Conference Volume	6th Symposium for Research in Protected Areas 2 to 3 November 2017, Salzburg	pages 629 - 632

Ferns in the spray: the pteridophyte flora of the Krimml Waterfalls

Oliver Stöhr

Abstract

In 2016 a survey of the fern flora at the Krimml Waterfalls was carried out on behalf of the National Park Hohe Tauern / Salzburg. In the course of this mapping, 36 taxa and 5 hybrids of fern allies were detected, including some notable taxa such as *Polystichum braunii*, *Dryopteris lacunosa* and *Lycopodium clavatum subsp. monostachyon*. On this basis it can be concluded that the area of the Krimml Waterfalls is very significant for the fern flora and is highly representative within the central alpine chains of the Eastern Alps.

Keywords

Austria, ferns, floristic mapping, pteridophytes, Krimml Waterfalls

Introduction

Around 12,000 species of fern plants are known worldwide, of which, according to current knowledge, approx. 90 species and subspecies occur in Austria. Up to now, about 70 native fern species and subspecies were detected in the province of Salzburg (see FISCHER et al. 2008). Although these numbers are manageable and therefore one may assume that our ferns are well-known, the native fern flora is not fully explored yet. For instance, only limited data were available for the area of the Krimmler Waterfalls, an area which is promising due to the 'fern-friendly' shady and permanently moist site conditions. A complete and systematic examination of the fern flora has not been carried out yet – quite in contrast to the local moss flora, which is described at lenght by the work of GRUBER et al. (2001). Against this background, the author was commissioned to carry out an extensive survey about the fern flora of the area around the Krimmler Waterfalls in 2016. The results are presented in a 152-page final project report (STÖHR 2016).

Methods

In an investigation area, which stretches over approx. 102 ha, fern-allied plants (i.e. clubmosses, horsetails and ferns) and their abundances were recorded in defined habitats.

In addition, rare and significant species for nature conservation were pinpointed precisely and shoots or stocks were counted.

Results and discussion

In the course of this mapping, 36 taxa (= species and subspecies) as well as 5 hybrids of fern allies were detected. Of these, 4 taxa belong to the family of the clubmosses, 1 species to the family of the moss fern plants, 6 species to the family of horsetail plants, 25 taxa and 5 hybrids to the class of the ferns. Compared with to data from other sources, i.e. official biotope mapping, literature and unpublished findings out of Peter Pilsls database (query status: August 2016), not only the previously known taxa were confirmed, but also eight taxa and hybrids were detected additionally. Particularly noteworthy is the occurrence of *Polystichum braunii*, *Dryopteris lacunosa* and *Lycopodium clavatum subsp. monostachyon*.

Polystichum braunii – a very old species with a worldwide but fragmented distribution with relict character – was already described in the area in 1864 by the great alpine botanist A.E. SAUTER. Although the number of new findings in Salzburg has recently been increased, it still is a relatively rare, potentially endangered species in this province, since the known occurrences are usually not rich in individuals and suitable habitats are restricted to small areas. In the area of the Krimml Waterfalls, the sites of this species are concentrated almost exclusively on the very humid, spray misty forest areas close to the waterfalls, where the fern even reaches a moderate number of individuals.

Dryopteris lacunosa is a triploid plant from the difficult *Dryopteris affinis*-aggregate, which was first described in 2011 (JESSEN et al. 2011) and therefore is still unknown to many botanists. In Austria only five sites from Salzburg, Vorarlberg and Tyrol were documented so far. With the two single records in vicinity to the Krimmler Waterfalls, this species was now detected in the Hohe Tauern for the very first time.

Lycopodium clavatum subsp. monostachyon is a rare arctic-alpine clubmoss, which was first discovered in the Eastern Alps by TEPPNER in 1975. Since then, there are a number of records from the central Alps in Salzburg, which show that these subspecies is somewhat more widespread on sites with silicate soil (especially acidic debris and block-mound edges, gappy dwarf shrubs heathers and secondly on forest road banks). In the area of the Krimmler Waterfalls this clubmoss is quite rare – only in two biotope areas at the southern end of the study area five individuals could be detected on the edge of silicate block mounds.

Among the hybrids the supposed, but not yet cytologically verified proof of *Dryopteris* × *sarvelae* (= *Dryopteris expansa* × *dilatata*) is worth mentioning. It could be regarded as a first record for the Eastern Alps and Austria. Furthermore, a hitherto unknown, taxonomically still not classified plant of the *Dryopteris carthusiana*-aggregate, which is provisiory named *Dryopteris* 'Krimmler Waterfall type' was discovered; it remains to be examined whether it is even a new species to science.

Special 'hot spots' of the fern flora are found in the following three places in the study area; they partly overlap with the most valuable areas for the mosses (see Gruber et al. 2001):

1. Spray-affected, block-rich spruce and gray alder forests at the lower waterfall orographically left and right: This area contains, regarding the fern flora, the most biodiverse forest parts of the study area (Fig. 1, Fig. 2) including a high occurrence of *Polystichum braunii* and the two sites of *Dryopteris lacunosa*.
2. Spray-affected, block-rich spruce forests and green alder bushes at the lower waterfall orographically left: This much smaller area is characterised by the second partial area of *Polystichum braunii*.
3. Sparsely wooded to woody block-mounds above the upper waterfall orographically right: This area is characterised by small occurrences of *Lycopodium clavatum subsp. monostachyon*, which spread along the driveway.

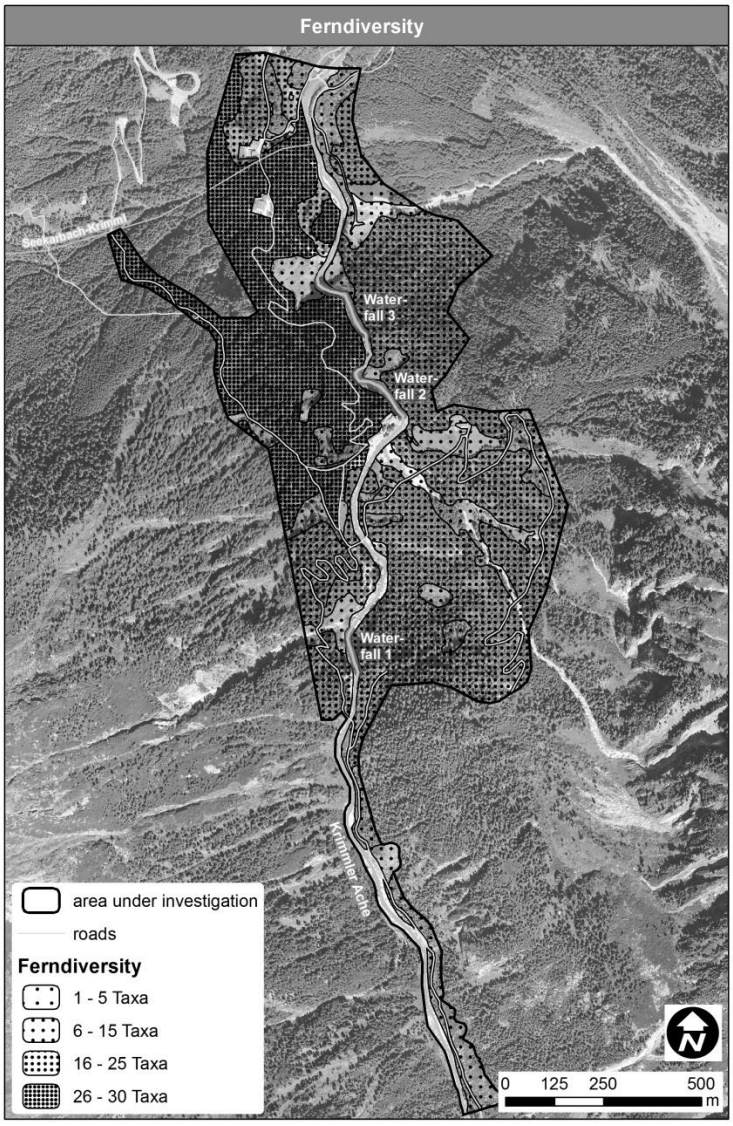

Figure 1: Map depicting the diversity of fern flora in the study area (cartography: M. Lumasegger / REVITAL)

Figure 2: Fern-rich spruce forest at the lower waterfall (credits: O. Stöhr)

Conclusion

Based on the carried out survey it can be concluded that the area of the Krimml Waterfalls is very important to the fern flora and also highly representative within the central alpine chain of the Eastern Alps. This is based on the following arguments:

1. Proven occurrence of 36 species and subspecies of vascular spore plants, which are around 50% of species and subspecies of the fern flora in Salzburg and approx. 40% of the Austrian fern flora.
2. Detection of five hybrids and an apparently evolving 'hybrid zone'.
3. Abundant occurrence of remarkable species, such as *Polystichum braunii*, *Dryopteris lacunosa* or *Lycopodium clavatum subsp. monostachyon*.
4. Typical ferns of montan-subalpine silicate habitats are highly present.
5. Detection of a taxonomically still unexplained, possibly new fern taxon (*Dryopteris* 'Krimmler waterfall type').

The fact that the area of the Krimmler waterfalls has such a remarkable fern flora is undoubtedly due to the waterfalls themselves, which act as local climate regulators (especially permanent high humidity) on the vegetation. Many ferns thrive well in this humid, spray-misty environment.

In conclusion, despite the high visitor and tourist appearance especially in summer, as a habitat for ferns the area still is in good condition. In particular the set visitor guidance measures, which mainly comprise signs and barriers to canalise the visitors to the area of the so-called 'Wasserfallweg', but still leave unobstructed views to the natural drama of the Krimml waterfalls as well as to the fern-rich forests orografically to the left.

References

FISCHER, M.A., OSWALD, K. & ADLER, W. 2008: Exkursionsflora für Österreich, Liechtenstein und Südtirol. 3. Aufl., Hrsg.: Land Oberösterreich, Biologiezentrum der OÖ. Landesmuseen, Linz.

GRUBER, J.P., KRISAI, R., PILSL, P. & SCHRÖCK, CH. 2001: Die Moosflora und -vegetation des Naturdenkmales Krimmler Wasserfälle (Nationalpark Hohe Tauern, Salzburg, Österreich). Wiss. Mit. Nationalpark Hohe Tauern 6: 9-49.

JESSEN, S., BUJNOCH, W., ZENNER, G. & STARK, CH. 2011: *Dryopteris lacunosa* – eine neue Art des *Dryopteris affinis*-Aggregats (Dryopteridaceae, Pteridophyta). Kochia 5: 9-31.

SAUTER, A.E. 1864: Kryptogamen-Flora des Pinzgaues. Mitt. Ges. Salzburger Landesk. 4: 163-216.

STÖHR, O. 2016: Farne im Sprühnebel: Die Pteridophytenflora der Krimmler Wasserfälle. Projekt-Endbericht i.A. des Nationalparkes Hohe Tauern/Salzburg.

TEPPNER, H. 1975: Botanische Studien im Gebiet der Planneralm (Niedere Tauern, Steiermark), IV: *Lycopodium lagopus* – neu für die Ostalpen. Mitt. Naturwiss. Ver. Steiermark 105: 172-178.

Contact

Oliver Stöhr
o.stoehr@revital-ib.at
REVITAL Integrative Naturraumplanung GmbH
Nußdorf 71
9990 Nußdorf-Debant
Austria