



△ A meltwater pool high in the alpine region (over 2,000 m above sea level) – a habitat with a view for the liverwort *Riccia breidlerii*. Heike Hofmann

Switzerland occupies only a small part of central Europe, but it is placed in an extremely diverse area and is therefore surprisingly rich in bryophytes. The main reason for this high level of biodiversity is the large altitudinal range. It stretches from 195 m above sea level in the south at the Lago Maggiore to 4,637 m at the Dufourspitze, south-east of Zermatt. In addition, the climatic conditions

vary considerably within short distances. Due to these factors, there is a high diversity of habitats which offers ideal ecological conditions for about 1,100 bryophyte species.

We now invite you to explore the different altitudinal zones and experience the climatic differences and the changing bryophyte flora. We start in the ‘Mediterranean’ parts and will reach the nival zone with ‘arctic’ conditions after a few kilometres.

### The ‘Mediterranean’ parts

The warmest parts of Switzerland are the Valley of the River Rhône in the south-west and the Tessin



Switzerland:

# where the Mediterranean meets the Arctic

Switzerland may only be a small country, but its varied landscapes and unique position in central Europe mean that it punches well above its weight when it comes to biodiversity. In this issue, **Heike Hofmann & Norbert Schnyder** take us on a bryological journey through this fascinating country.

in the south-east. Mean annual temperatures in both areas lie between 9 and 12°C, whereas the annual rainfall differs considerably: it is low in the Rhône Valley (approx. 600 mm) but high in the Tessin (approx. 1,600 mm).

The particularly dry and hot climate in the Rhône Valley offers Mediterranean conditions for a number of thermophilous species. Large areas of the valley have been industrialized and used for the production of wine and fruits (apricots, etc.). The botanically interesting sites are in the untouched areas, like the steep and rocky slopes of the various castle hills and some more rocky areas which are not suitable for growing

vines. The natural vegetation in these areas is a rocky steppe, with *Stipa pennata* and *Festuca valesiaca*. On the bare soil between the flowering plants grow species like *Pleurochaete squarrosa*, *Pterygoneurum subsessile*, *P. ovatum*, *Acaulon triquetrum*, *Mannia fragrans*, *Asterella saccata*, *Oxymitra incrassata* and *Riccia ciliifera*. Many of the species here have special adaptations to survive the hot and dry periods. The thalloid liverworts can inroll their thalli when they dry out, exposing the ventral surface, which is protected by large ventral scales, to the sun. Others, like *Pterygoneurum* spp., *Tortula caninervis*, *Grimmia crinita* and *Crossidium squamiferum*



have long, hyaline hair points to protect their leaf cells from high levels of radiation. Many of the species with long hair points grow on rocks. *Grimmia crinita* is almost exclusively found on west- or east-facing walls which are covered with mortar. Here, it grows appressed to the wall and is very well camouflaged against the grey of the wall. One has to look carefully to spot it, particularly if it is growing in small amounts. *Crossidium squamiferum* forms nice cushions on more south-facing rocks and walls. It perfectly resembles a *Grimmia* species at first sight, and only when you moisten it and look at it with a good lens do you discover the filaments on the surface of the leaves which tells you that it is not a *Grimmia* species.

The best season in which to visit the Rhône Valley is very early spring when temperatures are still low and enough moisture is available to keep the bryophytes turgescient. During the summer it gets really hot and many species simply disappear. Then, the countryside at higher altitudes is much more enjoyable.

### The subalpine zone

We now climb up quickly, leaving out the montane zone, and reach the subalpine zone at around 1,400 m. It starts where common beech

◁ **Top.** Castle Tourbillon at Sion, Valais, in the Rhône Valley. Several heat-loving species, like *Mannia fragrans* and *Acaulon triquetrum* grow here on the south-facing slopes. *H. Hofmann*

**Above middle.** *Mannia fragrans* is a frequent species in dry meadows of the lower Rhône Valley. It has a beautiful scent which aids identification. *H. Hofmann*

**Below middle.** *Acaulon triquetrum*, a tiny moss with striking triangular edges. It is a Mediterranean species which occurs rarely in the Rhône Valley. *N. Schnyder*

**Bottom.** *Crossidium squamiferum* looks like a *Grimmia*, but has filaments on the leaf surface and belongs to the Pottiaceae. *N. Schnyder*



△ *Tayloria rudolphiana* grows in large cushions on old sycamore trees, often with masses of sporophytes which have conspicuously orange setae. Heike Hofmann



trees disappear, and is characterized by conifer forests of *Picea abies*, *Abies alba*, *Larix decidua* or *Pinus cembra*. The subalpine zone is the region where alpine and lowland species meet. It is the most species-rich zone, with fairly mild temperatures and high levels of precipitation.

There are a few species which are restricted to the subalpine zone. One of these is *Tayloria rudolphiana*, a ‘nearly’ endemic of the Alps, which grows on old sycamore in regions with high precipitation. It is known from the Northern Alps in Switzerland, Germany and Austria, and from a few localities in China. Currently, we are carrying out a monitoring project where selected populations are being observed over a 4-year period in order to find out more about ecological requirements, natural fluctuations in population size and possible threats. *T. rudolphiana* is one of the species included in this project, and we visit five populations once a year. Preliminary results

◁ Norbert Schnyder resting in a dry meadow on cushions of *Crossidium squamiferum*. H. Hofmann



show that the populations are very stable and show little change in size. The main threat seems to be heavy snow cover which can pull off whole cushions. Another potential threat could be collecting because the populations recover very slowly. Although the species regularly produces a mass of sporophytes with fertile spores, it does not colonize all available habitats. Further studies are required to understand more about the population ecology of this rare species. There is a description of the monitoring project at [www.nism.uzh.ch](http://www.nism.uzh.ch) (in German).

There are many more interesting species which can be found in the subalpine zone, including *Frullania parvistipula*, *Paludella squarrosa*, *Seligeria calcarea*, *Tetraplodon mnioides*, *Trematodon ambiguus* and *Zygodon gracilis*.

### The alpine zone

As we continue to climb, the trees get smaller and finally disappear. We have now reached the alpine zone. It starts at approximately 2,000 m altitude and reaches about 3,000 m. The climatic

◁ **Top left.** One of the rare but charismatic species found on calcareous rocks in the subalpine zone is *Zygodon gracilis*. *H. Hofmann*

**Top right.** *Paludella squarrosa* with its characteristically squarrose leaves. It grows in mires mainly in the subalpine zone. *H. Hofmann*

**Middle left.** Although *Riccia breidlerii* is a rare species, it can grow abundantly where conditions are favourable in the alpine zone. It is an endemic of the Alps and is currently known from 11 localities in Switzerland. *H. Hofmann*

**Middle right.** *Tetraplodon urceolatus* forms tight cushions at altitudes up to 2,825 m. *Michael Lüth*

**Bottom left.** *Lophozia decolorans*. Like many liverworts in the alpine zone, *L. decolorans* has closely appressed leaves. *N. Schnyder*

**Bottom right.** *Plagiobryum demissum* used to be fairly frequent, but nowadays it is very rare. *Michael Lüth*

conditions differ considerably from those in the plane. Whereas Sion (598 m) in the Rhône Valley has a mean annual temperature of 9.2°C, the temperatures on the Grand San Bernard (2,472 m) on the Italian border reach a mean of only -1.4°C. To venture into this region one has to take not only warm clothing, but also rain gear as the annual precipitation is often greater than 2,000 mm. Many bryophytes and flowering plants grow well under these conditions. The typical vegetation type is alpine grassland. Here, you find the classical alpine plants like *Leontopodium alpinum*, *Gentiana acaulis*, *Androsace alpina* and *Dryas octopetala*. This is where you will find *Riccia breidlerii*, a true endemic of the Alps. Its habitat is meltwater pools above 2,000 m which dry out during the summer. It colonizes the bare ground of the pools and is locally abundant. *R. breidlerii* is another species for which we observe selected populations. So far, we have learned that the plants are able to survive for some time under water without damage, and also that the populations are very stable. However, to sustain these populations these pools must dry out during the summer, but not completely. Many pools do not meet this requirement and that is probably the main reason why *R. breidlerii* is a rare species.

There are a number of other species which occur only in the alpine zone. Some examples are *Oreas martiana*, *Arctoa fulvella*, *Trematodon brevicollis*, *Plagiobryum demissum*, *Lophozia decolorans* and *Desmatodon systylius*. Other species like *Tortella inclinata* and *Rhytidium rugosum* do not seem to have any altitudinal preference. They grow just as well in the lowlands as in the alpine zone.

### The nival zone

Above 3,000 m the nival zone begins. Here, the air gets thin, not only for bryologists, but also for bryophytes and flowering plants. In the nival

zone there is no vegetation cover. The habitat is dominated by rocks with very little mineral soil amongst them. Only a few flowering plants like *Ranunculus glacialis* and *Saxifraga biflora* grow, scattered in particularly sheltered places. At this altitude bryophytes are not conspicuous at all. One has to search carefully between and underneath rocks, and in crevices and little hollows in order to find them. So far, 92 species have been reported from above 3,000 m, 12 of which are liverworts and 80 mosses. The conditions under which they grow are extreme and comparable with the Arctic. Temperatures rarely climb above 0°C, and snowfall during the summer is not unusual. Amazingly, a few species, such as *Stegonia latifolia*, even manage to produce sporophytes under these extreme conditions. The genus which seems to be adapted best to the nival climate is *Grimmia*. The following 11(!) species have been reported from 3,000 m or

higher: *G. anodon*, *G. caespiticia*, *G. donniana*, *G. elatior*, *G. elongata*, *G. funalis*, *G. fuscolutea*, *G. incurva*, *G. sessitana*, *G. tergestina*, and *G. torquata*.

The 12 liverworts known from above 3,000 m are *Anthelia juratzkana*, *Athalamia hyalina*, *Barbilophozia hatcheri*, *Blepharostoma trichophyllum*, *Gymnomitrium concinnatum*, *G. corallioides*, *Lophozia excisa*, *L. opacifolia*, *L. sudetica*, *Scapania praetervisa* and *Tritomaria scitula*. The record is held by *Gymnomitrium corallioides* at 3,320 m.

For a long time the altitudinal record for mosses was held by *Grimmia incurva* which had been found on the Finsteraarhorn at 4,275 m. Recently, however, Professor Christian Körner visited the Dom and found *Bryum bicolor* and *Tortula (Syntrichia) ruralis* growing at 4,544 m. Both species also occur in the lowest regions of Switzerland, and therefore have a remarkably wide ecological range.

Here, at the highest bryological point in Switzerland, our little trip ends. If we have whetted your appetite for Swiss bryophytes and the Swiss countryside, come and visit us!

### Bryological societies and organizations

In Switzerland, the Bryolich is a united society of bryologists and lichenologists. It regularly organizes meetings and field trips, encourages exchange of data between people, and generally promotes bryology and lichenology. A great deal of information can be found on the society's website at [www.bryolich.ch](http://www.bryolich.ch).

The National Inventory of Swiss Bryophytes (NISM) is the record centre for bryophytes in Switzerland. It is located in Zürich and

◁ At higher altitudes bryophytes start to become scarce. Here, Michael Lüth is hunting for *Grimmia incurva* on Mount Sidelhorn (2,760 m, just below the nival zone).  
*H. Hofmann*





△ **Top left.** *Andreaea heinemannii* is almost the only species of the genus that grows above 3,000 m. *N. Schnyder*

**Top right.** *Stegonia latifolia* is one of few species which produces sporophytes in the nival zone. *Michael Lüth*

**Bottom left.** Growing at 3,320 m, *Gymnomitrium corallioides* holds the altitudinal record for liverworts in Switzerland. *N. Schnyder*

**Bottom right.** *Grimmia incurva* has been found at 4,275 m – the highest record for a *Grimmia* in Switzerland. *M. Lüth*

currently holds a database of 170,000 records of bryophytes from Switzerland. At [www.nism.uzh.ch](http://www.nism.uzh.ch) you find up to date distribution maps, information on conservation, the Swiss mapping project and much more.

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