The Mosses and Liverworts of Ben Lawers NNR

Often neglected compared to the ‘higher’ plants, the bryophytes (mosses and liverworts) of Ben Lawers are extraordinarily diverse and close inspection can reveal them to be of great beauty. Every habitat has its characteristic species, although they are more abundant in some habitats than others. On windswept summits woolly fringe-moss (*Racomitrium lanuginosum*) can dominate, its silvery-grey–green, woolly shoots covering large areas of ground where few other species can survive. Blanket bogs are not as common at Ben Lawers as they are in wetter areas further west but where they occur, bog-mosses are one of the most important parts of the vegetation. The dead remains of mound building species such as *Sphagnum papillosum* and the bright red *Sphagnum capillifolium* are some of the chief ingredients of peat. This can be many feet deep in some places, representing thousands of years of plant remains. In heathland, a quick look beneath the heather and blueberry reveals a mat of common mosses such as *Hylocomium splendens*, *Pleurozium schreberi* and *Hypnum jutlandicum*. In all, well over 300 species of bryophyte have been recorded from Ben Lawers NNR, almost one third of the British total. The number of rarities makes the reserve equally as important for its mosses and liverworts as it is for vascular plants and lichens.

The rare bryophytes of Ben Lawers NNR

The rarest species of moss recorded from Ben Lawers, first recorded in 1899, has not been seen since 1924. It was named *Bryum lawersianum* and was known from nowhere else in the world. It was recorded from an altitude of around 1070m, growing on open patches of base-rich soil on ledges of crags and crevices of rocks. There has long been debate over whether it is a true species or not, and currently it is regarded as synonymous with *Bryum arcticum*, presumably based on examination of herbarium material over one hundred years old. This is a nationally rare species recorded from a handful of locations in Scotland but also from elsewhere in other mountainous areas of the world. *Pseudocalliergon turgescens* is another very rare species. Until recently it was known within Britain from a single flush high on the Ben Lawers ridge and could be found nowhere else on the reserve despite much searching. Somewhat surprisingly it has recently been discovered on limestone pavement in Lancashire. This leaves only one species currently known from nowhere else in Britain: this is *Hypnum revolutum*. Historically it was recorded from two locations: on Creag na Caillich at the west end of the Tarmachan range and on Ben Lawers itself. It is currently known from a single calcareous rock below Ben Lawers, where there is a healthy if vulnerable colony. Despite unsuccessful searches, the possibility remains that more is to be found owing to the abundance of suitable habitat.

Many other rarities have been found at Ben Lawers. Since 1990, 31 nationally rare (known from fifteen or less 10km squares in Britain) mosses and 5 nationally rare liverworts have been recorded. This compares with 17 nationally rare species of vascular plant (herbs, shrubs, trees and ferns), which puts the importance of Ben Lawers NNR for bryophytes in perspective. Over 70 nationally scarce (known from between sixteen and one hundred 10km squares in Britain) bryophytes have been recorded.
Important bryophyte habitats at Ben Lawers NNR
The exceptional bryophyte flora of Ben Lawers is due to the range of unusual habitats which occur. As with the vascular plants, it is the occurrence of calcareous rocks at high altitudes which allows rare species to find a niche. The greatest abundance of rarities occurs on calcareous crags and block screes such as those found below the crags around the head of Lochan nan Cat. Slightly different conditions can suit different species: the lime content of the rock, its friability, the aspect of the crag (the direction in which it is facing) and the degree of exposure to wind all affect the assemblage of species. One of the most important variables is the wetness of the rock. *Hypnum revolutum* and *Bryum arcticum*, mentioned above, grow on dry rock whereas the Scottish endemic (growing nowhere in the world except Scotland) *Bryoerythrophyllum caledonicum* grows on rock down which water usually seeps.

An extensive habitat across the reserve comprises alkaline flushes associated with run off from calcareous rocks. These can be identified as areas of wet ground, often forming elongated patches running downslope among areas of drier vegetation. Common bryophytes such as *Campylium stellatum* and *Scorpidium scorpioides* are found in most alkaline flushes on the reserve. The nationally rare *Palustriella decipiens* can be locally abundant and this is the habitat in which *Pseudocalliergon turgescens* occurs. Acidic flushes hold a lower diversity of species but the bog-moss *Sphagnum lindbergii* has been found at its most southerly British locality in such a situation.

**Bryophytes under threat**
Snow beds typically occur on the sloping headwalls of shaded corries where snow lies late and deep far into the spring. They are nearly all found above 600m: the highest-altitude vegetation in Britain is a snow-bed community at over 1330m on Ben Nevis. The Cairngorms hold the most extensive areas of bryophyte dominated snow-beds in Britain. In comparison, Ben Lawers has large areas with numerous small patches rather than continuous cover. Bryophytes can become dominant as few vascular plants can tolerate such prolonged periods of snow cover. The community of bryophytes in this habitat is specialised and most cannot be found elsewhere. Many of them are among our smallest species, the habitat resembling bare ground until a closer look reveals the minute leaves of liverworts such as *Marsupella brevissima* and *Anthelia juratzkana* and mosses including *Polytrichastrum sexangulare* and *Kiaeria starkei*. It is a dynamic habitat, the ground being naturally unstable, allowing the liverwort crust to roll over on itself, burying some plants but exposing new soil for recolonisation.

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Crags and block screes are good habitats for bryophytes

Dichodontium palustre, commonly found in flushes

Monitoring snow bed bryophytes
This habitat could well be one of the most vulnerable at Ben Lawers, the main threat coming from climatic warming. Shorter and more erratic periods of snow cover could allow grasses such as tufted hair-grass *Deschampsia cespitosa* and mat-grass *Nardus stricta* to compete more effectively. It is also possible that the concentration of atmospheric pollutants in snow causes melt-water run off damaging to snow bed bryophytes. Neither of these are threats about which the NTS can do anything. Nevertheless, monitoring of this habitat was established in 2010 to allow any changes to the composition of the vegetation to be seen. In one 50cm x 50cm quadrat there was one nationally rare and nine nationally scarce species, illustrating the value of these snow bed communities.

**Gone for good?**

Some species recorded from Ben Lawers have not been seen for many years. Some may never be found again, others could be awaiting re-discovery owing to their small size and the vast expanse of potential habitat. One moss that has not been seen at Ben Lawers since 1939 is *Aplodon wormskioldii*. It is one of a family of mosses (the *Splachnaceae*) which grow on dung and decaying carrion. These are ephemeral species as their habitat is transitory, so appearance will be erratic and an element of luck is involved in finding them. *A. wormskioldii* usually occurs on boggy ground on sheep and deer carcasses and carnivore dung such as fox scats. It spreads to new sites by flies carrying its sticky spores.

*A. wormskioldii* has been designated as Critically Endangered. In Britain it has not been seen since 1981 when it was found at Newtonmore. The reasons for its decline are currently not well understood. Two possibilities, both difficult to substantiate, are a decline in the number of flies responsible for spore dispersion as a result of the increase in pesticide use and the effects of increases in numbers of carrion feeders such as crows and buzzards.

**Management for rare bryophytes**

As has already been mentioned, the possibility of changes to the flora of Ben Lawers as a result of climate change is something about which we can only theorise at present. As so many of the rare and scarce bryophytes at Ben Lawers occur at high altitudes, the logical assumption is that a warmer climate will threaten their long-term survival.

The level of grazing by sheep and deer is something over which there is the possibility of direct management influence. In contrast with many vascular plants, bryophytes are not deliberately selected by grazing animals, but they are often taken ‘in the bite’. Any change to grazing levels will benefit some species but be detrimental to others. Grazing may help bryophytes by preventing dominance by taller plants. This is certainly the case for the nationally rare *Ptychopodium plicatum* which grows in grazed species-rich turf in scree and at the base of cliffs but is absent in ranker grassland. Likewise, the cessation of grazing on flushes could lead to bryophyte-rich habitats becoming dominated by taller grasses and rushes.

Other species such as *Hypnum revolutum* and *Ctenidium procerrimum* survive on ledges completely free from grazing, although the dynamic effects of rock falls and the sloughing off of vegetation in hard winters are hard to quantify.

In general those species growing directly on rocks are not affected by grazing, although in some accessible locations bryophytes (and lichens) can be worn away from boulders and crags by sheep rubbing against them.
Although records of bryophytes found at Ben Lawers date back for over two hundred years, in most cases it has been the presence of species rather than their abundance which has been recorded. We therefore have little or no idea whether the populations of most species have declined, increased or remained stable, or what effect management decisions (such as creating fenced exclosures) have had. For these reasons monitoring of certain species has been built into the Ben Lawers monitoring strategy. Without knowing what is happening to rare mosses and liverworts there is no chance that we will be able to do anything to ensure their survival into the future.