but there are no similar data available from forest reserves. The significance of epixylic and epiphytic bryoflora can however be illustrated by the increased proportion of threatened taxa among these groups (Fig. 6). The general dependence of liverworts on the humidity of the biotope can be documented on the higher proportion of hygro-

-epilithic and hygro-terrestrial liverworts on the species spectrum (Fig. 5); the same reason probably applies to epixylic liverworts as well, as even here there is a large number of liverwort species that occur only in very humid epixylic substrates (these could not be reasonably distinguished in field).

The Žofín forest reserve is clearly an important refuge for threatened bryophyte species, particularly for those living in epiphytic and epixylic habitats. Although the percentage of recorded red-listed taxa is not extraordinarily high (close to 13% compared to 16–26% of recorded taxa in the cirques of the High Sudetes, Kučera et al. 2004a), most of the recorded threatened taxa are unique either in the fact that they have been recorded only here, at least recently (*Hypnum fertile, Hypnum imponens, Rhynchostegiella tenuicaulis*), or their population in the reserve is extraordinarily big and apparently stable with respect to other known occurrences in the country or even in the larger Central European region (*Dicranum viride, Neckera pennata, Anacamptodon splachnoides*).

With respect to all the facts described above it can be concluded that the Žofín primeval forest reserve belongs to the most important hot-spots of bryophyte diversity in Central European region.

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