

Killarney fern *Trichomanes speciosum* Willd. in Poland (2002–2008) – the state of population and protection perspective

KRZYSZTOF ŚWIERKOSZ¹, KAMILA RECZYŃSKA², MAREK KRUKOWSKI³

¹⁾ Museum of Natural History, University of Wrocław, Sienkiewicza 21,
PL-50-335, Wrocław, Poland; e-mail: krissw@biol.uni.wroc.pl

²⁾ Institute of Plant Biology, University of Wrocław, Kanonia 6/8,
PL-50-328 Wrocław, Poland; e-mail: kamire@interia.pl

³⁾ Institute of Environmental Management and Conservation, Wrocław University
of Environmental and Life Sciences, pl. Grunwaldzki 24, PL-50-363, Wrocław,
Poland; e-mail: mkrusk@miks.ar.wroc.pl

ABSTRACT: Killarney fern (*Trichomanes speciosum* Willd., Hymenophyllaceae) is one of the most endangered and interesting ferns in Europe, which forms exclusively independent gametophyte colonies. In Poland, it has been reported in two localities in the Westsudeten Foothills, Lower Silesia. They are the most eastern outposts of this taxon in Europe, suffering the most severe climatic conditions in the extent of its occurrence. In both sites, gametophytes occurred in horizontal rock fissures in the Upper Cretaceous sandstone, surrounded by degraded eastern oak-hornbeam forests. The analysis of its occurrence in Poland during sixth years showed dynamic changes of the population state. The population which occurs in the cave near Złotoryja has decreased between 2002 and 2006, to be almost extinct, but in the last two years its cover increased to half of its previous state. Gametophytes found in the locality near Lwówek Śląski (Panieńskie Skały) in years 2002–2004 have not been confirmed in 2008.

ABSTRAKT: Włosocień delikatny (*Trichomanes speciosum* Willd., Hymenophyllaceae) jest uznawany za jedną z najbardziej zagrożonych i interesujących paproci Europy, zdolną do formowania populacji złożonych wyłącznie z przedrośli (gametofitów). W Polsce gatunek ten znany jest z dwóch stanowisk na Pogórzu Sudetów (Dolny Śląsk), gdzie osiąga wschodnią granicę swojego zasięgu. Na obu stanowiskach, otoczonych przez zdegenerowane lasy grądowe, obecność gametofitów została stwierdzona w głębokich szczelinach skał piaskowca kredowego. Przez 6 lat od pierwszej obserwacji, obie populacje podlegały dynamicznym zmianom. Populacja

ŚWIERKOSZ K., RECZYŃSKA K., KRUKOWSKI M. 2008. Killarney fern *Trichomanes speciosum* Willd. in Poland (2002–2008) – the state of population and protection perspective. – In: E. Szczęśniak, E. Gola (eds), Club mosses, horsetails and ferns in Poland – resources and protection. – Polish Botanical Society & Institute of Plant Biology, University of Wrocław, Wrocław, p. 47–56.

występująca na stanowisku w pobliżu Złotoryi w ciągu 4 lat zmniejszyła się o połowę i w 2006 roku znalazła się na krawędzi wymarcia. W roku 2008 zaobserwowano jednak rozprzestrzenianie się gametofitów, których łączna powierzchnia stanowi obecnie połowę pierwotnie stwierzonej na stanowisku. Kontrola w 2008 roku nie potwierdziła obecności gametofitów na stanowisku koło Lwówka Śląskiego, gdzie były obserwowane w latach 2002–2004.

KEY WORDS: killarney fern, Hymenophyllaceae, Central Europe, Poland

Introduction

The killarney fern *Trichomanes speciosum* Willd. (syn. *Vandenboschia speciosa* (Willd.) G. Kunkel) is the most peculiar of the three European species of the family Hymenophyllaceae and the only European representative of the genus. It is a Macaronesian-European endemic (Rumsey *et al.* 1998), classified as an extremely oceanic element of the pteridophyte flora (Birks 1976). The restriction of *Trichomanes speciosum* sporophyte to areas of hyperoceanic climate, coupled with its historical excessive collection, resulted in its legal protection under the Bern Convention (Anon. 1979) and Habitat Directive (Anon. 1992) within the species range.

Sporophytes and gametophytes of the killarney fern are perennial and both are capable of vegetative propagation, with the extensive clonal development. They often exist as spatially separated populations (Farrar 1985), where sporophytes are restricted to European Atlantic fringe (Jalas, Suominen 1988) but gametophyte distribution is stretching over the more continental part of Central Europe (e.g., Vogel *et al.* 1993; Rumsey *et al.* 1998). *Trichomanes speciosum* is able to establish independent gametophyte generation, which survives beyond the known geographical and altitudinal limit of sporophyte generation (Farrar 1985; Rumsey, Sheffield 1996). The occurrence of gametophytes was reported more than 1000 km away from the nearest known killarney fern sporophyte localities (e.g., Vogel *et al.* 1993; Rumsey *et al.* 2000).

Gametophytes of *Trichomanes speciosum* Willd. were not observed in Poland before 2002 year, but the nearest localities were situated in a close vicinity – in the area of Elbsandsteingebirge and České Švýcarsko, known also as Saxonian-Bohemian Switzerland. The presence of Cretaceous sandstone areas in the Sudeten foothills gave a chance for possible occurrence of the killarney fern. The climatic conditions of this area differ from the neighbouring Saxonian-Bohemian Switzerland massif in stronger continentality, pronounced by lower mean air temperature, c. +7°C in the Sudeten foothills comparing to +8°C in Saxonian-Bohemian Switzerland, and rainfall, c. 650 mm and 720 mm respectively (Wiszniewski 1973; Vogel *et al.* 1993).

1. Ecology

The narrow ecological amplitude of *Trichomanes speciosum* gametophyte strongly limits the number of its potential sites. The main factor determining plant distribution is a suitable microclimate with proper temperature and water supply, the latter also in a form of water vapour in the air. The usual habitats of epilithic *Trichomanes speciosum* gametophytes are deep rock cracks and small caves with limited light access. As a consequence, these habitats have fairly constant humidity and a stable thermal regime, which prevent drying out or freezing of the delicate mats of the killarney fern prothalli (Farrar 1985). The new localities discovered in Poland are the most eastern outposts of the *Trichomanes speciosum* gametophytes in Europe (Krukowski, Świerkosz 2004; Fig. 1). Cretaceous sandstone massifs are also scattered further to the east, even in South-Central Poland, but it seems that meso- and microclimate conditions are far too unfavourable there. Likely, in the peripheral outposts, stable microclimatic conditions including high air humidity, which can be supported by a thick humus layer of moder type, are of a great importance for *Trichomanes speciosum* gametophyte to survive. Light limitation is not so stringent in lower temperatures (Raine, Sheffield 1997).

Trichomanes speciosum has slight abilities to compete. Accordingly, its adaptation to extreme terms such as low light, low respiration rates and therefore low compensation point eliminates potential competitors, especially shadow tolerant bryophytes. However, in very moist habitats, hepatics can compete with killarney fern prothalli because of about twofold faster growth rate than fern gametophytes (Vogel *et al.* 1993; Makgomol, Sheffield 2001).

It should be emphasised that *Trichomanes speciosum* is the most tolerant in the range of sporophyte distribution, where occupies differentiated habitats from nearly calcareous man-made habitats in Macaronesia (Rumsey *et al.* 2000) to various substrata with some enrichment of base in the British Isles (Ratcliffe *et al.* 1993). During relocation towards east, its tolerance becomes narrower. Therefore at the borders of distribution, the killarney fern occurs only on sandstones (Vogel *et al.* 1993; Turonova 2002).

2. Description of localities

In October 2002 two sites with minute colonies of *Trichomanes speciosum* gametophytes in West Sudeten foothills, Lower Silesia, SW Poland were found (Krukowski, Świerkosz 2004).

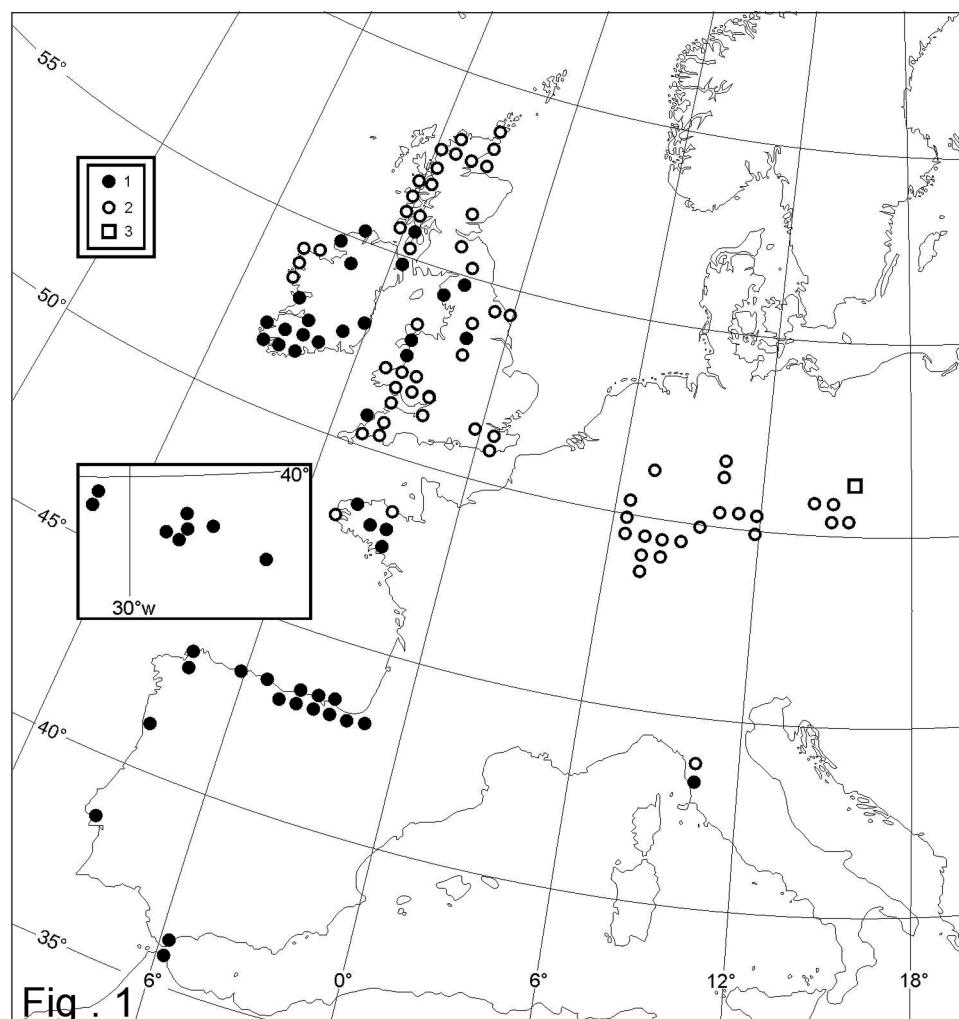


Fig. 1. Distribution of *Trichomanes speciosum* in Europe (black dots – sporophytes, white dots – gametophytes, squares – Polish localities)

Ryc. 1. Rozmieszczenie *Trichomanes speciosum* w Europie (czarne kółka – sporofity, białe – gametofity, kwadraty – stanowiska w Polsce)

The first one, called “Wilcza Jama” (Wolf Den) is located near Złotoryja ($51^{\circ}06'20''\text{N}$, $15^{\circ}54'20''\text{E}$; ATPOL BE41; Fig. 2). Gametophytes including one big and tightmat, and the second very small one grew on the bare rock surface under the overhanging of a small cave at c. 250 m a.s.l. on the lower Turonian medium grained sandstone. The cave is located in the upper part of a small SW exposed valley. Killarney fern gametophytes grew alone (Fig. 3), without any competitors at the bottom of the cave horizontal closure. Only

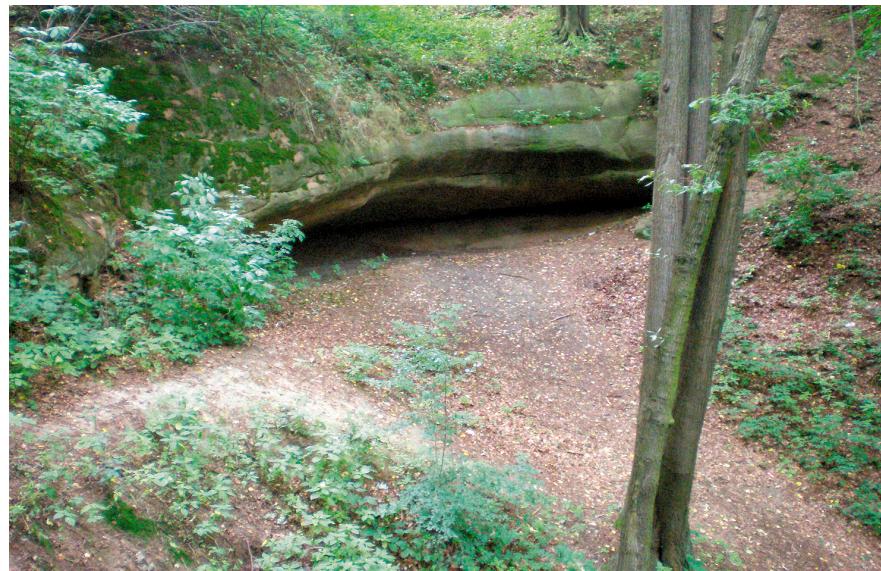


Fig. 2. Wilcza Jama Cave – locality of *Trichomanes speciosum* near Złotoryja (phot. K. Świerkosz)

Ryc. 2. Wilcza Jama – stanowisko *Trichomanes speciosum* koło Złotoryi (fot. K. Świerkosz)

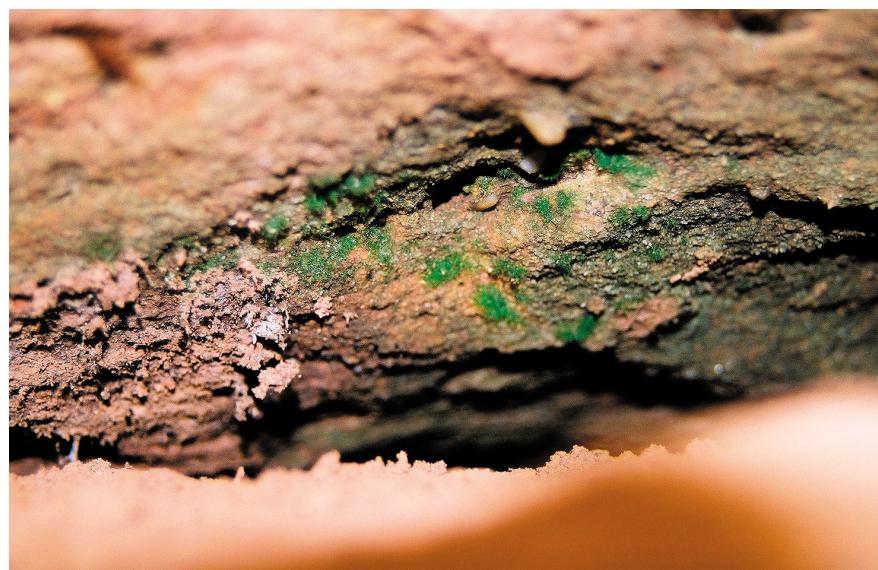


Fig. 3. Gametophytes of *Trichomanes speciosum* in locality near Złotoryja in 2006 (phot. K. Świerkosz)

Ryc. 3. Gametofity *Trichomanes speciosum* na stanowisku w Złotoryi w roku 2006 (fot. K. Świerkosz)

a bryophyte, *Pseudotaxiphyllum elegans* (Brid.) Z.Iwats., has been recorded nearby. The whole valley is covered by eastern oak-hornbeam forest (*Galio sylvatici-Carpinetum betuli* Oberd. 1957).

The second site, called “Panieńskie Skały” (“Maiden Rocks”), is located 1 km south of Lwówek Śląski ($51^{\circ}06'15''$ N, $15^{\circ}35'30''$ E; ATPOL AE49; Fig. 4) at 260 m a.s.l. The sandstone crest reaching 10 m of height is surrounded by the mixed, degraded form of oak-hornbeam forest *Galio sylvatici-Carpinetum betuli*, with addition of *Pinus sylvestris* trees. The humus layer is thick and of a moder type. In 2002, three small patches up to 3 cm^2 of *Trichomanes speciosum* gametophytes were found in 50 cm deep south-facing cracks of the coarse grained sandstone rocks of the middle Cenomanian. The cracks were sparsely colonised by mosses i.e., *Schistostega pennata* (Hedw.) F. Weber et D. Mohr and *Distichum inclinatum* (Hedw.) Bruch et Schimp. in Bruch (Krukowski, Świerkosz 2004; Świerkosz, Krukowski 2005).

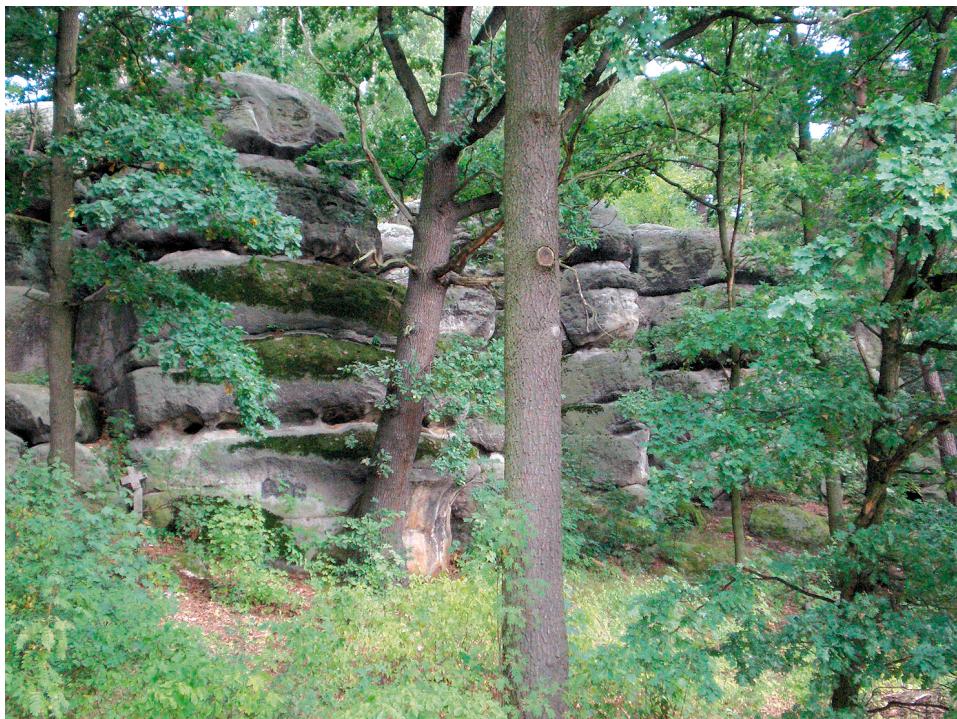


Fig. 4. Panieńskie Skały Rocks near Lwówek Śląski – locality of *Trichomanes speciosum* unconfirmed in 2008 (phot. K. Świerkosz)

Ryc. 4. Panieńskie Skały koło Lwówka Śląskiego – niepotwierdzone w 2008 r. stanowisko *Trichomanes speciosum* (fot. K. Świerkosz)

3. Materials and methods of monitoring

Described sites of *Trichomanes speciosum* gametophytes were monitored in 2003, 2004, 2006 and 2008, depending on the locality. The accurate measurement of gametophyte size was impossible due to location of individuals in very deep narrow rock fissures. Therefore, gametophyte size was estimated with the accuracy of 1 mm. The photographic documentation was taken. Herbarium material was not collected because of the ultra small size of population.

4. Results

The locality near Złotoryja was controlled in 2002, 2003, 2004, 2006 and 2008. In the year of discovery (2002), gametophytes formed a dense patch of 3 cm^2 . Next year the area occupied by prothalli doubled to 6 cm^2 (Świerkosz 2004). In 2004, the patch disintegrated into very small fragments but their total area was almost of the same size as in 2002. A severe winter 2005/2006 reduced the population to 0.2 cm^2 and made it critically endangered. However, in 2008, five new small individuals of the species with a total cover estimated for 1.6 cm^2 were found. New gametophyte covering 3 mm^2 emerged in a place outlying about 4 meters from known location of the species. Summarising, in years 2002–2008 in the site near Złotoryja the total surface of *Trichomanes speciosum* gametophytes decreased by a half, but the locality still exists. Detailed results of *Trichomanes speciosus* monitoring are shown in Table 1.

Tab. 1. Results of observation on the size and number of gametophyte fragments in the site near Złotoryja in years 2002–2008

Tab. 1. Wyniki obserwacji wielkości i liczby fragmentów gametofitów na stanowisku koło Złotoryi w latach 2002–2008

Year (Rok)	Number of gametophytes (Liczba gametofitów)	Total surface of gametophytes (Łączna powierzchnia gametofitów)
2002	1 dense gametophyte, 1 small fragment	3 cm^2
2003	2 dense gametophytes	6 cm^2
2004	several slight fragments	2.5 cm^2
2006	1 evanescent fragment	0.2 cm^2
2008	5 gametophytes	1.6 cm^2

The locality near Lwówek Śląski was monitored in 2002, 2004 and 2008. In 2002, the Panieńskie Skały (Maiden Rocks) site counted 3 small gametophytes having about 3 cm^2 . However, during the control in 2004 only one partially decaying gametophyte was found (Świerkosz, Krukowski 2005). Monitoring in 2008 did not reveal the presence of the killarney fern. The extinction was probably caused by the partial clearance of the undergrowth, which until now

has been responsible for shading rocks from direct solar radiation and wind. Dramatically changed conditions, i.e. mainly intensive insolation and a lack of protection against variable temperature and desiccation, may result in a disappearance of whole population or cause the uselessness of the site for the further development of the killarney fern. The renewed species occurrence in this locality would be possible only after the reconstruction of previous microclimatic conditions.

5. Protection perspective

Both sites are localised in Natura 2000 areas, namely “Panieńskie Skały” already approved by European Commission in December 2007 and “Góry i Pogórze Kaczawskie” the area, which is planned to be protected. Moreover, *Trichomanes speciosum* is a species which requires creation of protection zones. In spite of the Polish law, protection zones for both localities have not been formed yet. Further explorations of this species should be taken in the Panieńskie Skały and in potential sites nearby Żerkowice and Skałka villages in a close vicinity to the presented here locality.

The best method of *Trichomanes speciosum* protection includes the strict conservation of rock fissures with gametophytes as well as surrounding forest communities.

Additionally, the new Natura 2000 site should be established near Skałka and Żerkowice villages to protect the potential sites of the species in its referential range.

References

- ANON. 1979. The Convention on the Conservation of European Wildlife and Natural Habitats. – Council of Europe, Strasbourg.
- ANON. 1992. Council directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats of wild faunas and floras. – Official Journal of the European Communities **206**: 7–49.
- BIRKS H.J.B. 1976. The distribution of European pteridophytes: A numerical analysis. – New Phytol. **77**: 257–287.
- FARRAR D.R. 1985. Independent fern gametophytes in the wild. – Proc. Roy. Soc. Edinb. **88B**: 361–369.
- JALAS J., SUOMINEN J. (eds) 1988. Atlas Flora Europaea: distribution of vascular plants in Europe, Vol. I. 1. Pteridophyta (Psilotaceae to Azolaceae). – University Press, Cambridge. 416 pp.

- MAKGOMOL K., SHEFFIELD E. 2001. Gametophyte morphology and ultrastructure of the extremely deep shade fern, *Trichomanes speciosum*. – New Phytol. **151**: 243–255.
- KRUKOWSKI M., ŚWIERKOSZ K. 2004. Discovery of the gametophytes of *Trichomanes speciosum* Willd. (Hymenophyllaceae: Pteridophyta) in Poland and their biogeographical importance. – Fern Gaz. **17**(2): 79–85.
- RAINE C.A., SHEFFIELD E. 1997. Establishment and maintenance of aseptic culture of *Trichomanes speciosum* gametophytes from gemmae. – Amer. Fern J. **87**: 87–92.
- RATCLIFFE D.A., BIRKS H.J.B., BIRKS H.H. 1993. The ecology and conservation of the Killarney Fern *Trichomanes speciosum* Willd. in Britain and Ireland. – Biol. Conserv. **66**: 231–247.
- RUMSEY F.J., SHEFFIELD E. 1996. Inter-generational ecological niche separation and the “independent gametophyte” phenomenon. – In: CAMUS J.M., GIBBY M., JOHNS R.J. (eds), Pteridology in perspective. – Royal Botanic Garden, Kew, p. 563–570.
- RUMSEY F.J., VOGEL J.C., GIBBY M. 2000. Distribution, ecology and conservation status of *Trichomanes speciosum* Willd. (Pteridophyta) in the Azorean archipelago. – Arquipélago. Life and Marine Sciences. Suplement **2A**: 11–18.
- RUMSEY F.J., VOGEL J.C., RUSSELL S.J., BARRETT J.A., GIBBY M. 1998. Climate, colonisation and celibacy: population structure in Central European *Trichomanes speciosum* (Pteridophyta). – Bot. Acta **111**: 481–489.
- ŚWIERKOSZ K. 2004. *Trichomanes speciosum* Willd. Włosocień delikatny. – In: SUDNIK-WÓJCIKOWSKA B. (ed.), Podręczniki ochrony siedlisk i gatunków Natura 2000. Gatunki roślin **9**: 59–62.
- ŚWIERKOSZ K., KRUKOWSKI M. 2005. Main features of sandstone flora and plant communities of the North-Western part Sudeten Foreland. – Ferrantia **44**: 127–132.
- TURONOVA D. 2002. The Killarney Fern (*Trichomanes speciosum*) in sandstone regions of the Czech Republic. – In: KOPRIVOVÁ L. (ed.), Sandstone Landscapes: Diversity, Ecology and Conservation, Doubice, p. 35–36.
- VOGEL J.C., JESSEN S., GIBBY M., JERMY A.C., ELLIS L. 1993. Gametophytes of *Trichomanes speciosum* (Hymenophyllaceae: Pteridophyta) in Central Europe. – Fern Gaz. **14**: 227–232.
- WISZNIEWSKI W. (ed.) 1973. Atlas klimatyczny Polski. – PPWK, Warszawa, 141 pp.

Włosocień delikatny (*Trichomanes speciosum* Willd.) w Polsce (2002–2008) – stan obecny i perspektywy ochrony

Włosocień delikatny (*Trichomanes speciosum* Willd.) jest znany we florze Polski od roku 2002, kiedy to kontrola potencjalnych stanowisk gatunku w obrębie Pogórza i Przedgórza Izerskiego zaowocowała odkryciem dwóch niewielkich populacji tej paproci (Krukowski, Świerkosz 2004). Odkrycie to nie tylko

przesunęło granice występowania gatunku w kierunku północno-wschodnim (ryc. 1), ale też pozwoliło zweryfikować wiedzę o wymaganiach klimatycznych *Trichomanes speciosum*. Dolnośląskie stanowiska leżą bowiem w strefie, w której średnia temperatura roczna jest niższa o blisko 1°C od najbardziej wysuniętych na północ stanowisk w Czechach, zaś średnie opady są niższe o około 80 mm rocznie. Oba stanowiska podlegały regularnym kontrolom, które pozwalały na bieżąco monitorować wielkość populacji gatunku. Z uwagi na bardzo głębokie ułożenie okazów w ciasnej szczelinie skalnej, niemożliwe było dokładne mierzenie wielkości gametofitów, ich wielkość szacowano więc z dokładnością do około 1 mm.

Stanowisko położone w pobliżu Złotoryi (51°06'20" N, 15°54'20" E; ATPOL BE41; ryc. 2, 3), było monitorowane w latach 2002, 2003, 2004, 2006 i 2008. Po mroźnej zimie 2005–2006 populacja znajdowała się na krawędzi wymarcia. W roku 2008 zaobserwowano jednak rozprzestrzenianie się gametofitów, które do tej pory występowały tylko w jednym miejscu szczeliny, pojawił się też nowy, niewielki gametofit o powierzchni 3 mm² w miejscu oddalonym o 4 metry od dotychczasowego stanowiska (tab. 1).

Stanowisko na Panieńskich Skałach koło Lwówka Śląskiego (51°06'15" N, 15°35'30" E; ATPOL AE49; ryc. 4), w roku 2002 liczyło 3 niewielkie gametofity o powierzchni oszacowanej na 3 cm², jednak podczas kontroli w roku 2004 odnaleziono już tylko jedną, w połowie zamierającą matę gatunku (Świerkosz, Krukowski 2005). Kontrola stanowiska w roku 2008 nie wykazała obecności włosocienia, na co prawdopodobnie wpływ miała wycinka podrostu drzew oraz podszytu w lesie grądowym, osłaniającym stanowisko przed bezpośrednim wpływem promieniowania słonecznego oraz zmniejszających wilgotność wiatrów.

Oba stanowiska znajdują się w obszarach Natura 2000 („Panieńskie Skały” – zatwierdzony przez Komisję Europejską w grudniu 2007 oraz „Góry i Pogórze Kaczawskie” – planowany). Mimo obowiązującego prawa polskiego strefy ochronne dla obu stanowisk nie zostały jeszcze utworzone. Należy podjąć ponowne poszukiwania gatunku w Panieńskich Skałach oraz na potencjalnych stanowiskach w okolicy Żerkowic i Skałki.