British Red Data Books

mosses and liverworts

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6 Species accounts

Plan of the species accounts

The species accounts appear in alphabetical order of the accepted scientific name (Blockeel and Long 1998), for liverworts (including hornworts) and mosses separately. English names are also provided if they are specified in Schedule 8 of the Wildlife and Countryside Act 1981. The heading also specifies the status which qualifies the species for inclusion on the Red List, and gives its status in Europe, which here is taken to include Macaronesia (European Committee for the Conservation of Bryophytes 1995). All species on the Red List (*Extinct, Critically Endangered, Endangered* and *Vulnerable*) and all *Data Deficient* species have full species accounts. *Hamatocaulis vernicosus* and *Petalophyllum ralfsii*, now both categorised as *Nationally Scarce*, also have species accounts because of their listing in national and international legislation. *Lower Risk* (*near threatened*) species do not have species accounts but are listed in Appendix 2. Other *Nationally Scarce* species are not listed here, but are included on the JNCC website (http://www.jncc.gov.uk).

The text of the species accounts provides a brief 'pen portrait' of the species, and describes its habitat and distribution in Britain. In describing the distribution, 'recent' refers to the period from 1970 onwards, and the 'counties' usually refer to Watsonian vice-counties (Dandy 1969). Names of vice-counties have sometimes been amended slightly where they are thought to be obscure (e.g. 'Skye' is cited rather than 'North Ebudes'). Wherever possible, the number of localities in which the species has been seen from 1970 onwards which are scheduled as Sites of Special Scientific Interest (SSSIs) are estimated. Reasons for any decline of the species are discussed and current threats outlined. The wider distribution of the species is also described.

Distribution maps have been provided for a small number of species in cases where their known distribution differs significantly from that published in the Atlas (Hill et al. 1991, 1992, 1994). Finally, the number of hectads in which the species has been recorded is given, together with the corresponding figure for the period from 1970 onwards. It should be noted that many areas have not been surveyed for bryophytes since 1970, so the latter figure is probably an unduly pessimistic estimate of the current distribution of many species.

Mosses

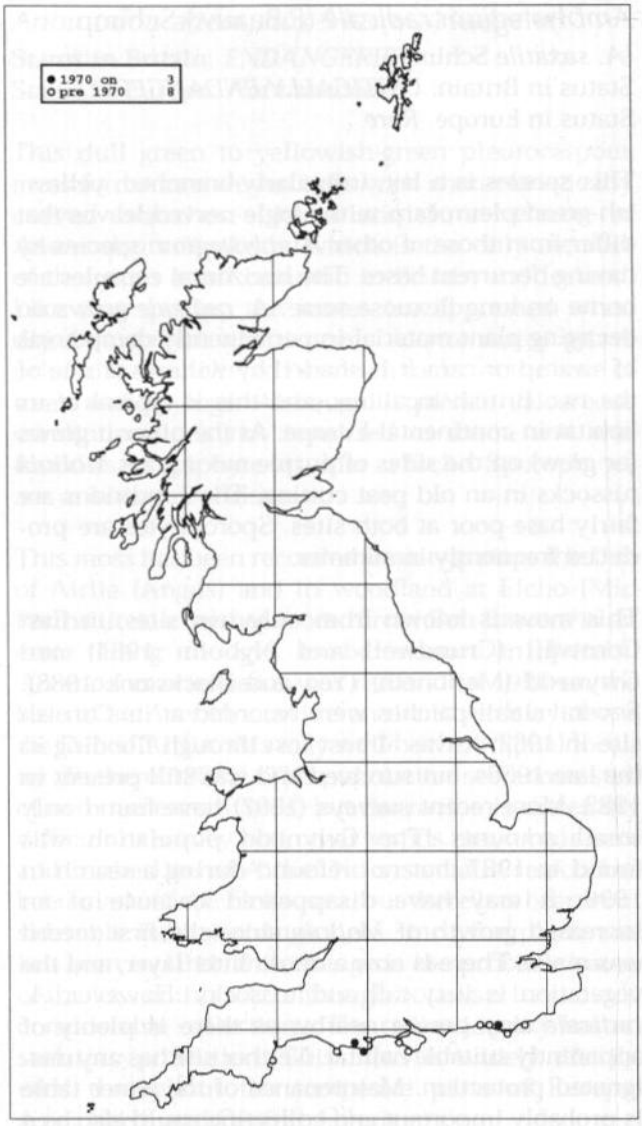
Acaulon triquetrum (Spruce) Müll.Hal.

Triangular pygmy-moss
Status in Britain: *ENDANGERED.* WCA Schedule 8
Status in Europe: *Not threatened*

Acaulon triquetrum is a minute, bud-like green or reddish-brown moss growing up to 1.5 mm tall, with the capsule enclosed by the upper leaves. It differs from the more frequent *A. muticum* in the keeled upper leaves, giving the plant a distinctly triangular appearance from above, and the curved seta. *A. triquetrum* is a winter annual, growing on bare, usually calcareous soil close to the sea, often on south-facing slopes and especially on cliff tops, particularly near the edge, where the open vegetation is maintained by soil slippage. It is also found near tracks and on turf-cutting scars. It was reported from mud banks at one of its former sites. Sporophytes are produced in abundance in winter and early spring.

This moss has been recorded from scattered sites along the south coast of England from Devon to East Sussex. Never common, it has been recorded at only three sites since 1970. Two of these are in Dorset, each with between 200 and 300 plants in 1998–99, and the third near Peacehaven in East Sussex (Rose et al. 1991), where there are several dozen small colonies, each *c.* 1–2 cm in diameter. All the currently known populations of this plant are within SSSIs. Urban expansion may have caused the loss of this moss from several of its former localities, although this threat is minimal at the remaining sites. Loss of bare ground, encroachment of coarse vegetation and excessive erosion are more serious threats: the East Sussex site is next to a popular coast path, and the turf there is in danger of becoming eroded by walkers and over-fertilised by dogs. It is also possible that some colonies could be lost to natural erosion of the cliff. Continuation of rabbit grazing is probably necessary to maintain the short, species-rich turf with bare patches that this plant requires. At one of the Dorset sites the bare patches within a coarse grassland sward are kept open by a combination of thin soils, summer drought and soil slippage. It is the subject of a Biodiversity Action Plan. *A. triquetrum* is widely distributed in the Mediterranean region, and reaches its northern limit in Ukraine, Germany and England. It has also been recorded from Asia, north Africa, Macaronesia, central and eastern North America and Australia.

Total no. of hectads: 11 1970 onwards: 3



Amblystegium radicale (P.Beauv.) Schimp.

(*A. saxatile* Schimp.)
Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Rare*

This species is a lax, irregularly-branched, yellowish-green pleurocarp with single-nerved leaves that differ from those of other *Amblystegium* species by having decurrent bases. The horizontal capsules are borne on long flexuose setae. *A. radicale* grows on decaying plant material in permanently damp areas of swamp or carr. It is shaded by willows at one of the two British localities, and this is typical of its habitat in continental Europe. At the other it grows (or grew) on the sides of purple moor grass *Molinia* tussocks in an old peat cutting. The conditions are fairly base-poor at both sites. Sporophytes are produced frequently in summer.

This moss is known from only two sites, in East Cornwall (Crundwell and Nyholm 1964) and Gwynedd (Merioneth) (Yeo and Blackstock 1988). Several small patches were recorded at its Cornish site in 1962; it was almost lost through flooding in the late 1960s, but survived and was still present in 1983. More recent surveys (1997) have found only small amounts. The Gwynedd population was found in 1987, but not refound during a search in 1996: it may have disappeared because of an increased growth of *Molinia* since the first record was made. There is now a dense litter layer, and the vegetation is very tall and tussocky. However, *A. radicale* may persist nearby, as there is plenty of apparently suitable habitat. Neither site has any designated protection. Maintenance of the water table is probably important and collecting could also be a threat, as the populations are very small. Further study of its ecology at the Cornish site is needed. *A. radicale* is widely distributed across central Europe, from France and Britain to the former USSR, reaching south to Italy and north to southern Fennoscandia. It is also widely distributed in the Americas and Asia. It is apparently very rare over much of its range and not common anywhere.

Total no. of hectads: 2 1970 onwards: 2

Andreaea alpestris (Thed.) Schimp.

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

Andreaea alpestris is a critical species which can only be distinguished with difficulty from the common *A. rupestris* (Murray 1988). Confirmation of identification involves the comparison of cell structure with that of *A. rupestris*, but in the field British material is very small and blackish-brown and forms more complex mats than typical *A. rupestris*. It forms small cushions or patches on gravel or small stones in areas that are at least periodically irrigated, often during snow-melt, in montane sites, most of which are subject to late snow-lie. Sporophytes are infrequent.

Apart from old and dubious records from Snowdon and Rum, all the sites are in the classic snow-bed localities of the Cairngorms, Glas Maol (Angus), Ben Nevis (Westerness) and Beinn Dearg (East Ross). With a plant that is so difficult to identify with certainty in the field, estimates of abundance are very difficult, but it is probable that in the Cairngorms, where suitable habitat is relatively extensive, the total population could be substantial. The major threat to these populations is the effect of global warming on the accumulation and duration of the snow pack, but locally there may be some threat from trampling as the surface on which they occur is often fragile. All sites are within SSSIs and most are within an NNR. *A. alpestris* is an arctic–alpine species, most frequent in the north, but with scattered alpine sites down to Spain; it is also found in arctic Asia, North America, Greenland and southern Africa.

Total no. of hectads: 9 1970 onwards: 6

Andreaea frigida Huebener

Status in Britain: *VULNERABLE*
Status in Europe: *Vulnerable*. Endemic

A typical 'rock moss' in colour and habit, *Andreaea frigida* is most closely related amongst British species to the common *A. rothii*, but can usually be distinguished by its larger size and gradually narrowing leaf with the lamina distinct to the apex. In its best known localities little confusion is likely with *A. rothii*, but it often occurs with *A. nivalis*, which is superficially similar but usually has more strongly falcate, toothed leaves. Most stands are above 900 m and occur on rocks that are regularly irrigated, either on loch margins, in streams or where melt water percolates over rocks. These stands are all associated with areas where snow persists late into the summer and sometimes all year. Sporophytes are frequent in all stands.

The bulk of the British population is in the Cairngorms where *A. frigida* can be locally abundant in suitable habitat in some of the larger coires. There are two anomalous records from England, one fairly recent record (1952) from the Lake District (Cumberland) and a much older (1854) record from upper Teesdale (North-west Yorkshire). The habitat available at both sites is so different from that in the Cairngorms that some investigation of these records is a priority. The Cairngorm sites are all very remote so the only real threat is from the effect of global warming on snow-fall, and its accumulation and persistence in snow-beds. All sites are within SSSIs and most are within an NNR. *A. frigida* is the subject of a Biodiversity Action Plan. Outside Britain, it has a scattered distribution throughout the mountains of Europe north to central Norway, south to Portugal and east to Romania

Total no. of hectads: 5 1970 onwards: 3

Anomodon attenuatus (Hedw.) Huebener

Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This dull green to yellowish-green pleurocarpous moss forms interwoven tufts with characteristically curved branches, like a miniature version of *Anomodon viticulosus*, which is the only member of the genus at all common in Britain and Ireland. Like that species, the leaves are appressed when dry, but spread when moist. *A. attenuatus* grows primarily on sheltered base-rich rocks, at the base of trees and on logs. Although it prefers calcareous conditions, it is not restricted to them, and was found as an epiphyte on alder at Elcho. Sporophytes are unknown in Britain.

This moss has been recorded from two sites, the Den of Airlie (Angus) and in woodland at Elcho (Mid Perthshire); a further record from Ben Lawers is an error. Long thought to be extinct in Britain, *Anomodon attenuatus* was refound in 1996 on the base of an *Acer* in a ravine on the River Islay above the Den of Airlie: this may well be the original locality (Rothero 1998a). The population seen consisted of two moderate stands, but the ravine is extremely difficult to survey and other stands may occur here and in the Den of Airlie. No systematic search has been made of the Elcho area, but there has been considerable habitat change here since the plant was last seen in 1911; this change is the probable cause of the loss of this site, although botanists have made considerable collections. The recent locality has no statutory protection. This moss is widely distributed throughout the temperate parts of Europe, Asia, North and Central America.

Total no. of hectads: 3 1970 onwards: 1

Anomodon longifolius (Brid.) Hartm.

Status in Britain: *VULNERABLE*. WCA Schedule 8
Status in Europe: *Not threatened*

Like *Anomodon attenuatus*, this yellowish-green, patch-forming pleurocarp is smaller than the distinctive, robust and much more common *A. viticulosus*, with which it often grows. It is further distinguished from that species by the pointed tip to the leaf and each leaf cell having only a single papilla. As in *A. viticulosus*, the leaves are appressed when dry, but spreading when moist. *A. longifolius* grows on calcareous, usually vertical, rock faces in woodland, particularly in ravines, and it seems to require at least partial shade. Most sites are on limestone but this moss has also been recorded from calcareous sandstones and schists. Sporophytes have never been found in Britain.

A. longifolius has been recorded from a total of about 15 sites in Britain, but has apparently decreased. It has not been seen for over 50 years in Herefordshire, North Somerset or Monmouthshire, or at four of the five sites in Mid-west and North-west Yorkshire. Two of the post-1970 sites for this species, in West Gloucestershire and South-west Yorkshire, are within SSSIs. The Co. Durham site, where it occurs in local abundance over a stretch of about 600 m along the upper riverbank, has no site protection. In Angus, the population at Reeky Linn is reasonable, if scattered, and has no statutory protection; the population in the Den of Airlie is very small and is in an SSSI and NNR. The Mid Perthshire site, at Killin, is also extremely small, and has no statutory site protection.

Tree-felling may be a threat to this species, disrupting the light and humidity regime around colonies of the plant. Collecting by botanists may be a threat at some sites, as the plant usually occurs in small quantity. The Scottish population was surveyed recently as part of the Scottish Cryptogamic Conservation Project 1993–1995. This species is widely distributed throughout most of Europe and eastwards to northern and central Asia.

Total no. of hectads: 13 1970 onwards: 6

Aplodon wormskjoldii (Hornem.) Kindb.

Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Not threatened*

Aplodon wormskjoldii is one of the 'dung-mosses' and, like others of the group, forms dense patches on 'scats' or animal remains. When fertile it is easily distinguished by the fragile, hyaline seta, but when sterile it is superficially very similar to the common *Splachnum sphaericum* which, however, differs in cell shape. Most records suggest that *A. wormskjoldii* is usually found in wet or waterlogged peaty habitats in the uplands, often near streams or pools, although there is one record from among acid gritstone boulders on a hill summit. Sporophytes are produced frequently.

All but one of the records for this species are from two areas. It has been found at five sites in upper Teesdale (Co. Durham) and the adjacent parts of Cumberland and Westmorland, where it was last seen in 1974. In Scotland records centre on the eastern part of the Breadalbane mountains, with most coming from the Meall nan Tarmachan range, where the species was last seen in 1939. The most recent record is from Glen Banchor in the Monadhliath hills where it was found in 1981 but could not be refound in 1996. Most sites are within SSSIs and some are in an NNR. Herbarium collections can be large, and the plant can clearly be abundant on its very localised habitat. The transient nature of this habitat makes any survey of *A. wormskjoldii* very difficult, and it will always be problematic to determine the true status of this species. Specific threats include reduction of habitat by drainage and afforestation, as well as more complex changes in animal husbandry, reduction of carrion in the hills and population changes in carnivores, which may all affect both the quantity and quality of substrate and the insect vectors upon which the plant depends. The failure to find *A. wormskjoldii* at any of its former Scottish sites during a short survey in 1996, or in upper Teesdale in 1998, gives cause for concern, and a detailed survey of the two core areas for the species should be a priority. This is a predominantly arctic species occurring in Svalbard, Fennoscandia, northern Russia, Greenland and arctic North America.

Total no. of hectads: 8 1970 onwards: 2

Atrichum angustatum (Brid.) Bruch & Schimp.
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

A dull green acrocarpous moss which, like the other three British *Atrichum* species, forms patches made up of many single, erect, unbranched shoots with long, narrow, toothed leaves spreading when moist but curled when dry. *A. angustatum* is best distinguished from the other *Atrichum* species by the smaller cells and spores, and the greater number of longitudinal lamellae on the upper surface of the nerve. This moss typically grows on fairly bare, moderately acid (pH 6.0–6.5), damp, shaded, loamy or sandy soil in rides or by paths in woodland. More rarely it grows on roadside banks, open grassland heaths and in disused sandpits. Sporophytes are produced rarely, in winter.

Records of this species in Britain are concentrated in the Weald of Kent and Sussex, where it has been recorded from about 32 sites in total, but it has not been seen at over a third of these since 1950, and has been recorded at only one since 1970. Elsewhere in the country, it has been recorded from 11 scattered sites, but has been seen at only two (both near Arundel in West Sussex) since 1970. None of the recent sites has any designated site protection.

The reasons for the decline of this species are uncertain. They may include loss of habitat through tree-felling operations in woodland, or sites becoming overgrown. A thorough survey of sites is necessary to ascertain the present state of populations and to identify any management needs. This species is widely distributed throughout most of Europe reaching north to Iceland and southern Fennoscandia, and east to European Russia. It also occurs in Turkey, the Azores, eastern and central North America and Japan.

Total no. of hectads: 34 1970 onwards: 3

Bartramia stricta Brid.
Rigid apple-moss
Status in Britain: *CRITICALLY ENDANGERED.*
WCA Schedule 8
Status in Europe: *Not threatened*

Bartramia species are medium-sized, cushion-forming mosses with long narrow, toothed, glaucous-green leaves and more-or-less spherical capsules. *B. stricta* is distinguished from other members of the genus by having straighter leaves when dry, and a symmetrical, erect capsule. This moss grows on thin soil on ledges and in crevices amongst base-rich rocks on sunny, sheltered, mainly south-facing slopes. Most of the populations were recorded from basaltic rocks, but there is one record on limestone, and the old Sussex record was on calcareous sandstone. Sporophytes are common, produced in spring.

This species has been recorded from one site in Mid Perthshire, where it could not be refound during searches in 1995 and 1998, two sites in Powys (Montgomeryshire and Radnorshire) from one of which it has disappeared, and a site in East Sussex, where it was last seen in 1864. It also occurs in the Channel Islands on Alderney and Guernsey. Quarrying eliminated *B. stricta* from one of its Powys (Montgomeryshire) sites. At its remaining site, which is both an NNR and an SSSI, disturbance from rock climbing and scrub encroachment are probably more serious threats. *B. stricta* is particularly vulnerable to collecting by botanists as it is a relatively conspicuous species, and the extant population is very small. It is the subject of a Biodiversity Action Plan and a monitoring programme at its remaining site in Powys (Radnorshire). This species is widespread around the Mediterranean and in Europe, reaching north to Britain, Germany and the Baltic States. It is also known in central Africa, Macaronesia, North America and Australia.

Total no. of hectads: 4 1970 onwards: 1

Blindia caespiticia (F.Weber & D.Mohr) Müll.Hal.
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This is a very small dark green acrocarpous moss with relatively long, thin leaves. It is distinguished from the common *Blindia acuta* by its capsule, which is immersed in the upper leaves rather than borne on a long seta. *B. caespiticia* grows on calcareous mica schist or limestone in sheltered, often damp, crevices on friable rock faces, either on crags or on large boulders in scree on slopes which have a variety of aspect. It is always recorded with fruit, but sterile plants may be overlooked as *B. acuta*.

B. caespiticia is restricted to a population on the Ben Lawers massif in Mid Perthshire, where it is locally abundant over limited areas, and another in Coire Cheap on Aonach Beag by Ben Alder (Westerness). Both sites are within SSSIs and Ben Lawers is also an NNR. There is also a 19th century record from Ben Lomond (Stirlingshire) but the species is presumed to have disappeared from there. There are no known threats to the current populations of this species, but they are vulnerable to change because of their restricted extent. The extent of the Ben Lawers populations was identified more accurately during a survey in 1996. Outside Britain the species is restricted to the mountains of Fennoscandia and central Europe. A record from central Africa needs confirmation.

Total no. of hectads: 3 1970 onwards: 2

Brachythecium erythrorrhizon Bruch, Schimp. & W.Gümbel
Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

This is a slender, yellowish-green pleurocarp with plicate leaves that are sometimes curved to one side. More distinctive are the frequent tufts of reddish-brown rhizoids along the older parts of the stem, distinguishing it from small forms of *Brachythecium albicans*, which has straight leaves and only a few rhizoids on the stem. In Britain, where it has never been seen with sporophytes, *B. erythrorrhizon* grows on calcareous sand dunes and sand-covered rocky slopes near the sea, amongst cushions of mountain avens *Dryas octopetala* (Barkman 1955). Elsewhere in Europe it is more typically found on shaded rocks and thin organic soils, and usually grows more luxuriantly than it does in Britain.

This moss is restricted to one area of sand dunes on the north coast of West Sutherland. In 1948, when it was discovered, it was found in small quantity, but there has been no subsequent information on population size. The locality has no designated site protection. A survey is necessary to ascertain the extent of the population, and to identify potential threats. There is also some doubt about the identity of the British material, so further work to determine whether it does indeed belong to this species is highly desirable. *B. erythrorrhizon* is an arctic–alpine species with a scattered distribution in northern and central Europe. It also occurs in Asia and North America.

Total no. of hectads: 1 1970 onwards: 1

Brachythecium starkei (Brid.) Bruch, Schimp. & Gümbel

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Brachythecium starkei forms patches creeping over rocks or growing in flushed grassland. In Britain it appears to be a strictly montane species with most sites in block scree, but also occurring in flushed grassland associated with snow-melt. In this habitat it is only likely to be confused with *B. reflexum* and, especially, *B. glaciale*. The former is a smaller plant with a strong nerve that extends to the apex. *B. glaciale* is more of a problem, and for many years the two species were confused in Britain. In *B. glaciale* the margin at the base of the leaf is much more strongly recurved, the angular cells are quadrate rather than rectangular, and the perichaetial leaves are straight rather than squarrose. All sites for *B. starkei* are associated with rocks that are moderately to strongly base-rich. It has been found only once with fruit in Britain but at that site sporophytes were abundant.

At present *B. starkei* has been recorded from only three areas of Scotland — Ben Lawers (Mid Perthshire), Caenlochan Glen (Angus) and the Beinn Dearg area (East and West Ross) — and has been seen recently at all three. Confusion in the field with the more common *B. glaciale* means that estimates of stand sizes and total population are difficult. Suitable habitat is extensive on Ben Lawers, and the plant may well be locally frequent here, but it is likely to be very rare in the Beinn Dearg massif. Above Caenlochan, *B. starkei* was abundant in an area of flushed grassland over several square metres. All sites are within SSSIs and one is within an NNR. There are no obvious specific threats to this species, but acquiring some baseline data on population size at its three localities would seem a sensible precaution. *B. starkei* is an arctic–alpine species widespread in the mountains of Europe, central and eastern Asia and in North America.

Total no. of hectads: 4 1970 onwards: 3

Brachythecium trachypodium (Brid.) Bruch, Schimp. & Gümbel

Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Not threatened*

This yellowish-green or golden pleurocarpous moss is close to, and easily confused with, *Brachythecium velutinum*. *B. trachypodium* can be distinguished by the leaves tapering from about mid-leaf, rather than from near the base, and by the slightly smaller, thicker-walled alar cells. It grows on calcareous mountain rocks at 1,080 m on Aonach Beag by Ben Alder, Westerness, the only site where it has been recorded recently, which is an SSSI and where specific threats are likely to be few. Sporophytes have not been seen in Britain. *B. trachypodium* was not known to occur in Britain until its discovery on Aonach Beag in 1989, but a 19th century specimen collected from Ben Lawers in Perthshire has subsequently been traced (Corley 1990). It has been searched for recently without success on Ben Lawers, most specimens proving to be forms of the common *B. plumosum*. However, further survey work may possibly be successful. In world distribution it is a widespread but rare circumpolar arctic–alpine species.

Total no. of hectads: 2 1970 onwards: 1

Bryum archangelicum
Bruch, Schimp. & Gümbel
Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

This reddish acrocarp resembles a form of *Bryum arcticum*, or the much more widespread *B. inclinatum*, but it is characterised by the long-excurrent nerve, the short lid on the capsule and, especially, the blackish spores. It grows on presumably calcareous soil on damp rock ledges at *c.* 700 m altitude. *B. archangelicum* has been found once in Britain, in 1979, near the head of Caenlochan Glen, Angus (Townsend 1994), but may occur elsewhere in the Scottish Highlands.

There are likely to be few, if any, specific threats to this species, other than those affecting arctic–alpine species in general — for example, climate change and overgrazing. The site, which is within an SSSI, is well known in Britain for its special arctic–alpine flora and general conservation management for this is likely to benefit *B. archangelicum* too. Outside Britain, *B. archangelicum* is a circumboreal arctic–alpine species.

Total no. of hectads: 1 1970 onwards: 1

Bryum arcticum (R.Br.)
Bruch, Schimp. & Gümbel
Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

Bryum arcticum is a small, often deep red, budlike acrocarp but, like many other species of *Bryum*, is only reliably to be identified when fertile. The common *B. pallens* is similar, but it is usually larger and pink rather than red. *B. arcticum* forms red tufts on basic soil among limestone or calcareous mica-schist rocks on mountains at altitudes above 500 m. In Britain, *B. arcticum* has been recorded from seven mountains in the Scottish Highlands, in Mid and East Perthshire, Angus and South Aberdeenshire.

It seems that *B. arcticum* has genuinely declined, as there have been no reliable records since 1966, even though Ben Lawers and Meall nan Tarmachan have been surveyed intensively, and Caenlochan has also been visited several times by bryologists. The localities of *B. arcticum* are not likely to be under any particular threat, and the species may well still be present at some of them, but its absence from the records over the past 35 years is mysterious. Indeed, the distribution of records of this species over time and space shows a curious pattern, with a cluster of records from the Ben Lawers area in the 1890s and 1900s, then a long gap before another cluster, this time more geographically scattered, in the 1950s and 1960s. The reason for this is a matter for speculation. *B. arcticum* is widely distributed throughout the Arctic, and in the mountains farther south in the Northern Hemisphere.

Total no. of hectads: 7 1970 onwards: 0

Bryum calophyllum R.Br.

Status in Britain: *VULNERABLE*
Status in Europe: *Rare*

This acrocarpous moss, with broadly oval, rather blunt-tipped leaves, is rather similar to *Bryum marratii* and *B. cyclophyllum*, forming patches up to 1.5 cm tall. The drooping capsule, often produced in autumn and winter, is longer than wide (as long as wide in *B. marratii*). The leaves are narrower and more concave than in *B. cyclophyllum*, and more strongly bordered than in *B. marratii*. *B. calophyllum* grows on moist, mainly bare sandy soils, particularly in coastal dune slacks which are at least moderately calcareous. It has been recorded from one inland site (in 1865), an old gravel pit. Sporophytes are produced frequently.

This species has been recorded from about 19 sites, but has been refound at only about half of these since 1950, and a mere five since 1970. The most recent records are from the Sefton coast in South Lancashire in 1983, Ynyslas in Ceredigion (Cardiganshire) in 1991 and West Ross in 1995. One of the post-1970 British sites is within an NNR, another three are SSSIs, while the remaining site has no designated site protection.

B. calophyllum has declined because of the loss or degradation of its habitat. Factors contributing to this have included reclamation for farmland, urban and leisure development, and dune stabilisation caused by both construction of coastal defences and lack of grazing pressure, promoting the growth of coarse vegetation. In view of the decline of *B. calophyllum* a survey is required to ascertain the present state of the populations. Where dune slacks have become overgrown, the introduction of an effective grazing regime can often restore the vegetation structure, an approach that has been successful at Newborough Warren in Anglesey. Where there is no new dune accretion, wet dune slacks can be restored by turf cutting or pond dredging. *B. calophyllum* was not refound during a recent survey (1995) of the Sefton coast in Lancashire, historically one of its main strongholds. This moss is scattered around the coast of northern Europe, occasionally occurring inland. It is rare in the Mediterranean, but it occurs in a few places in eastern Europe. It also occurs in Asia, central Africa, northern North America and Greenland

Total no. of hectads: 21 1970 onwards: 6

Bryum cyclophyllum (Schwägr.) Bruch & Schimp.

Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This acrocarpous moss grows as isolated erect or prostrate shoots or in small patches. The broadly oval, blunt-tipped leaves are distant from each other, and the plant looks superficially more like a small *Rhizomnium punctatum* than a *Bryum*. This moss grows principally on moist, bare, sandy mud, particularly in the draw-down zones of large lakes and reservoirs. It has also been recorded at the edge of a canal and in a sedge swamp. Gemmae are the sole means of reproduction for this species in Britain.

B. cyclophyllum has been recorded from 10 sites in Britain, with only three records since 1970, in Gwynedd (Merioneth), Dunbartonshire and Stirlingshire. It has not been refound in Cumberland or West Ross since the 1930s, or from the two Argyll sites since their discovery in 1968 and 1969 respectively. None of the recent sites for this species has any designated site protection. Any moves to stabilise the water levels in reservoirs, e.g. for angling, are potential threats to this moss. Where water levels are kept constant there is often the threat of encroachment from reeds and other shoreline vegetation. This needs to be controlled, for example by cattle grazing. This species is widely distributed through temperate and boreal regions of the Northern Hemisphere.

Total no. of hectads: 10 1970 onwards: 3

Bryum gemmilucens R.Wilczek & Demaret
Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

A small acrocarp in the bulbiferous *Bryum bicolor* complex, *B. gemmilucens* is characterised by its yellowish axillary bulbils, on which the leaf primordia are only rudimentary or indistinguishable. These are the principal, if not the only, means of propagation in a species from which sporophytes are unknown. It is a plant of non-calcareous soil in stubble fields, woodland rides, etc. The distribution of *B. gemmilucens* in Britain is probably not fully known, as it was recognised as a British species only in 1978 (Smith and Whitehouse 1978) and is almost certainly under-recorded. It has been found at about eleven sites in southern England, with one old record (detected by a redetermination of herbarium material) from North-east Yorkshire. No threats have been identified. It appears to have a scattered distribution throughout Europe and also occurs in Turkey and western North America.

Total no. of hectads: 12 1970 onwards: 11

Bryum gemmiparum De Not.
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This acrocarp grows as dense dull green tufts up to 3 cm tall. Like plants in the *Bryum bicolor* complex, it has greenish or reddish bulbils in the leaf axils, but differs in its generally larger size and in having a wider, more concave and often bordered leaf with a thinner nerve. *B. gemmiparum* is, in fact, closer to *B. alpinum* than to *B. bicolor*, both taxonomically and in appearance. Sporophytes are unknown in Britain but the species reproduces vegetatively by bulbils and rhizoidal gemmae (Whitehouse 1966).

This moss has been recorded from rocks and stones, often silted, in two rivers (one little more than a stream) in North Devon, and from several localities in the River Usk system in Monmouthshire and Powys (Breconshire). There is also an old record from a coastal site at the mouth of the Dart in South Devon. Other records, from South Somerset and Carmarthenshire, are either errors or unconfirmed. It seems to be declining in the Usk system and has not been seen at one of the Devon sites since 1961. At one of the most recently surveyed (1999) of its localities on the Usk, *B. gemmiparum* was found growing in small cushions with *Cinclidotus fontinaloides* and *Didymodon luridus* (*Barbula trifaria*) on flat, silted sandstone rocks above the mean water level, but in the flood zone only two small cushions were seen. It was not refound at another site on the Usk during a recent (1999) BBS field excursion, but was refound there early in 2000. One of the Devon sites is within an SSSI, and the whole of the River Usk has also been notified. The main threat to this species is probably habitat destruction resulting from engineering work such as river straightening. The effects of pollution on the species are not known but could be significant. *B. gemmiparum* is widespread throughout the Mediterranean region. The wider distribution of the species is unclear because of taxonomic confusion.

Total no. of hectads: 7 1970 onwards: 4

Bryum knowltonii Barnes

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Bryum knowltonii is a small acrocarpous moss forming pale green to reddish patches up to 1 cm tall. It closely resembles *B. warneum* (q.v.), but has a reddish leaf base. Sporophytes are produced frequently in late spring and microscopic examination of the spores and peristome teeth is necessary for identification. This species grows on moist, basic, usually sandy soils, particularly in coastal dune slacks and at the sandy edges of saltmarshes. The inland sites are usually damp areas in old sand quarries or gravel pits, where *B. knowltonii* is a colonist of bare ground. In Fennoscandia it often grows on lakeshores.

This species has a scattered distribution around the coast of Britain, where it has been recorded from about 38 sites from Dorset to West Ross. It has also been reported from several inland sites. Suffering from a very serious decline, since 1970 *B. knowltonii* has been recorded from only about eight sites: in Buckinghamshire, South Lancashire, West Norfolk, Westmorland, Gwynedd (Merioneth and Caernarvonshire), Powys (Montgomeryshire) and West Ross. About three of these are within SSSIs (there is some uncertainty because of imprecisely localised records), while the others have no designated site protection.

The decline of *B. knowltonii* at coastal sites has been for the same reasons as described for *B. calophyllum*. At the inland sites, the main threats are usually tipping and drainage. In view of its decline, a survey of the remaining sites for this species is necessary to ascertain the present state of the populations. Where sites are drying out or becoming overgrown, measures such as introducing grazing, turf cutting or pond dredging might be considered. This moss is widespread in northern and central Europe, south to the Balkans. It also occurs in northern and eastern Asia, the Himalayas, Greenland and northern North America.

Total no. of hectads: 36 1970 onwards: 8

Bryum lawersianum H.Philib.

Status in Britain: *EXTINCT.* Endemic
Status in Europe: *Extinct.* Endemic

This distinctive species was endemic to Scotland where it was recorded from Ben Lawers, in Mid Perthshire. It was last seen in 1924 and is almost certainly extinct. The recorded habitat was bare, damp, micaceous soil above 1,000 m altitude. The reasons for its disappearance are unknown, but collecting by bryologists may be responsible. The site has been visited by many bryologists, and Ben Lawers was the subject of an intensive bryophyte survey in 1996, but *Bryum lawersianum* has not been refound; it therefore seems likely that the species has, indeed, disappeared.

Total no. of hectads: 1 1970 onwards: 0

Bryum mamillatum Lindb.

Dune thread-moss
Status in Britain: *CRITICALLY ENDANGERED.*
WCA Schedule 8
Status in Europe: *Rare*

This is a small acrocarp with erect shoots up to 5 mm tall and oval leaves with an excurrent nerve. The capsule has a wider mouth than in *Bryum warneum* (q.v.) and is longer than in *B. marratii* (q.v.), which also has more blunt-tipped leaves. Microscopic examination of the sporophyte and spores is essential for identification. This moss grows on moist, calcareous, sandy soils near the coast, particularly in dune slacks. It produces sporophytes frequently.

This species, always the most geographically restricted of the coastal *Bryum* species, has been recorded from four sites in South Lancashire, North Lincolnshire and West Norfolk. It has not been positively identified since 1965, when it was recorded on the Lincolnshire coast near Cleethorpes. Most of the suitable habitat on the North Lincolnshire coast has now virtually disappeared, and the remaining dune systems are sandwiched in a narrow strip between the sea and arable farmland. However, recent conservation management work in the area may lead to the reappearance of *B. mamillatum* and other dune *Bryum* species. A survey of the Sefton coast (South Lancashire) in 1995 found a specimen that was provisionally identified as *B. mamillatum* in a dune slack now threatened by inundation with eutrophic water, with *B. warneum* and *Petalophyllum ralfsii* growing close by. The record was never confirmed but, in view of the evidence, there seems little reason to doubt it. Both the Lincolnshire site and the Lancashire sites are within SSSIs. The decline of *B. mamillatum* nationally has been for the same reasons as described for *B. calophyllum*. *B. mamillatum* is the subject of a Biodiversity Action Plan. This species has a scattered distribution around the Baltic and North Sea coasts and north to Svalbard and Greenland.

Total no. of hectads: 6 1970 onwards: 1

Bryum marratii Hook.f. & Wilson

Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This is a small moss (up to 5 mm tall) with broadly oval leaves, crowded at the top of the stem, that are blunter-tipped than those of most other species in the genus. *Bryum calophyllum* is similar but has a more strongly bordered and partly recurved leaf margin (the margin is flat in *B. marratii*), smaller leaf cells and a relatively longer capsule. *B. marratii* grows on moist, bare, usually calcareous, sandy soils near the coast, particularly in dune slacks, on the sandy edges of saltmarsh, or in damp places on the shore. Sporophytes are produced occasionally, in summer.

This is a widely scattered coastal species, recorded at some time from about 20 sites from North Lincolnshire and Ceredigion (Cardiganshire) north to West Sutherland. It has been seen at only five sites since 1970, in Ceredigion, Argyll, Caithness and West Sutherland. Three of the post-1970 sites for this species are within SSSIs, and one is also an NNR. The remaining two sites have no designated site protection.

The same factors that have led to the decline of *B. calophyllum* (q.v.) and other sand dune species are also responsible for the decline of *B. marratii*. A survey of these coastal *Bryum* species is urgently needed to establish their current distribution and formulate a policy to arrest their decline. This species is distributed around the coasts of north-western Europe between Iceland, Fennoscandia, the Baltic States and France. In North America it has been reported from the north coast of Newfoundland and at inland sites in Alberta and North Dakota.

Total no. of hectads: 20 1970 onwards: 5

Bryum neodamense Itzigs. ex Müll.Hal.
Status in Britain: *ENDANGERED*. WCA Schedule 8
Status in Europe: *Rare*

This is a reddish-green moss forming tufts up to 10 cm tall, with concave, ovate, blunt-tipped leaves. The rather similar *Bryum pseudotriquetrum* also has a reddish leaf base, but its leaves are less concave and sharply pointed at the tip. *B. neodamense* grows on wet calcareous soils in dune slacks, fens, swamps, ditches and lake edges. In England and Wales most sites are in dune slacks, but in Scotland (and Ireland) it is mainly a plant of inland fens and lake edges. Sporophytes are very rare and the plant lacks gemmae.

B. neodamense is recorded from about eight widely scattered sites in Britain. It is now extinct in Northwest Yorkshire and Angus. However, populations remain strong on the South Lancashire coast, where it is recorded from two hectads. The other recent sites are in Gwynedd (Caernarvonshire), where the species has not been refound since its discovery in 1970, and Caithness, where it still occurs. All three of the modern sites are within SSSIs, and one is also an NNR. *B. neodamense* is considerably more frequent in Ireland.

All known populations on the Lancashire coast are found in slacks that have been artificially created or reprofiled — a fact that has positive implications for similar management work in Lancashire and at other sites. In Ireland most populations grow by inland waters and are apparently less threatened. In Britain, it is the subject of a Biodiversity Action Plan. This species is widespread in northern and central Europe, but rare in the south. It also occurs in northern Asia, North America and Greenland.

Total no. of hectads: 8 1970 onwards: 4

Bryum salinum I.Hagen ex Limpr.
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

The gametophyte of this small *Bryum* is fairly typical of the genus, and it is necessary to examine the narrowly ellipsoid, drooping capsule to separate *B. salinum* from other *Bryum* species (Nyholm and Crundwell 1958). *B. imbricatum* (*B. inclinatum*) is similar, but the peristome teeth are not perforated as they are in *B. salinum*. This species grows on damp, peaty or sandy, often grass-covered, soils by the sea in dune slacks, at the edges of saltmarshes, on the sides of ditches and on soil over rocks. It has been recorded at seven widely scattered sites, all but one of which are in Scotland: in Kincardineshire, East and West Ross, East Sutherland, Jura, Ayrshire and South Somerset. It has not been seen in Somerset for over 50 years, and has been recorded only at the two sites in West Ross and East Sutherland, the latter of which is within an SSSI, since 1970.

Threats to this species in Britain include drainage, stabilisation of dunes resulting in the loss of damp habitats, and erosion due to recreational pressures, although some of the sites are sufficiently inaccessible for these threats to be small. Turf cutting or digging of pools could be considered at sites that are drying out. *B. salinum* is widespread around the shores of northern Europe from Svalbard and Ireland to Russia. It has also been recorded from Greenland, Canada and Alaska.

Total no. of hectads: 7 1970 onwards: 2

Bryum schleicheri Lam. & DC.

Schleicher's thread-moss
Status in Britain: *CRITICALLY ENDANGERED.*
WCA Schedule 8
Status in Europe: *Not threatened*

This is a large *Bryum* forming swollen, yellow–green tufts up to 10 cm tall. The leaves are concave, broadly oval, pointed at the tip and reddish at the base. The leaf margin may be flat or incurved and the leaf cells are, on average, wider than in other British *Bryum* species. British material of this species is referred to var. *latifolium* (Schwägr.) Schimp. At its only extant British site, in the Touch Hills of Stirlingshire, *B. schleicheri* grows in a spongy, mossy flush dominated by *Chrysosplenium oppositifolium* and *Montia fontana* by a hillside stream at an altitude of about 300 m (Allen 1993). In 1994 it was restricted to 400 individual shoots growing in one larger and one smaller stand in a single flush (Long and Rothero 1995–96). A colony was seen in a second flush in 1988 but could not be refound in 1994. However, it is now clear that the number of shoots fluctuates considerably from year to year, depending on conditions. Sporophytes have never been seen in Britain. The site from which the species is currently known is an SSSI. There are several 19th century records from other sites in Mid Perthshire and Stirlingshire but the plant has apparently disappeared from these.

The extreme rarity of this species renders it vulnerable to casual disturbance, as well as to changes in land-use (such as afforestation) and water pollution. It is a large and attractive species and it may therefore be at risk of collection by botanists, particularly in years when there are few shoots present. The British population was surveyed recently as part of the Scottish Cryptogamic Conservation Project 1993–1995. This species is widespread throughout much of Europe, western, central and northern Asia and north Africa.

Total no. of hectads: 6 1970 onwards: 1

Bryum stirtonii Schimp.

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Bryum stirtonii closely resembles *B. elegans* and belongs to the *B. capillare* group; both differ from *B. capillare* in having leaves that are not spirally twisted when dry and in having shoots that are more julaceous. *B. stirtonii* can usually be distinguished from *B. elegans* in having shoots that are less julaceous and glossy; in addition *B. elegans* is usually a plant of dry calcareous rocks while *B. stirtonii* occurs in sites that are regularly flushed with base-rich water. *B. stirtonii* is a montane species, with all British sites above 500 m, growing on wet calcareous substrates. On Ben Lawers all recent sites are on ledges of calcareous crags or in base-rich flushes. Outside Britain it grows on soil or rock ledges, and on or under boulders. Sporophytes are rare.

The taxonomic status of *B. stirtonii* was not clarified until 1973 (Syed 1973) and the critical nature of the species has meant that this has been a neglected plant in Britain. It has been seen since 1970 only in Angus, Mid Perthshire and South Aberdeenshire. Five sites for this plant were located on Ben Lawers during a survey in 1996, all in a single hectad. There are older records from North Northumberland (Bizzle Burn) and East and West Perthshire (Glas Tulaichean, Ben Ledi and Ben Vorlich). There are no known specific threats to this species, but calcareous montane flushes are both scarce and fragile, so known populations should be kept under observation. *B. stirtonii* has a scattered distribution throughout northern Europe east to Siberia, and in the mountains farther south. It is also widespread in northern North America.

Total no. of hectads: 8 1970 onwards: 3

Bryum turbinatum (Hedw.) Turner

Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

This moss forms green or pinkish patches up to 3 cm tall. It is easily distinguished when fertile, the capsule being distinctively short and wide, and markedly narrowed just below the mouth when dry. *Bryum pseudotriquetrum* can look similar but has a recurved leaf margin (flat in *B. turbinatum*) and a longer capsule that is not constricted near the mouth. *B. schleicheri* can also look similar but is larger with broader, more concave leaves. *B. turbinatum* is a species of thinly vegetated, damp, often sandy or gravelly soils, often in dune slacks and old peat and gravel pits. Sporophytes are produced in spring and summer.

The distribution of this plant has been complicated by confusion with other *Bryum* species, but the species has clearly suffered a catastrophic decline in Britain, where it may now be extinct (Jones 1991). The most recent records are from Staffordshire and Rum in the 1940s. There are older, mostly 19th century, records from scattered sites from West Sussex to South Northumberland.

This species was probably a transient weed at most sites. Its disappearance from the gravel pits in Oxfordshire, where it was once locally abundant, was probably due to the sites becoming overgrown; it has failed to colonise other more recent gravel pits nearby. Although successional changes provide the reason for the disappearance of the species from individual sites, the reason for the overall decline of the species is unknown. Possibly it produces sporophytes less frequently than it used to, perhaps because of pollution, and is therefore overlooked by bryologists. This moss is widely distributed throughout most of Europe and in Africa, Asia and South America.

Total no. of hectads: 16 1970 onwards: 0

Bryum uliginosum (Brid.) Bruch & Schimp.

Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Not threatened*

Bryum uliginosum forms greenish patches up to 3 cm tall and is very similar to several other species of *Bryum*, notably *B. imbricatum* (*B. inclinatum*), *B. intermedium* and *B. pallens*. *B. uliginosum* is characterised by a combination of the relatively wide leaf border, the cilia among the peristome teeth, lacking a reddish leaf base and being autoecious. It grows on damp, often calcareous, sandy soils in flushes, stream sides, dune slacks and ditches through dunes. There are also records from a damp wall and among grass in a wet meadow.

In the 19th century this species was widespread in Britain from Oxfordshire northwards, particularly in the Yorkshire–Lancashire area. By the early 20th century it had already declined seriously (Jones 1991) and there have been only six records since 1910. It has been recorded at two sites since 1950 (in North-west Yorkshire and Dumfriesshire) and has not been seen at either of these since 1970. It may now be extinct. The reasons for the decline of this species are not understood. Drainage and pollution may be factors, but it is doubtful if they can be the only factors responsible for such a marked decline. It is possible that *B. uliginosum* has been overlooked because it produces sporophytes less frequently than it used to. This moss is widely distributed throughout most of Europe and is also found in northern and central Asia, North and South America and New Zealand.

Total no. of hectads: 49 1970 onwards: 0

Bryum warneum (Röhl.) Blandow ex Brid.

Status in Britain: *VULNERABLE*
Status in Europe: *Rare*

This is a small moss forming patches up to 1 cm tall. The pointed leaves, which are not spirally twisted when dry and have bordered, recurved margins and red-brown bases, separate it from other British *Bryum* species except *B. algovicum*, which has a longer capsule and an excurrent nerve. *B. mamillatum* can be similar but has a wider capsule mouth and peristome teeth with a different structure. *B. warneum* is a species of dune slacks, wet sandy ground at the edges of saltmarshes and occasionally old gravel pits. Elsewhere in Europe it also sometimes grows by lakes and rivers. The sporophytes mature in late summer and autumn.

This species is widely distributed around the coast of Britain. It has been recorded from about 35 sites, but has not been refound at over half of these since 1950; it has been seen at only seven sites since 1970, in East Kent, Gwynedd (Merioneth), Angus, East Lothian and West Ross. Six of the post-1970 British sites for this species are within SSSIs, two of which are also NNRs; the other site has no designated site protection. Good populations of *B. warneum* were found in two hectads on the Sefton coast (South Lancashire) during a survey in 1995. There is also an inland record from South Lancashire but the plant has not been refound there for over a century. This is one of a number of coastal *Bryum* species that have undergone a catastrophic decline since the 19th century, for reasons given under *B. calophyllum*. There is an urgent need for a survey of these species at most of their sites. In Britain, it is the subject of a Biodiversity Action Plan. This moss has a widespread, but mainly coastal, distribution in northern and central Europe. It is also recorded from Asia (Altai, Himalayas) and Canada.

Total no. of hectads: 36 1970 onwards: 7

Buxbaumia viridis (Moug. ex Lam. & DC.) Brid. ex Moug. & Nestl.

Green shield-moss
Status in Britain: *ENDANGERED*. WCA Schedule 8
Status in Europe: *Vulnerable*. Bern Convention, Appendix 1; EC Habitats & Species Directive, Annex IIb.

Buxbaumia viridis is a very distinctive moss with a large, conspicuous sporophyte produced from a very reduced gametophyte. It is distinguished from *B. aphylla* by its matt, hardly flattened capsule, from which the cuticle peels off at maturity, and the less coarsely papillose seta. Both species grow as scattered individuals (or sporophytes, at any rate) rather than in dense patches. *B. viridis* grows on decaying wood and is apparently restricted (in Britain) to the decorticated fallen trunks and stumps of coniferous trees in humid, sheltered woodland. The only site where it has been recorded recently is on a steep, south-east-facing slope in a wooded ravine. Here it grows on a very soft and well-rotted *Pinus sylvestris* log, in association with *Brachythecium rutabulum*, *Hypnum cupressiforme*, *Mnium hornum*, *Rhytidiadelphus triquetrus* and *Peltigera* sp. Populations of this species may be ephemeral, depending on the availability of habitat. In continental Europe it has also been recorded from humus-rich soil, sometimes with *B. aphylla*.

B. viridis has been seen at only three sites since 1950. In one site, in Easterness, it was last seen in 1951 but there are later records from another Easterness site. The species has been sporadically recorded since 1961 at this latter site, which is an SSSI, with recent sightings in 1993 and 1995 on different logs (Long and Rothero 1995–96). A visit in 1998 was unsuccessful in refinding the plant, but three colonies were found in 1999: one colony had 17 sporophytes on one log and four on another; the second colony had three sporophytes on a single log; and the third colony had two sporophytes on one log. In 1999, five capsules of *B. viridis* were found at a new site, on a decorticated pine log in an area of wooded block scree not far from Kindrogan (East Perthshire). This gives a total known sporophyte production in the UK of 31 sporophytes on five logs in two localities. Of these 31 sporophytes, 17 are known to have survived to dehiscence and shed their spores (or, 45% of sporophytes produced failed to reach maturity). *B. viridis* has previously been recorded from four other sites in South Aberdeenshire, Angus and East Ross, but has not been seen at any of these for over a century. However, because the gametophyte is much reduced and therefore easily overlooked, *B. viridis* may be more frequent than records suggest.

Fruiting *B. viridis* is a relatively conspicuous plant and the small populations may be vulnerable to botanical collection. However, the biggest threat is the lack of available sites for establishment: many of the fallen trees in the Easterness ravine now have an extensive cover of large, woodland floor bryophytes. Circumstantial evidence suggests that grazing by slugs and snails is responsible for much if not all the damage to the young green sporophytes, as numerous slugs were observed at both current localities, and snails were seen at the Easterness site. If reproduction by spores is the only method of perennation in *B. viridis*, then this is a significant loss of potential plants. The extreme rarity of this species, and its transient occurrence in a short-lived habitat, make it a difficult plant to conserve. At the existing sites suitable large, decorticated logs need to be safeguarded even if they are not currently occupied by the species. Elsewhere, general conservation measures for Caledonian pine woodland, including retention of rotting wood, should ensure the availability of suitable habitat. The existing site was surveyed recently as part of the Scottish Cryptogamic Conservation Project 1993–1995 and is the subject of a Biodiversity Action Plan. One result of this is that the extant Easterness site is being surveyed (1999) at two-monthly intervals to determine the phenology of the plant. This species is widely but sparsely distributed throughout most of Europe, and is also recorded from south-western Asia, China and western North America.

Total no. of hectads: 7 1970 onwards: 2

Campylophyllum halleri (Hedw.) M.Fleisch.

Status in Britain: ENDANGERED
Status in Europe: Not threatened

The small size, green to yellow-brown colour and the stiff, squarrose leaves make this species easy to identify in its montane habitat. The plant forms spreading patches, which can be relatively large, on the faces of crags and boulders composed of calcareous schist or metamorphosed limestone. All the recorded sites are above 800 m. Sporophytes seem to be produced regularly at the site in the Ben Alder SSSI, but are more sporadic at Ben Lawers, although usually present on some stands (Long 1982).

In Britain *Campylophyllum halleri* is restricted to three areas: Aonach Beag by Ben Alder (Westerness), the Lawers area (Mid Perthshire) and Caenlochan Glen (Angus), all of which are SSSIs and one is an NNR. It is locally frequent over a very small area of both Ben Lawers and Aonach Beag, both areas where it has been seen recently. Other stands in the Lawers area and the population at Caenlochan have not been seen for some time, and are presumed to be very sparse. No threats to this species have been identified, but the lack of records other than from its main sites gives cause for some concern. This is an arctic–alpine species found in Fennoscandia and many of the major mountain ranges running across Europe. It is also reported from the Himalayas, Yunnan, China, Japan, and in North America it is frequent in the western mountains but rare in the east.

Total no. of hectads: 5 1970 onwards: 2

Ceratodon conicus (Hampe ex Müll.Hal.) Lindb.

(Ceratodon purpureus subsp. conicus (Hampe ex Müll. Hal.) Dixon)
Status in Britain: ENDANGERED
Status in Europe: Not threatened

This diminutive brownish-green acrocarp is a smaller plant than the very common *Ceratodon purpureus*. It differs from it in that the leaf rarely has any teeth, the nerve is more often excurrent, the leaf cells are, on average, smaller and the capsule is usually erect, straight and with little or no swelling at its base (Burley 1986; Burley and Pritchard 1990). Identification of *C. conicus* is complicated by the extreme variability of *C. purpureus*, but *C. conicus* grows in calcareous habitats while *C. purpureus* normally grows in base-poor habitats. This is a species of dry, bare, sandy or clayey soils overlying oolitic limestone on, for example, paths and track-sides and in old quarries. In the 19th century it was usually found on the tops and in soil-filled crevices of mud-capped limestone walls. It appears to fruit rather infrequently.

C. conicus was once widely scattered and perhaps locally frequent on the oolitic limestone of central England from East Gloucestershire to South Lincolnshire, but it has declined significantly and its only two recent sites, which are not protected, are close together in Oxfordshire (Jones 1953, 1991). Scattered records from elsewhere in Britain are known or suspected misidentifications of *C. purpureus*. The decline of this species is attributable, at least in part, to the disappearance of mud-capped walls. A survey of current and past sites of this inconspicuous species is needed to ascertain the present state of populations and formulate an appropriate recovery plan if necessary. There are scattered confirmed records from continental Europe, north Africa and south-west Asia.

Total no. of hectads: 20 1970 onwards: 2

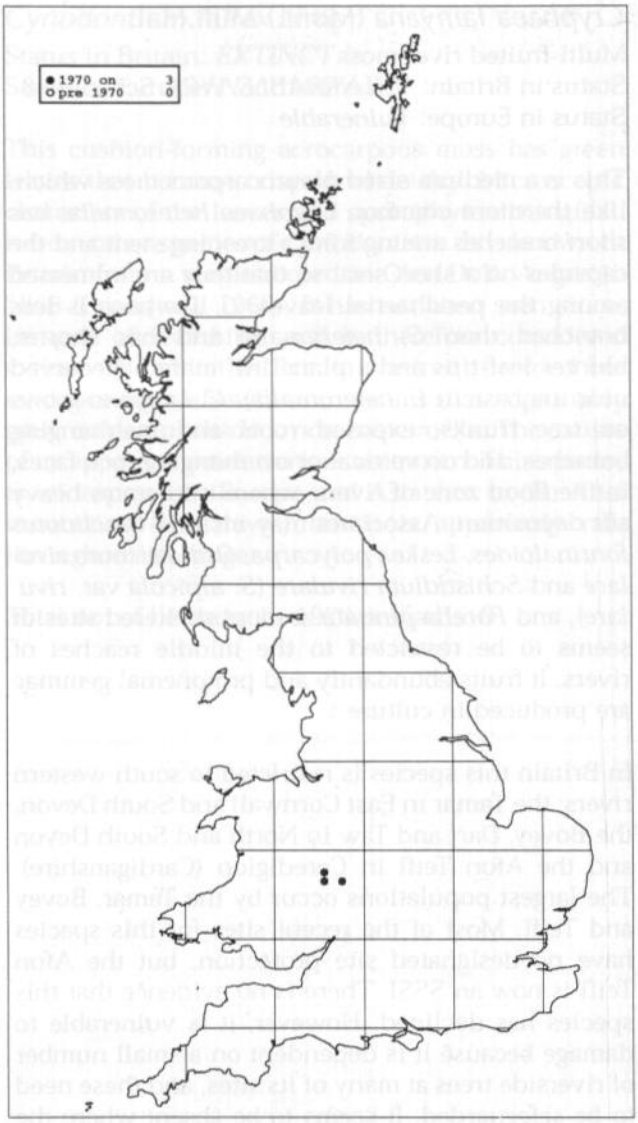
Cinclidotus riparius (Brid.) Arnott

Status in Britain: VULNERABLE
Status in Europe: Not threatened

Resembling compact forms of *Cinclidotus fontinaloides*, *C. riparius* is a bushy, dark green, essentially aquatic species. When wet, the leaves of *C. riparius* are wider and more spreading than those of *C. fontinaloides*, and the leaf border lacks the strongly differentiated internal cells (seen in cross-section) found in the latter species. *C. fontinaloides* has immersed capsules, whereas those of *C. riparius* are exserted, but sporophytes have not been found on *C. riparius* in Britain. It grows on rocks and stones, including retaining walls, on the banks of the River Teme in Worcestershire, Herefordshire and Shropshire, often in pure patches or with *C. fontinaloides*. Frequent associates are *Brachythecium rutabulum*, *Didymodon insulanus* (*Barbula cylindrica*) and *Fontinalis antipyretica*.

C. riparius has an interesting history in Britain. Although collected, and correctly named, in the 19th century, British material lacked sporophytes. Subsequent investigation therefore concluded that the specimens could not be named definitively, and it was generally supposed that the British material was merely a form of *C. fontinaloides*. However, Blockeel (1998) has shown that the character of the leaf margin is diagnostic in separating *C. riparius* from *C. fontinaloides*, and the species has therefore been reinstated to the British list. It is locally frequent, even occasionally abundant, along stretches of the River Teme where there is rocky substrate available but, as it is apparently confined to this one river in Britain, it is probably vulnerable to any changes resulting from pollution or inappropriate riverbank management. The sites do not receive statutory protection. *C. riparius* has a predominantly southern distribution in Europe, being widespread in the Mediterranean region, and extending more sparsely northwards to The Netherlands, Germany, Ireland and Poland. It also occurs in North America.

Total no. of hectads: 3 1970 onwards: 3



Cryphaea lamyana (Mont.) Müll.Hal.

Multi-fruited river moss
Status in Britain: *VULNERABLE*. WCA Schedule 8
Status in Europe: *Vulnerable*

This is a medium-sized pleurocarpous moss which, like the more common *Cryphaea heteromalla*, has short branches arising from a creeping stem and the capsules on a short seta, so that they are immersed among the perichaetial leaves. *C. lamyana* is less branched than *C. heteromalla* and has shorter, blunter leaf tips and a plane leaf margin (recurved near the base in *C. heteromalla*). *C. lamyana* grows on tree trunks, exposed roots and overhanging branches, and on vertical or overhanging rock faces, in the flood zone of rivers, where it tolerates heavy silt deposition. Associates may include *Cinclidotus fontinaloides*, *Leskea polycarpa*, *Orthotrichum rivulare* and *Schistidium rivulare* (*S. alpicola* var. *rivulare*), and *Porella pinnata* at more sheltered sites. It seems to be restricted to the middle reaches of rivers. It fruits abundantly and protonemal gemmae are produced in culture.

In Britain this species is restricted to south-western rivers: the Tamar in East Cornwall and South Devon, the Bovey, Dart and Taw in North and South Devon and the Afon Teifi in Ceredigion (Cardiganshire). The largest populations occur by the Tamar, Bovey and Teifi. Most of the recent sites for this species have no designated site protection, but the Afon Teifi is now an SSSI. There is no evidence that this species has declined. However, it is vulnerable to damage because it is dependent on a small number of riverside trees at many of its sites, and these need to be safeguarded. It seems to be absent where the river is very shaded by the tree canopy, so some tree management may be necessary occasionally. The population along the Teifi has recently been surveyed in detail (Orange 1993). A Biodiversity Action Plan has been written for this species. This species is restricted to the Atlantic coastal fringe of Europe from Wales to Portugal, and the western Mediterranean from the Iberian Peninsula and north Africa east to Italy and Switzerland.

Total no. of hectads: 12 1970 onwards: 8

Ctenidium procerrimum (Molendo) Lindb.

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This species is very similar to the common *Ctenidium molluscum*, the principal difference being the lack of a toothed margin to the leaves. In the field, the glossy, golden-brown, pinnate shoots with branches regularly increasing in length away from the apex are quite distinctive. Recent records are restricted to three sites in Britain, one on Ben Lawers (Mid Perthshire) and two in Glen Feshie (Easterness). At all three localities it grows in bryophyte-rich turf on friable, calcareous mica-schist, but the Glen Feshie sites are much lower, at 450 m, and drier than the site on Ben Lawers at 1,050 m. Sporophytes are unknown in Britain.

The population on Ben Lawers is very limited, extending over a short section of one crag, but it was locally frequent within this band in 1996. Nothing is known of the size of the two populations in Glen Feshie. Although there is no specific threat to this species, the small and localised nature of the Lawers population, and the lack of knowledge of the sites in Glen Feshie, render it vulnerable. This is a circumpolar arctic–alpine species which is found scattered throughout Europe, Asia and northern North America.

Total no. of hectads: 3 1970 onwards: 2

Cyclodictyon laetevirens (Hook. & Taylor) Mitt.

Bright green cave-moss
Status in Britain: *ENDANGERED*. WCA Schedule 8
Status in Europe: *Rare*

This is a medium-sized, soft, glossy, dark green, pleurocarpous moss. The complanate shoots bear some resemblance to *Hookeria lucens* and species of *Plagiothecium*, but the leaves are very distinctive in having a long double nerve, an apiculus and a border of long, very narrow cells. The capsule, like that of *H. lucens*, is horizontal and borne on a stout seta. *Cyclodictyon laetevirens* is a strongly oceanic species of wet, well-shaded rocks in caves, ravines and by waterfalls near the sea. Its associates in Scotland include *Jubula hutchinsiae* and *Calliergonella cuspidata*. In Ireland it has also been found growing epiphytically on the fronds of Killarney fern *Trichomanes speciosum*. It is restricted to sea level in Britain but it ascends to 330 m in Ireland.

This species was first discovered in a cave in Cornwall in 1840, where it was regularly seen and collected until 1933 (Paton 1969; Rilstone 1947). It was then assumed to have been rendered extinct by a combination of over-collecting, competition from *Conocephalum conicum* and the roof of the cave collapsing, until it was rediscovered in 1996. *C. laetevirens* was discovered at two sites in the Inner Hebrides in the 1960s and 1970s, and was refound at one of these in 1994 (Long and Rothero 1995–96) and again in 1998, in a basalt sea cave at the back of a raised beach, where it was abundant over about 2 m^2. It was also reportedly abundant at its other hebridean site. None of its British sites receives statutory protection. This species is more common in Ireland, where it has a strongly south-western distribution.

This handsome moss is potentially threatened by collecting and nutrient-enriched groundwater at its newly rediscovered Cornish locality. The Scottish populations are too remote for this to constitute a real threat. There appear to be no other threats. One of the Scottish sites was surveyed recently as part of the Scottish Cryptogamic Conservation Project 1993–1995. This species has a scattered distribution along the Atlantic fringe from Scotland and Ireland to Macaronesia, and also occurs in tropical Africa.

Total no. of hectads: 3 1970 onwards: 3

Cynodontium fallax Limpr.

Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

This cushion-forming acrocarpous moss has green leaves that become crisped when dry. Microscopic characters of the leaves and sporophyte distinguish it from other species of *Cynodontium*. It is known in Britain from a single record in Glen Doll, Angus in 1868 (Crundwell 1960). It has not been seen since, in spite of searching, and is therefore considered extinct. Its habitat in Britain was not recorded but evidence from elsewhere indicates that it probably grew on damp, shaded, non-basic rocks. The causes of its apparent extinction are unknown. This species is widespread in Europe and Asia east to the Altai mountains (Himalayas) but it is apparently rare throughout its range.

Total no. of hectads: 1 1970 onwards: 0

Cynodontium polycarpon (Hedw.) Schimp.

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

Cynodontium polycarpon is a small green tuft-forming acrocarp that can be distinguished from other *Cynodontium* species only by microscopic characters of the sporophyte and leaves. It grows on shaded acidic rock faces and among boulders at altitudes above 300 m. This species has a scattered distribution in Britain, with records from seven sites in Cumberland, North Northumberland, Gwynedd (Merioneth), Angus and Easterness, but has been seen recently only at its Welsh locality. However, this does not necessarily mean that it is declining: it was considerably over-recorded in the past, because of confusion with other species, and its actual past and present distribution in Britain is probably not fully understood. No specific threats to this poorly known plant have been identified. It is widely distributed throughout most of Europe and also occurs in central and eastern Asia and possibly North America.

Total no. of hectads: 6 1970 onwards: 1

Daltonia splachnoides (Sm.) Hook. & Taylor

Status in Britain: *VULNERABLE*
Status in Europe: *Vulnerable*

This small moss forms shiny, dark green patches and cushions on tree roots and twigs, shrubs, rotting logs and occasionally rocks in very humid sites, usually where spray from waterfalls or even inundation is a regular feature (Crundwell 1951). In the field the habit and colour are useful characters, as is the usually present capsule, which is very small but conspicuously papillose and with a fringed calyptra. Microscopically, the border of long narrow cells and the single nerve in the narrow, lanceolate leaf are unique in British pleurocarpous mosses. The difficulty with *Daltonia splachnoides* is not with identification but in finding the often tiny stands. Most sites are at low altitudes (up to 230 m in Scotland). All sites are very close to the heads of sea lochs on the west coast, where rainfall can be prodigious, and almost all have a north or north-easterly aspect.

In Britain it has been recorded from eight localities up the west coast of Scotland from Argyll to Torridon (West Ross) (Bell 1950) and during a survey in 1996 it was refound at all but two of these sites. The population near Glen Coe is by far the largest; here *D. splachnoides* is locally frequent in a number of small burns that run down one section of hillside. The population on the Beinn Eighe NNR is also reasonably healthy with *D. splachnoides* occurring in six different localities, and further survey work would certainly reveal more. At the other extant sites, populations are very small indeed. However, at the one site that has been monitored for 15 years, the number of plants has fluctuated markedly over time. The possible loss of two of the eight sites for this species is a matter of concern but it is probable that, given the short-term nature of the preferred habitat, the plant is adapted to moving around. Of the sites seen in 1996, three are SSSIs, and one an NNR, and the rest have no protection.

D. splachnoides is more widespread in south-western Ireland, although it has not been seen at the type locality (Secawn Mountain, Co. Dublin), since it was found in the early 19th century, despite being looked for on several occasions. Sites for this plant should not be subject to management operations that would cause a local reduction in humidity. However, clearance of *Rhododendron* should be encouraged if it is causing a problem at specific sites. In Europe *D. splachnoides* is restricted to Scotland, Ireland and the Azores, but it also occurs in Madeira, tropical Africa and America and New Zealand.

Total no. of hectads: 8 1970 onwards: 7

Dichodontium flavescens (Dicks.) Lindb.

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

Dichodontium flavescens is a small green acrocarp very similar to the common *D. pellucidum*, with rather distant leaves and a (usually) toothed leaf margin. It differs in its symmetrical capsule and less variable leaves, always acute and narrowly lanceolate rather than often ovate and obtuse. However, the sporophyte character is the only really reliable method of identification and many older records have been rejected in the absence of sporophytes. *D. flavescens* grows in wet places, usually among rocks by streams and waterfalls in similar habitats to *D. pellucidum*. Records indicate a scattered distribution over western and northern areas of Britain, and the species is absent from the south-east. The distribution map for *D. flavescens* (Hill et al. 1992) and the paucity of subsequent records, suggest a serious decline. This may be so, but non-fruiting material may be relatively widespread but unrecorded. Much more information on its current status is therefore needed. The world distribution of this species is also uncertain, but it has been recorded from continental Europe and North America.

Total no. of hectads: 40 1970 onwards: 6

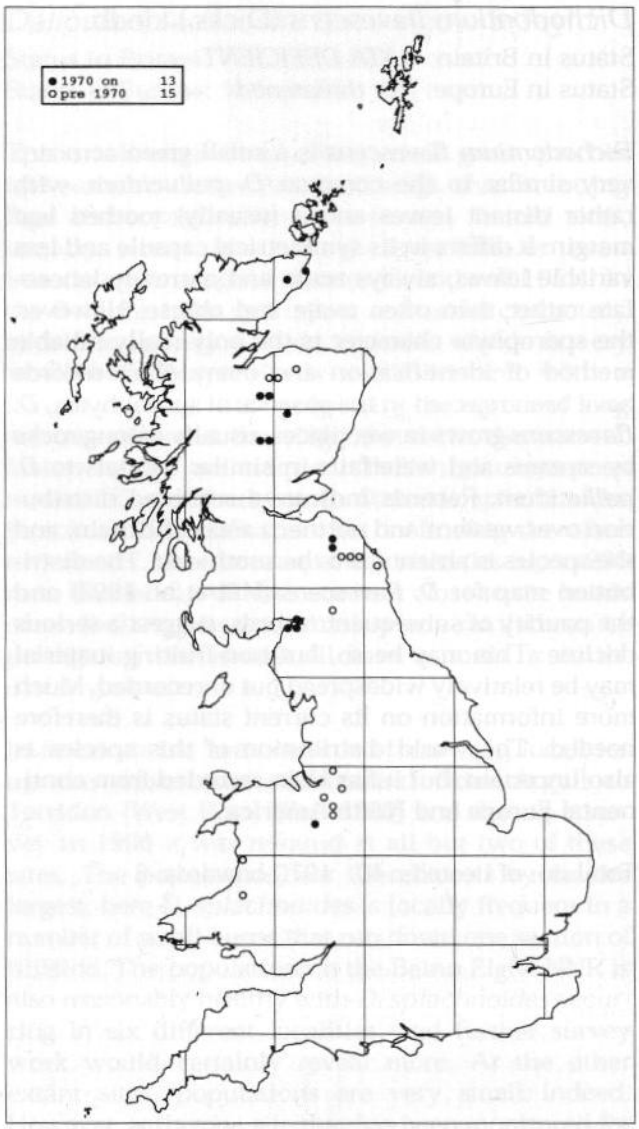
Dicranum bergeri Bland. ex Hoppe
(*Dicranum undulatum* Schrad. ex Brid.,
D. affine Funck)
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This is a large, yellowish- or olive-green acrocarpous moss forming cushions up to 15 cm tall, with long, narrow, pointed, transversely undulate leaves. Microscopic examination is necessary to distinguish it from related species, although with experience it can be recognised easily in the field. *Dicranum bergeri* grows in bogs, particularly raised bogs, that have received little or no disturbance. Sporophytes are known from only a few of its localities but can be abundant.

In Britain this species has been recorded from approximately 30 scattered sites in Wales, northern England and Scotland, but is decreasing and has been confirmed at only 13 of these since 1970. The decline of *D. bergeri* in Britain is attributable to the loss or degradation of its habitat because of drainage, peat extraction, burning and afforestation. Colonisation by woodland is a secondary threat where drainage has disrupted the hydrology: indeed, many of the sites where this moss was recorded in the past have dried out considerably, with resultant scrub invasion. It has disappeared from the South Lancashire and Cheshire mosses, surviving in England at a tiny handful of sites in the Shropshire and Solway mosses. It has been rediscovered only recently in Wales, at a new site, having not been seen at either of its other two Welsh sites for many years.

All the Scottish sites where this species has been recorded were surveyed in 1996–97, where it was refound at five sites, most of which supported reasonable populations. Of the other six sites, it was considered that *D. bergeri* was still likely to be present at two, even though it was not seen during the survey. As for the other four, one had been lost to afforestation, two to changes such as *Calluna* and birch *Betula* encroachment, and one was described as 'enigmatic'. The Caithness site had recently been burned, clearly to the detriment of *D. bergeri*, although it was still present. Three further populations have recently been found in raised mires in the Abernethy Forest area (Easterness), and another in a flushed area near Braemar. All but one of the post-1970 sites are within SSSIs, three are also NNRs and others are Wildlife Trust or RSPB reserves. This species is widespread across northern and central Europe extending to central Asia. It has also been recorded from Greenland and North America.

Total no. of hectads: 28 1970 onwards: 13



Dicranum elongatum Schleich. ex Schwaegr.

Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Not threatened*

This is a yellowish-green, cushion-forming acrocarp growing up to about 6 cm tall, with narrow, pointed, often curved leaves. The leaves are shorter (up to 3 mm) and straighter when dry than those of the very similar *Dicranum fuscescens*. Microscopic examination is necessary to identify this species. Outside Britain, *D. elongatum* is typically a plant of the tundra zone, where it grows on barren rocky slopes and peaty soils. All the British records are from more-or-less montane areas and, on the infrequent occasions when the habitat was recorded, from peaty moorland or in dense tufts among short *Calluna*. Sporophytes are unknown in Britain.

The last reliable record of *D. elongatum* was in 1964, when it was found on Morrone Hill, South Aberdeenshire. The only other post-1950 record was made in 1954, also in South Aberdeenshire, when it was recorded growing 'in large tufts on boggy moorland' near Creag an Dail Bheag in the Cairngorms (Wallace 1955). A more recent Aberdeenshire record, from a pine plantation, is almost certainly an error. Before 1910 it was recorded from at least seven scattered sites in North Northumberland, Angus, Caithness, Easterness, Shetland, Westerness and West Ross. The threats to this species are obscure. The effects of muir-burning are unknown but are likely to be detrimental. There is a clear need to refind this very rare species and for a detailed survey of its ecology, so that an appropriate conservation policy can be formulated. *D. elongatum* is common in the arctic and sub-arctic regions of the Northern Hemisphere, becoming rarer and restricted to mountains southwards to the Alps, Caucasus, central Asia, Japan and Colorado (USA).

Total no. of hectads: 7 1970 onwards: 0

Dicranum leioneuron Kindb.

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

A large narrow-leaved acrocarp similar to *Dicranum scoparium*, *D. leioneuron* has non-undulate, deeply channelled leaves with an untoothed nerve, and distinctive fragile, small-leaved apical shoots (which, however, may not always be present). Like several other species of the genus, it grows mainly with *Sphagnum* on blanket and raised bogs. Sporophytes are unknown in Britain. *D. leioneuron* has been recorded from a small number of sites in Cumberland, South Northumberland, Ceredigion (Cardiganshire), Powys (Breconshire and Montgomeryshire), Mid Perthshire and South Aberdeenshire, but has not been seen at its Northumbrian or Scottish sites recently. Certainly not a common plant, *D. leioneuron* may nevertheless be overlooked, and it cannot be asserted that it has declined. No specific threats to *D. leioneuron* have been identified except those that affect bogs as a whole, such as drainage and afforestation. It is widespread in Fennoscandia and also occurs in north-east Asia and North America.

Total no. of hectads: 9 1970 onwards: 4

Dicranum spurium Hedw.

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Dicranum spurium is a large, yellow–green, tuft-forming acrocarp similar to forms of the common *D. scoparium*. It has strongly undulate leaves that become crisped when dry, with the upper leaf cells mamillose and non-porose. It is a heathland plant, often growing under leggy *Calluna* on dry slopes, either where burning has ceased some while ago or at sites away from managed moorland. It often occurs as small isolated populations and presumably must come and go with the 'heather cycle' (G P Rothero, pers. comm). Sporophytes are very rare.

D. spurium has a curiously scattered distribution in Britain, with most of the populations concentrated in the New Forest, Surrey/Sussex and Dorset heaths, and the eastern Highlands of Scotland. The heathlands of Norfolk, Lincolnshire and South Yorkshire formerly constituted a third centre of distribution, but *D. spurium* has now largely, perhaps completely, disappeared from these because of drainage and afforestation. There are scattered occurrences recorded elsewhere, but most of these too have now disappeared, although a new site in Co. Durham was detected in 1993. Indeed, this plant appears to have suffered a catastrophic decline in recent years and can now no longer be found at many of its southern English sites either. The general degeneration of heathland, because of increased levels of nitrogen, may be a serious threat to this species, and burning is clearly detrimental to individual populations. *D. spurium* is a boreal moss of northern Europe and has also been recorded in Asia and North America.

Total no. of hectads: 80 1970 onwards: 16

Didymodon cordatus Jur.

(*Barbula cordata* (Jur.) Braithw.)
Cordate beard-moss
Status in Britain: *VULNERABLE*. WCA Schedule 8
Status in Europe: *Not threatened*

Didymodon cordatus is a small, dark green to brownish-green acrocarp forming patches or low cushions. Like many other related species, it has ovate leaves tapering to a narrow, pointed tip. *D. cordatus* has a very broad, excurrent nerve and spherical gemmae in the leaf axils. Sporophytes have never been found in Britain but gemmae are produced abundantly. This species is known from a single site in North Devon, where it was first found growing on an earth-topped wall, which has since disappeared. However, it also occurs on a roadside bank and on sandstone sea cliffs at the same site, where there are several colonies. Crumbling sandstone somewhat stabilised by the growth of encrusting lichens seems to be its favourite habitat.

The biggest populations growing on the cliffs are within an SSSI and on National Trust land. The roadside bank colony is just outside the SSSI boundary. Routine road maintenance could be a potential threat to the roadside bank colony. Coastal protection schemes could possibly pose a threat to the cliff colonies, if they resulted in increased stability. Current proposals for a new pipeline may also prove to be a threat to this moss. Natural erosion of the unstable cliff face is probably beneficial, as it provides constant exposure of suitable substrate for colonisation by the gemmae; however, excessive disturbance could be detrimental. This moss is widespread in southern Europe, extending east to the former USSR and Turkey and northwards to Britain, The Netherlands, Germany and Poland.

Total no. of hectads: 1 1970 onwards: 1

Didymodon glaucus Ryan

(*Barbula glauca* (Ryan) H. Möller, *Didymodon rigidulus* Hedw. var. *glaucus* (Ryan) Wijk. & Marg.)
Glaucous beard-moss
Status in Britain: *CRITICALLY ENDANGERED.*
WCA Schedule 8
Status in Europe: *Vulnerable.* Endemic

This is a minute, bright glaucous-green acrocarp forming patches 1–3 mm tall. The leaves are narrowly lanceolate and pointed. *Didymodon umbrosus* (*Trichostomopsis umbrosa*) can be similar, and separation of the two species may require microscopic examination. *D. rigidulus* can also be very similar, but lacks the glaucous-green colouration. *D. glaucus* grows on thin, immature soils on or below bare, sheltered chalk or limestone cliff faces. It has never been found with sporophytes in Britain, but dispersal occurs by the distinctive moniliform gemmae.

This species is now known from only one site in North Wiltshire, an SSSI, where there is a colony covering about 60 cm^2 and a few smaller colonies growing nearby. Formerly occurring at sites in North-west Yorkshire and West Sussex, it has not been seen at either of these since 1924. The Yorkshire locality was described very imprecisely, and a detailed search might yet lead to the rediscovery of the species there. The reasons for the disappearance of this species from its localities in Sussex and Yorkshire are not known for sure but, when the Sussex site was re-examined during the 1980s, it was thought likely that *D. glaucus* had been shaded out by scrub. Threats at the remaining site have included casual rubbish dumping and possibly collecting by botanists. This population declined rapidly in the early 1980s because of shading by encroaching shrubs and other vegetation, but it recovered rapidly once the scrub was cleared away as part of an active conservation programme by EN. Further management to combat scrub encroachment is likely to be needed in the future. This moss has been the subject of a monitoring programme since 1993. It is also on EN's Species Recovery Programme and is the subject of a Biodiversity Action Plan. *D. glaucus* probably has a scattered distribution throughout continental Europe but it may have been confused with other species on the continent and therefore be very much rarer than previously supposed.

Total no. of hectads: 3 1970 onwards: 1

Didymodon mamillosus (Crundw.) M.O.Hill

(*Barbula mamillosa* Crundw.)
Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Vulnerable.* Endemic

A small green acrocarpous moss closely related to *Didymodon rigidulus*, *D. mamillosus* was described in 1976 from a gathering made by E C Wallace in 1967 from calcareous rock crags at the head of Kirkton Glen, Balquhidder (West Perthshire) (Crundwell 1976). The leaves are relatively shorter and broader than those of *D. rigidulus*, and the rather large spherical axillary gemmae and the conspicuously mamillose leaf cells are also characteristic. It was recently refound at its type locality (Hodgetts 1999), where a single small tuft, *c.* 1 x 2 cm, was found growing on a limestone rock. Axillary gemmae were abundant. More recently still, the population has been shown to be larger than previously thought (G P Rothero, pers. comm.).

This species has rarely been recognised in the field, and therefore its ecology is poorly known. The single rock where it was rediscovered in 1999 is next to a footpath, but *D. mamillosus* is probably not particularly threatened here, except by the small size of the population. The nearby larger stand is less accessible. It should be monitored regularly and taken into *ex-situ* cultivation. *D. mamillosus* is the subject of a Biodiversity Action Plan. The five known localities for this moss outside Scotland are: on limestone at *c.* 2,000–2,050 m in Garmisch, Bavaria, (1979); on a dry limestone boulder in the university botanic garden, Prague, Czech Republic (1996); Englische Bucht, Jan Meyen Island (1899); a locality in north-east Spain; and a recently discovered locality in the Hautes-Alpes of France (Boudier 1999).

Total no. of hectads: 1 1970 onwards: 1

Ditrichum cornubicum Paton

Cornish path-moss
Status in Britain: *ENDANGERED*. WCA Schedule 8. Endemic
Status in Europe: *Endangered*. Endemic

This recently described species (Paton 1976) is a very small, dull green acrocarp growing to a maximum height of 5 mm, either as scattered shoots or denser patches. The bluntly pointed, lanceolate leaves become more crowded higher up the stem and have a broad nerve. Microscopic examination is necessary for identification. *Ditrichum cornubicum* is restricted to acid soils contaminated by copper, in areas of old mine spoil, where the vegetation is open or sparse. It is a pioneer species unable to compete with larger plants, and is particularly characteristic of disturbed ground and the edges of tracks and paths. Only male plants are known, but the plant reproduces vegetatively by means of rhizoidal tubers.

This species is known at present from only two sites in East Cornwall, with numerous separate small colonies. One site is an SSSI and protection for the other is under consideration. *D. cornubicum* has disappeared from its only other known site, in West Cornwall, where it was seen in 1963. The main threats to this species may include encroachment of coarse vegetation, excessive churning up of the soil by vehicles, the resurfacing of tracks and development of the sites for tourism. Collecting by botanists might also be a threat, given the small size of the remaining population. Careful management is needed to ensure the continued existence of open ground that is not too heavily disturbed by vehicles. As a threatened endemic, *D. cornubicum* is the subject of a Biodiversity Action Plan, and it is included on a list of the world's most threatened bryophytes (Hallingbäck and Hodgetts 2000).

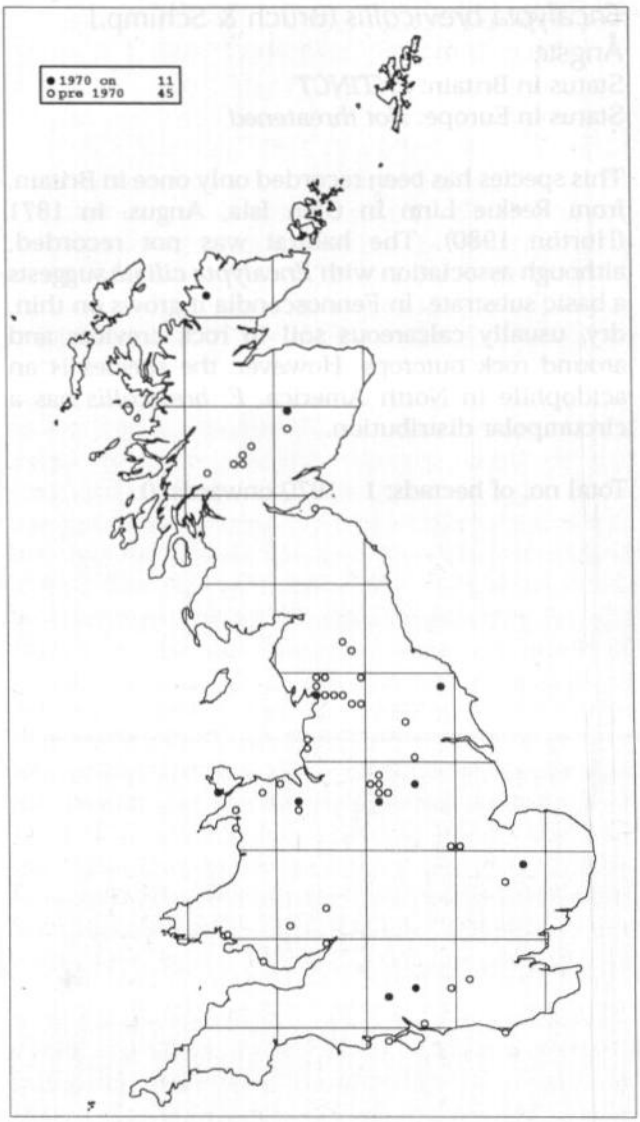
Total no. of hectads: 3 1970 onwards: 2

Ditrichum flexicaule (Schwägr.) Hampe

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

Ditrichum flexicaule is a bright or dark green acrocarp growing in dense tufts. The long, subulate leaves are not as long nor as flexuose as those of *D. gracile* (*D. crispatissimum*), from which it was recently segregated (Frisvoll 1985). Flagelliform shoots are often present. Until recently all plants in this group were named *D. flexicaule*, but it is now clear (Smith 1993) that *D. flexicaule* is a rare plant in Britain, *D. gracile* being the common species. As far as is known, the two species have a similar ecology, growing in calcareous habitats such as sand dunes, wall tops and chalk and limestone grassland. The recent revision of British collections (Smith 1993) shows that most specimens of *D. flexicaule* were collected before the First World War, with very few collections since. This, along with the fact that only a small handful of records have been made since the revision, seems to indicate that this species is, indeed, rare and that it has declined substantially over the last 100 years. The post-1970 hectad total of 11 might be a slight underestimate, because three post-1950 records mapped by Smith (1993) could not be traced to ascertain whether they were also post-1970. However, it is impossible to allocate a threat status without further information. Targeted survey work at some of the old localities for *D. flexicaule* is needed to clarify its status. This species is known from scattered sites throughout Europe and from North America.

Total no. of hectads: 57 1970 onwards: 11



Encalypta brevicollis (Bruch & Schimp.) Ångstr.
Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

This species has been recorded only once in Britain, from Reekie Linn in Glen Isla, Angus, in 1871 (Horton 1980). The habitat was not recorded, although association with *Encalypta ciliata* suggests a basic substrate. In Fennoscandia it grows on thin, dry, usually calcareous soil in rock crevices and around rock outcrops. However, the species is an acidophile in North America. *E. brevicollis* has a circumpolar distribution.

Total no. of hectads: 1 1970 onwards: 0

Ephemerum cohaerens (Hedw.) Hampe
Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Endangered*

This is a minute ephemeral moss less than 1.5 mm tall with an almost spherical capsule borne on a very short seta. It differs from other British *Ephemerum* species by having a strong nerve running from the base to the tip of the leaf (but not excurrent), relatively wide leaf apices and relatively long leaf cells. *E. cohaerens* grows on non-calcareous, damp, bare muds and fine soils at the edges of lowland ponds, lakes, reservoirs, or on nearby moist banks and cattle tracks, often in association with *Riccia cavernosa* and *Aphanorhegma patens*. Other rare specialist species, including *Micromitrium tenerum* and *Physcomitrium eurystomum*, have also been recorded nearby. In other parts of its range *E. cohaerens* also grows at the edges of streams and on wet bare soils in pastures and marshes. It produces sporophytes, with large spores, in the autumn. Numbers fluctuate according to availability of habitat.

This species has been recorded from four British sites, in Hertfordshire, Leicestershire and West Sussex, but has not seen at any since 1963, in spite of occasional searching. The reasons for the apparent decline of this species are not known. However, the water level at at least one site is now permanently maintained at an artificially high level for angling, which has removed the plant's habitat. Elsewhere, it may have been overlooked because of its small size, and unpredictable and ephemeral occurrence. The very large spores produced by *E. cohaerens*, which are potentially long-lived, indicate a 'shuttle' life strategy (During 1992): the plant may reappear irregularly in the same areas when conditions become suitable, but is perhaps not very mobile. It may yet be refound at some of the sites where it was previously recorded. Its main requirements are annual (or at least periodic) fluctuations in water levels or cattle poaching to maintain suitable open muddy habitats. This species is found scattered across central and southern Europe from Ireland to Romania and south to north Africa. It is also occurs in eastern and central North America.

Total no. of hectads: 3 1970 onwards: 0

Ephemerum stellatum H.Philib.

Status in Britain: *ENDANGERED*
Status in Europe: *Vulnerable*

Like other species of *Ephemerum*, this is a minute, ephemeral moss with a capsule borne among the leaves on a very short seta. The distinguishing features of *E. stellatum* are the narrow, nerveless, pointed leaf with an untoothed or slightly denticulate margin (never coarsely toothed as in the much commoner *E. serratum*, which also lacks a nerve). This is an ephemeral species of sparsely vegetated, non-calcareous soils. It has been found in woodland rides, fallow fields and stubble fields, on an earth-covered bridge parapet and a cliff-top path. It fruits freely in autumn.

E. stellatum has been recorded from five British sites, all in the south-east from Hampshire to Kent, but has been found recently at only three sites, in West Sussex and North and South Hampshire, none of which has any designated site protection. This species is poorly known and seems unaccountably rare, considering the apparently diverse nature of its habitats, but intensification of agriculture has probably reduced the population significantly. As a species with large spores, it is probably a relatively immobile 'shuttle' species (During 1992) and the main threat is likely to be a shortage of bare ground to colonise in the vicinity of existing colonies. Like many of the rarer 'stubble field bryophytes', *E. stellatum* tends to appear in the second year since cultivation: one of the recent sites was a 'set-aside' field that had been fallow for 14 months. Artificial disturbance may be necessary at some sites to maintain suitable open habitats. *E. stellatum* is the subject of a Biodiversity Action Plan. This is an extremely rare plant worldwide, known outside Britain only from Ireland, France and Germany.

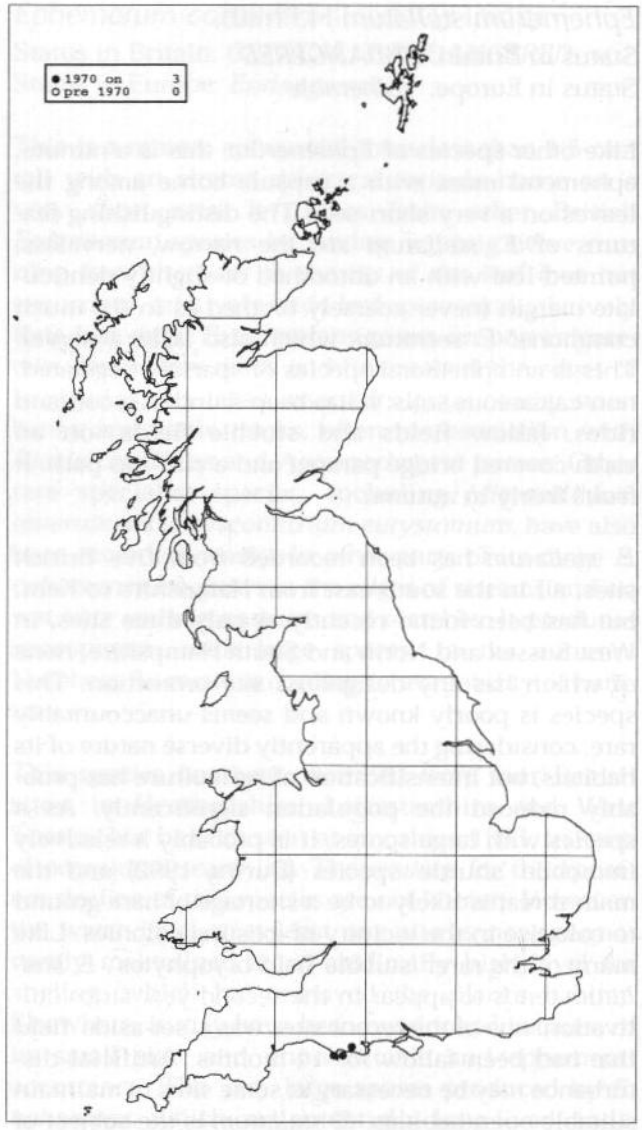
Total no. of hectads: 5 1970 onwards: 3

Eurhynchium meridionale
(Bruch, Schimp. & Gümbel) De Not.
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This medium-sized, glossy, yellowish-green pleurocarpous moss resembles its common relative *Eurhynchium striatum* in its plicate leaves. However, it is smaller, forms denser patches, with more crowded branches and also differs in cell structure. In Britain, *E. meridionale* grows on bare soil in thin turf on cliffs, and on sheltered boulders in screes and disused quarries on the Purbeck limestone, and on bryophyte- and lichen-rich chalk pebble and flint scree, in association with *Hypnum lacunosum*, *Scorpiurium circinatum* and *Tortella tortuosa*. Sporophytes have not been found in Britain.

This is a strongly southern plant restricted in Britain to the south coast of Dorset, where at least six separate populations have been found on the Isle of Portland since 1980, of which five are within an SSSI, and a further population near Lulworth Cove, also within an SSSI. *E. meridionale* is apparently not in decline, but some populations are threatened by scrub encroachment, particularly ivy. This species is widespread in the Mediterranean and Black Sea regions and extends along the Atlantic fringe of Europe from Macaronesia to England.

Total no. of hectads: 3 1970 onwards: 3



Eurhynchium pulchellum (Hedw.) Jenn.
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This is a small, green pleurocarp with imbricate leaves that forms loose wefts. It superficially resembles *Isothecium myosuroides* var. *brachythecioides* rather than any other *Eurhynchium* species, and microscopic examination is necessary for positive identification. British material is referred to var. *diversifolium* (Bruch, Schimp and Gümbel) C E O Jensen. *E. pulchellum* grows in a range of base-rich habitats. In West Suffolk it was a species of lowland grassland, growing in short turf on dry, highly calcareous soils. In Angus it grew on sandstone rocks. In Skye it is found on basalt rock outcrops, growing on intact and decomposed rock and on mossy cliff-ledges at altitudes up to 500 m, close to other uncommon species such as *Didymodon icmadophilus*, *Encalypta alpina* and *Mnium thomsonii*. Sporophytes have not been seen in Britain.

This species is currently known from three sites on the Trotternish ridge in Skye, at one of which there are at least six small colonies. It was last seen at its single site in the Suffolk Breckland (Rose 1952a; Warburg 1950) in 1980 — where it has been searched for more recently but without success — and it has not been seen at its Angus site since 1889. Records from other sites are dubious or erroneous (Hill 1993). The recent British sites are within SSSIs. The Breckland population of this species declined, apparently to extinction, as the open turf in which it grew became longer and denser as a result of reduced grazing pressure. The last record was from an area where the soil had previously been stripped. Material from this locality is in cultivation and could be reintroduced to the site if suitable conditions could be recreated. The reasons for its apparent disappearance from Angus are unknown. The Scottish sites are less threatened, but intensive tourist pressure around the Old Man of Storr in the summer months could result in erosion and damage to *E. pulchellum*. This species is widespread in Europe, but seems to be rare in the west. It also occurs widely in north Africa, Asia and the Americas.

Total no. of hectads: 4 1970 onwards: 3

Fissidens serrulatus Brid.
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This is a medium-sized to rather large *Fissidens* with stems sometimes up to 7.5 cm long. The leaves are narrow and in two ranks, each leaf with an extra sheathing leaf blade on one side at the base, as in other *Fissidens* species. *F. serrulatus* most closely resembles *F. adianthoides* and *F. polyphyllus*, but differs from both in its conically mamillose leaf cells. It grows on shaded, neutral to acid soils, or on rocks and exposed tree roots where it may be subject to periodic inundation by water. Its usual habitat in Britain is on steep or vertical banks at the edges of streams and rivers, often in association with *F. polyphyllus*, but it was found on wet shaded rocks in a cave at one site. Only male plants are known in Britain but it is capable of reproducing vegetatively by tubers, which are sometimes produced on the rhizoids.

This is a south-western species restricted in Britain to four sites in West Cornwall, South Devon and Gwynedd (Merioneth). It occurs in small quantity at the Cornish site, where it was recorded most recently in 1995, but is locally abundant along a stretch of the River Dart in Devon. It has not been seen in Gwynedd since its discovery there in 1968. Two sites for this species are within SSSIs and one is on land owned by the National Trust. The other site has no designated protection. *F. serrulatus* seems to have suffered from over-collecting at one of its sites in the late 19th and early 20th centuries, and is still vulnerable because of the small size of the population. Water pollution, bank subsidence and reduction of shade and humidity due to insensitive river-bank management may also be potential threats. This species occurs along the Atlantic fringe of Europe from Britain and Ireland to Macaronesia, and in the Mediterranean region east to Rhodes (Greece) and Tunisia.

Total no. of hectads: 4 1970 onwards: 3

Grimmia alpestris (F.Weber & D.Mohr) Schleich.

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

Grimmia alpestris forms small compact tufts, green above and blackish below, and the leaves have a hyaline hair-point. It is distinguished from related species by the bulging lamina cells and the brown fusiform capsule with the base lacking stomata and gradually narrowing into the seta. The occurrence of this plant in Britain has a complicated nomenclatural history. Long thought to occur in the eastern Highlands of Scotland, (Corley and Hill 1981; Smith 1978), further study resulted in this plant being redetermined as *G. sessitana* De Not. (Greven 1995a), and it appears as such in the current checklist (Blockeel and Long 1998). However, a recent revision (Muñoz 1998) has shown that: the Scottish plant is, in fact, *G. ungeri* (see below); the correct name for *G. sessitana* is *G. reflexidens* Müll.Hal., which does not occur in Britain; and true *G. alpestris* has been recorded at a single British locality, near Marros in Carmarthenshire, where it was collected in 1907 by H H Knight.

It is not known what the ecology of this plant is in Britain, but Muñoz (1998) states that, in general, it occurs on dry, exposed siliceous rocks 'in open areas above the tree line'. Sporophytes are common. The British population needs to be refound before anything further can be said about its status and conservation. Elsewhere it occurs in montane areas of western Europe, becoming less frequent to the east, with occasional records from western and central Asia, and western North America.

Total no. of hectads: 1 1970 onwards: 0

Grimmia anodon Bruch & Schimp.

Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

Like many other species of *Grimmia*, this small acrocarpous moss has a hoary appearance because of the long white hair-points at the tips of the leaves. It differs from other British *Grimmia* species in the concave leaves with a flat margin and the globose capsule, which lacks any peristome teeth, borne on a short, curved seta, immersed among the leaves. This plant grows in rock crevices on dry, vertical, exposed and usually base-rich rocks such as slate, basalt and limestone. Sporophytes are produced frequently.

G. anodon has been recorded reliably from two sites: a railway bridge in Westmorland, and a rock outcrop on Arthur's Seat in Edinburgh (Blockeel 1996). The Edinburgh population was discovered in 1869, but it was last collected there in 1871 and has never been refound despite repeated searches. The Westmorland site has been known since 1886 but the plant has not been seen there since 1961 and is thought to have disappeared. Several records of this moss (including more recent ones from Arthur's Seat) are now known to be erroneous determinations of other species, including *Grimmia tergestina* and *Coscinodon cribrosus*. The reasons for the disappearance of this species from both its British sites are unknown, although it has been suggested that it may have been eliminated from the Westmorland site by over-collecting. *G. anodon* is widely distributed throughout most of Europe, extending east to central Asia and the Himalayas and south to north Africa and Macaronesia. It is also widespread in Greenland and North America south to Mexico.

Total no. of hectads: 2 1970 onwards: 0

Grimmia crinita Brid.

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

This small moss forms compact low cushions on which the long hair points of its leaves all point in much the same direction, giving an impression of well-groomed mouse fur. It is usually fertile, the somewhat asymmetrical capsules being almost immersed among the perichaetial leaves because the seta is short and curved. Unlike the rather similar *G. anodon*, it has a well-developed peristome. In Britain it has been found only on calcareous masonry of walls, but in southern Europe it also occurs on calcareous rocks, normally in open sunny locations. There are two records of *G. crinita* in Britain. From 1872 until at least 1889 it grew on mortar of an old canal bridge near Hatton in Warwickshire (Braithwaite 1888; Bagnall 1891), but has not been refound there despite recent attempts to relocate it. In February 1999 a single small patch was found on unshaded south-east facing, vertical concrete of a wall at Treviscoe in East Cornwall (Blockeel et al. 2000). Further study is needed to determine its status at the locality in Cornwall.

Although the occurrence in Warwickshire has been regarded as almost certainly an introduction (e.g. by A J E Smith in Hill et al. 1992) — following a suggestion by Braithwaite (loc. cit.) — it seems quite feasible that both the old record and the recent one in Cornwall result from natural colonisation by wind-blown spores. *G. crinita* is a thermophilous southern European species with its main distribution in Mediterranean areas, previously recorded northwards to The Netherlands, Belgium and western France (dép. Charente-Maritime) (Greven 1995b).

Total no. of hectads: 2 1970 onwards: 1

Grimmia elatior Bruch ex Bals.-Criv. & De Not.

Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

A notably large species, *Grimmia elatior* is distinguished by having a leaf with a margin that is strongly recurved on one side only, and with bistratose cells in the upper part. This species has been recorded from acidic montane rocks in Glen Clova, Angus (Duncan 1966). In 1868, when first collected by the Revd J Fergusson, it was reported to be growing in large masses up to 30 cm in length. Fergusson continued to collect it until 1871 but it has not been seen there since. This collecting may have been responsible for its extinction, but it is conceivable that further survey work might result in its rediscovery, since there are many localities in Glen Clova that are potentially suitable. *G. elatior* is an arctic–alpine species widely distributed in northern Europe and in mountainous areas further south. It also occurs in Asia, North America and Greenland.

Total no. of hectads: 1 1970 onwards: 0

Grimmia ovalis (Hedw.) Lindb.
(*G. commutata* Hübener)
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This moss forms low cushions, occasionally up to 4 cm tall with long, white hair-points at the leaf tips that give it a hoary appearance. The leaves have flat or incurved margins, opaque, bistratose upper cells and a very broad base, which has a pale marginal band. *Grimmia ovalis* usually grows on exposed rock outcrops, particularly basic igneous rocks such as basalt or dolerite. It also occasionally grows on roof tiles. Populations are usually small and sporophytes are produced only rarely.

At one time this species was relatively frequent, if scattered, but it has suffered a serious decline over most of its range, and has been recorded from only seven widely disjunct sites since 1970, in Co. Durham, Herefordshire, West Sussex, Powys (Radnorshire), Berwickshire and West Sutherland. Three of these are within both NNRs and SSSIs, but the others have no designated site protection. In the past, this species was often confused with *G. affinis*, leading to many erroneous records.

The reasons for the marked decline of *G. ovalis* are unclear, although it is possible that it may be sensitive to atmospheric pollution. Fires threaten some of the *G. ovalis* sites, particularly the burning of gorse (*Ulex* spp.). The colonies on roof tiles are particularly difficult to protect, being vulnerable to disturbance during routine maintenance work: they may best be regarded as transient. However, the owner of a house in Herefordshire where *G. ovalis* was discovered recently has been informed of its presence and asked to try to minimise damage to the plant. The owner of the Sussex site, a tiled roof of a farm building, was similarly notified. This moss is widespread through most of Europe and has also been recorded widely in Asia, Africa, Greenland, and North and South America.

Total no. of hectads: 44 1970 onwards: 7

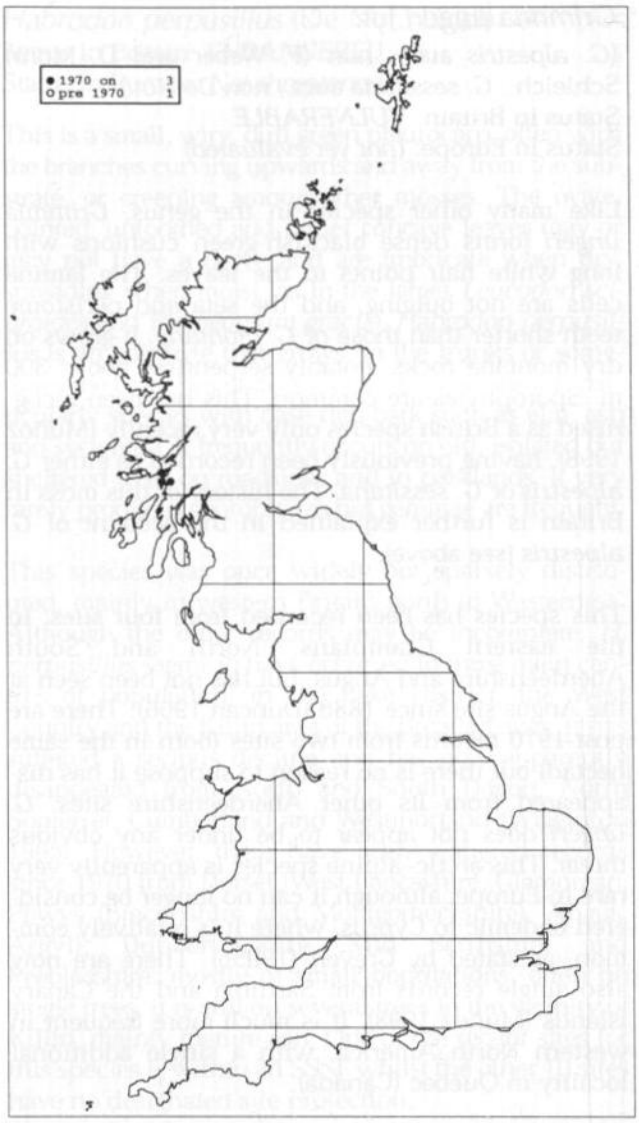
Grimmia tergestina
Tomm. ex Bruch, Schimp. & Gümbel
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Grimmia tergestina grows in low, dense, olive-green to blackish cushions that may cover extensive surfaces of sloping or vertical, relatively dry basic rocks in south-facing coastal areas. Occasionally these continuous cushions may break up, giving a fragmented appearance. The very long, white hair points are conspicuous and it superficially resembles *G. laevigata* or even *G. pulvinata*. Sporophytes were discovered on British material only recently (Porley 1997).

G. tergestina was not recognised as a British plant until very recently (Greven 1994), although it was first collected in 1965. Herbarium material of *G. laevigata* has now been reviewed, and it is clear that *G. tergestina* is a genuinely rare plant. Specimens are known from three stations in Argyll and one on the Isle of Mull (Blockeel 1996), all within a 15-km radius. It is locally abundant in at least one of the Argyll localities, and all of them have recent records. Only the Mull site is within an SSSI, but the only record is from 1968. There has been a suggestion that this plant is spreading across north-west Europe, but this is not supported by the presence in Scotland of both male and female plants and sporophytes, occurring on natural rock outcrops in a relatively remote area. It is better to regard it as representing a relict population. No particular threats have been identified.

This Eurasian southern–temperate species is known chiefly from south and east Europe, and extends very sparsely north-west through Belgium, France and The Netherlands (Greven 1991). It is also reported from central Asia and north Africa.

Total no. of hectads: 4 1970 onwards: 3



Grimmia ungeri Jur.

(*G. alpestris* auct., non (F. Weber and D. Mohr) Schleich., *G. sessitana* auct., non De Not.)
Status in Britain: *VULNERABLE*
Status in Europe: (*not yet evaluated*)

Like many other species in the genus, *Grimmia ungeri* forms dense blackish-green cushions with long white hair points to the leaves. The lamina cells are not bulging, and the seta and peristome teeth shorter than those of *G. montana*. It grows on dry montane rocks, notably serpentine, above 300 m. Sporophytes are common. This has been recognised as a British species only very recently (Muñoz 1998), having previously been recorded as either *G. alpestris* or *G. sessitana*. The history of this moss in Britain is further explained in the account of *G. alpestris* (see above).

This species has been recorded from four sites: in the eastern Grampians, North and South Aberdeenshire and Angus, but has not been seen at the Angus site since 1886 (Duncan 1966). There are post-1970 records from two sites (both in the same hectad) but there is no reason to suppose it has disappeared from its other Aberdeenshire sites. *G. ungeri* does not appear to be under any obvious threat. This arctic–alpine species is apparently very rare in Europe, although it can no longer be considered endemic to Cyprus, where it is relatively common, as stated by Greven (1995b). There are now also single records from Sardinia and the Canary Islands (Muñoz 1998). It is much more frequent in western North America, with a single additional locality in Québec (Canada).

Total no. of hectads: 3 1970 onwards: 1

Grimmia unicolor Hook.

Blunt-leaved grimmia
Status in Britain: *VULNERABLE*. WCA Schedule 8
Status in Europe: *Not threatened*

Grimmia unicolor forms dark green mats superficially resembling those of *Racomitrium ellipticum*, with which it often grows. Unlike most species of *Grimmia*, *G. unicolor* lacks white hair-points at the leaf tips, a feature it shares with *G. atrata*. It differs from *G. atrata* in habit and in having leaves with a hooded apex and a plane, not recurved, margin. In Britain, *G. unicolor* grows on large, gently sloping and periodically irrigated slabs of coarsely grained diorite at an altitude of approximately 450 m, with a smaller population nearby on more basic schist (Long and Rothero 1995–96). Elsewhere in Europe the species grows in crevices of wet acid rocks near lakes, streams or the splash zones of waterfalls. Sporophytes are common.

The main site for this species, in Glen Clova, Angus, has been known for over 160 years (Duncan 1966). It was last visited in 1996, when the population was described as 'very large'. Therefore it is likely to be capable of withstanding limited catastrophic events such as rockfalls or avalanches. There are also records of a population in nearby Glen Doll (in, however, the same hectad), and it seems likely that there are further populations remaining to be found in this very restricted area. The main site does not lie within an SSSI. The population was surveyed as part of the Scottish Cryptogamic Conservation Project 1993–1995. This is an arctic–alpine species occurring in Fennoscandia and some of the central European mountain ranges. It also occurs widely in Asia and in north-eastern North America.

Total no. of hectads: 1 1970 onwards: 1

Gyroweisia reflexa (Brid.) Schimp.

Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

This minute green acrocarp differs from the much more common *Gyroweisia tenuis* in having reflexed upper and perichaetial leaves and in possessing a rudimentary peristome. It produces both sporophytes and gemmae frequently. It is recorded in Britain only from a sandstone quarry at Nuneaton in Warwickshire, where it was seen between 1933 and 1938. The site has since been built on and the plant is now extinct. Although it has been speculated that *G. reflexa* was an introduced species, it is included in the British Red List until good evidence for this is presented. However, its reinstatement should probably not be regarded as a priority. Elsewhere, the species occurs on damp calcareous rocks in Macaronesia and the Mediterranean region and there is a doubtful record from Ontario (Canada).

Total no. of hectads: 1 1970 onwards: 0

Habrodon perpusillus (De Not.) Lindb.

Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This is a small, wiry, dull green pleurocarp, often with the branches curving upwards and away from the substrate, or creeping among other mosses. The ovate, pointed, untoothed and rather concave leaves may or may not have a nerve and are imbricate when dry, spreading when moist, as in the larger *Leucodon sciuroides* and *Pterogonium gracile*. *Habrodon perpusillus* is an epiphyte that grows on the trunks or sometimes the branches of deciduous trees and shrubs, particularly species with base-rich bark such as elm, ash and sycamore. It frequently occurs on old, isolated but sheltered trees on roadsides and in parklands. It very rarely produces sporophytes but gemmae are frequent.

This species was once widely but sparsely distributed, mainly in western Britain north to Westerness. Although the older records may be incomplete, *H. perpusillus* seems to have occurred in three main centres of population, in the Lake District, the West Country and the Killin area of the Breadalbanes. It has suffered a serious decline and has now apparently disappeared from North and South Devon, North Somerset, Cumberland and Westmorland (Wigginton 1995). However, there have been scattered records since 1970 from Dorset, West Lancashire, Glamorgan, Powys (Breconshire and Montgomeryshire), Angus, Argyll, Dunbartonshire, Mid Perthshire and Peeblesshire, mostly of small populations, often on single trees. It is still on several trees in the vicinity of Killin, mainly mature ash. One of the recent sites for this species is within an SSSI, whilst the other 10 sites have no designated site protection.

The reasons for the decline of this species are not fully understood but, like many epiphytes, it may be sensitive to air pollution. Although the beginning of the decline of *H. perpusillus* predated the recent outbreaks of Dutch elm disease, this has undoubtedly caused further losses. Populations on isolated trees may be at risk from agricultural herbicides and fertilisers sprayed on surrounding fields. The Dunbartonshire colony may have disappeared following the conversion of surrounding parkland to a golf course in 1989. The last Lancashire colony disappeared in 1990 following the death of the tree on which it was growing. *Habrodon* may have disappeared from its Glamorgan site because of the growth of scrub and excessive shading of the tree trunks. Protection of host trees and planting appropriate trees in the vicinity of existing colonies should be a priority for the conservation of this moss. It is widespread in the Mediterranean region and along the Atlantic fringe of Europe from south-west Norway to Macaronesia and also occurs in Africa and Asia.

Total no. of hectads: 44 1970 onwards: 12

Hamatocaulis vernicosus (Mitt.) Hedenäs
(*Drepanocladus vernicosus* (Mitt.) Warnst.)
Status in Britain: *NATIONALLY SCARCE.* WCA Schedule 8
Status in Europe: *Insufficiently known.* Bern Convention, Appendix 1; EC Habitats & Species Directive, Annex IIb.

This is a medium-sized to rather large pleurocarpous moss growing in wet ground and shallow water in mires. The shoots are typically erect and irregularly pinnately branched, green to pale brown in colour, with the tips characteristically hooked like a walking stick. In general habit and size *Hamatocaulis vernicosus* is similar to some other mire species. Most notable is *D. cossonii* (*D. revolvens* var. *intermedius*), from which it differs in the more distinctly plicate stem leaves, the complete absence of enlarged alar leaf cells, and (diagnostically) the absence of a stem hyalodermis and central strand (Hedenäs 1989).

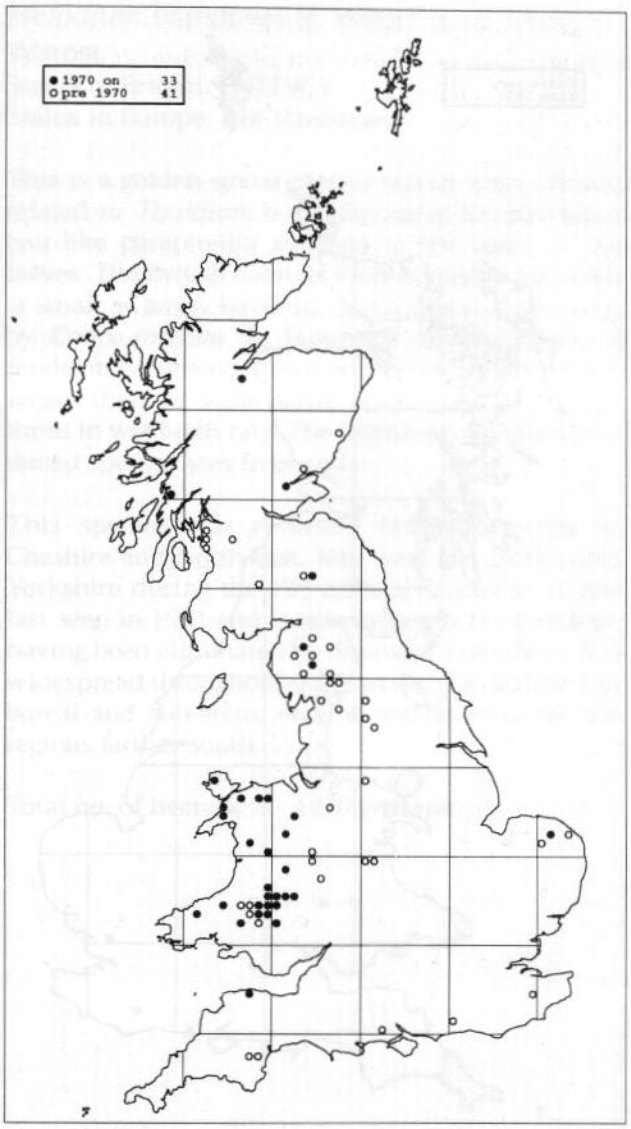
The ecology and distribution of *Hamatocaulis vernicosus* require further elucidation because a significant proportion of the records are misidentifications of *D. cossonii* and, to a lesser extent, of *Palustriella commutata* var. *falcata* (*Cratoneuron commutatum* var. *falcatum*). It is characteristic of mires which are mineral rich but not strongly calcareous. At one extreme, it has been collected from a *Ranunculus omiophyllus–Montia fontana* flush, indicating a relatively poor substrate. At the other, its habitat overlaps with that of the basiphile *D. cossonii*. Although the two species are not often found growing together, very occasionally they occur intermixed or in close proximity. *H. vernicosus* is also known as an associate of *Saxifraga hirculus*. However, its associates are often unremarkable (e.g. *Calliergonella cuspidata*, *Philonotis fontana*) and consequently it may be under-recorded.

H. vernicosus has been recorded throughout Britain but it is relatively frequent only in parts of north Wales and perhaps north-west England. In much of England and Scotland it is apparently a rare species. Most records from coastal areas, particularly dune slacks, and some of those from inland areas, are erroneous. Its scarcity in Scotland is particularly difficult to explain.

Like many mire species, *H. vernicosus* has undoubtedly declined during the past century. However the extent of the decline is uncertain because of confusion with other species. There is no evidence for a significant decline in north Wales, but the species has not been found recently in some of the southern and eastern counties in which it formerly occurred. It may have disappeared from East Anglia through eutrophication of spring water and cessation of grazing: it has not been found at Buxton Heath, its main Norfolk site, in recent survey work, and suitable fens have disappeared completely at other former Norfolk localities. The number of post-1970 records, being based largely on herbarium research, is almost certainly an under-estimation. However, recent (1999) survey work at selected sites in Wales and Cumbria suggests that *H. vernicosus* may have disappeared from a proportion of its sites, some of which were clearly no longer suitable, having been destroyed or damaged by changes in the grazing (either cessation or intensification), drainage or afforestation. Draining and disturbance of mires remains the most obvious threat to the species. High levels of atmospheric pollution in the past may have contributed to its apparent disappearance from the southern Pennines in England. In Britain, *H. vernicosus* is the subject of a Biodiversity Action Plan.

The count of hectads given below is based on records confirmed recently from voucher material. Additional records may be expected.

Total number of hectads: 74 1970 onwards: 33

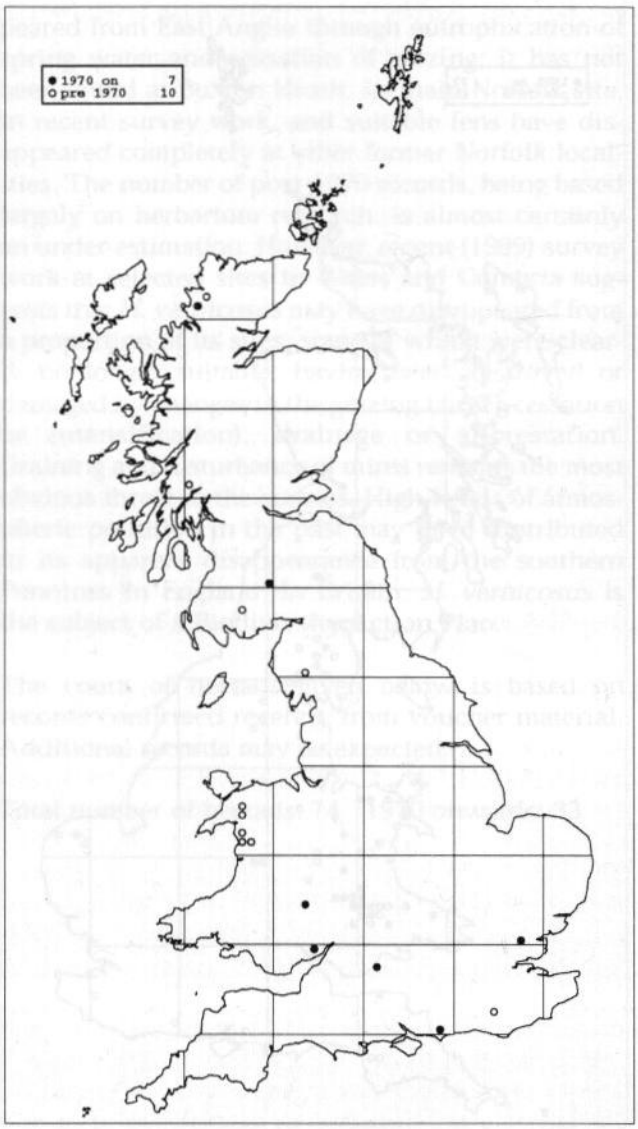

● 1970 on 33
○ pre 1970 41

Hedwigia ciliata (Hedw.) P. Beauv.
Status in Britain: *DATA DEFICIENT*
Status in Europe: (*not yet evaluated*)

Following the recent revision of *Hedwigia* in Sweden (Hedenäs 1994) and subsequently in Britain and Ireland (Crundwell 1995), it is now clear that there are two species in this complex in Britain, the common one being *H. stellata* Hedenäs, with *H. ciliata* being very much rarer. They are rather glaucous-green pleurocarpous plants, with the leaves tipped with hair points of varying lengths. *H. ciliata* is distinguished from *H. stellata* principally by many of the mid-leaf cells having more than one papilla, whereas most of the cells in *H. stellata* are unipapillose.

H. ciliata has a widespread distribution in Britain, apparently centred on North Wales, with a number of records from Gwynedd (Merioneth and Caernarvonshire) and further records scattered widely throughout the country. Although seen since 1970 only in Herefordshire, West Sussex, North Wiltshire, North Essex, Monmouthshire, Dumfriesshire and West Sutherland, it cannot yet be asserted that it has declined as, until very recently, all material in Britain was recorded as *H. ciliata* rather than *H. stellata*. There are two varieties of *H. ciliata*: var. *ciliata*, with short hair-points, and var. *leucophaea* B., S. & G., with long hair-points, giving the plant a very hoary appearance. The latter has been recorded only twice in Britain, on both occasions with var. *ciliata*, at sites in Kircudbrightshire and West Sutherland, in the 19th century. The international distribution has yet to be elucidated but, in Sweden, *H. ciliata* is the more common and widespread plant, *H. stellata* having a markedly southern distribution.

Total number of hectads: 17 1970 onwards: 7



Helodium blandowii (F. Weber & D. Mohr) Warnst.
Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

This is a golden–green pleurocarpous moss closely related to *Thuidium* but differing in the abundant hair-like paraphyllia attached to the bases of the leaves. The British habitats for this species included 'a small swampy hayfield' and a marsh dominated by *Carex rostrata*. In Europe it usually grows in moderately base-poor fens and flushes, particularly where there is some scrub cover, and also sometimes in wet birch carr. The British populations produced sporophytes frequently.

This species was recorded from four sites in Cheshire and North-east, Mid-west and North-west Yorkshire during the 19th century. However, it was last seen in 1901 and is now believed to be extinct, having been eliminated by drainage. Elsewhere, it is widespread throughout the Northern Hemisphere in boreal and sub-arctic regions and in mountainous regions farther south.

Total no. of hectads: 4 1970 onwards: 0

Heterocladium dimorphum (Brid.) Bruch, Schimp. & Gümbel
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Heterocladium dimorphum is a straggling pleurocarpous moss forming lax patches that superficially resemble some other species occuring in the same habitat. The small leaves are strongly reflexed, particularly when wet, and at least some of the lower leaves are abruptly contracted to a long, sometimes filiform apex. At its best known site on Ben Lawers, *H. dimorphum* is primarily a plant of block scree composed of calcareous schist where it occurs in dry crevices, usually on the upper surfaces of rocks and mixed with other bryophytes. Sporophytes are unknown in Britain.

This species has been recorded from seven mountains in the southern and eastern Scottish Highlands, in Angus, Dunbartonshire and Mid and East Perthshire. Only four of these records have been located in the last 40 years, but it is likely that it still occurs in at least some of its other sites. On Meall nan Tarmachan and Ben Lawers it is widely scattered in about 10 different sites; some sites have numerous stands but these tend to be small, although in one case *H. dimorphum* covered the whole upper surface of a large rock. It is present in very small quantity on Glas Tulaichean in East Perthshire. There are no specific threats to this species, but the status of the plant at the sites where it has not been seen for many years should be clarified. It is an arctic–alpine with a wide distribution in northern Europe and in many of the mountain ranges farther south. It has a similar distribution in Asia, North America and Greenland.

Total number of hectads: 8 1970 onwards: 3

Homomallium incurvatum (Brid.) Loeske

Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Not threatened*

This is a slender, glossy green, irregularly branched pleurocarpous moss which grows appressed to calcareous rock surfaces. In its slightly curved and upturned leaves it is very similar to *Hypnum resupinatum* (*H. cupressiforme* var. *resupinatum*), but is autoecious, has rather narrow, strongly curved capsules and regularly arranged alar cells with rather thin walls. It usually grows on dry calcareous rocks and walls in sheltered valley woodlands; exceptionally it has been recorded on soil. In continental Europe it is also recorded as an epiphyte on trees with base-rich bark.

Most of the British records of this species are from the Carboniferous Limestone in the north of England, from Derbyshire northwards, but concentrated in the Yorkshire Dales and the Lake District. There are also a few occurrences in central Scotland. Records from the southern part of Scotland have proved to be erroneous.

H. incurvatum appears to have declined substantially since the early part of this century; it has been found at only four sites within the last 40 years, and at only one since 1970, within an SSSI by the River Tees, in Co. Durham. There is a record from the Ingleton district of Yorkshire in 1969. It is possible that the species is still present at some of its old stations, as these districts have not been intensively bryologised in recent years. *Homomallium* is also readily overlooked because of its similarity to species of the *Hypnum cupressiforme* complex, which many bryologists tend to disregard. There are no obvious threats to the species, although it has probably been over-collected in the past at one or two of its classic sites, most notably at Ingleton in Mid-west Yorkshire. *H. incurvatum* is a widely distributed Eurasian species occurring from western Europe to Japan. It is rather common in some continental montane areas.

Total number of hectads: 22 1970 onwards: 1

Hygrohypnum molle (Hedw.) Loeske

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Like *Hygrohypnum duriusculum* (*H. dilatatum*), this pleurocarp has very broad leaves with a double nerve, but the texture of *H. molle* is much softer, the leaves are toothed and its habitat distinctive. It grows in soft, greenish tufts on submerged rocks in slow or fast flowing streams at altitudes above 900 m, usually where they are fed by meltwater from late-lying snow patches. Sporophytes have not been found in Britain.

In Britain this arctic–alpine species is restricted to four localities in the Cairngorms and one in the Ben Nevis range (Westerness), with an old (1905) record from Lochnagar. All populations appear to be rather small and localised with perhaps the biggest population on Braeriach, where the plant is frequent over at least 50 m of one burn. There are no obvious threats at present, apart from the general threat to snowbeds from climate change, but the restricted nature of its populations make it potentially vulnerable to damage. All the sites are within SSSIs. *H. molle* occurs in northern and montane areas of Europe and also in Asia and North America.

Total no. of hectads: 5 1970 onwards: 3

Hygrohypnum polare (Lindb.) Loeske

Status in Britain: *ENDANGERED*. WCA Schedule 8
Status in Europe: *Not threatened*

This greenish or brownish pleurocarp is distinguished from other members of the genus by its ovate–lanceolate leaf with a single long nerve extending almost or quite to the leaf apex. In Britain it grows submerged on rocks at the edge of a lochan above 650 m in altitude at a single site in West Ross (Wallace 1972), within an SSSI. The population here is relatively large with some 60 patches, some up to 40 x 60 cm, spread around the lochan. Sporophytes are unknown. Providing the integrity of the lochan is maintained, collecting by botanists is probably the main threat to this species, although this activity is likely to be minimal. This is an arctic–alpine species that is widespread in Europe and has also been reported from northern Asia, North America and Greenland.

Total no. of hectads: 1 1970 onwards: 1

Hygrohypnum styriacum (Limpr.) Broth.

Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Rare*

This small pleurocarpous moss has broadly ovate spreading, dentate leaves nerved to halfway, with a narrow channelled tip. *Hygrohypnum luridum* has narrower leaves with a longer nerve. In the absence of sporophytes *H. styriacum* is much more likely to be confused with small forms of *Ctenidium molluscum* or with *Heterocladium heteropterum* but microscopic examination will reveal that this resemblance is superficial. *H. styriacum* grows at an altitude of nearly 1,100 m on a steep north-facing crag, in rock crevices which are kept moist by seepage from melting snow (Corley and Rothero 1992). Although the rock is granite, evidence from other species occurring nearby suggests that the drainage line in which it grows is fairly base-rich. It was found with sporophytes.

This species is restricted to a single site in the Cairngorms, where it was discovered in 1989, in very small quantity, within an SSSI (Corley and Rothero 1992). The greatest threat is from erosion on the crags and from competition with other bryophytes. Other threats are minimal, as the site is well away from normal direct human influence but, because the population is very small, it could easily disappear. *H. styriacum* is an arctic–alpine species known from a few sites in Fennoscandia and Iceland and rather more in the Alps, Tatra and Carpathian mountains. In also occurs in North America.

Total no. of hectads: 1 1970 onwards: 1

Hypnum revolutum (Mitt.) Lindb.
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This yellowish or brownish pleurocarp differs from other species of *Hypnum* in its relatively strongly recurved leaf margins. It grows in dense patches on calcareous rocks in montane areas. Sporophytes are unknown in Britain. In Britain, *H. revolutum* has been recorded only from Ben Lawers and Meall nan Tarmachan in Mid Perthshire. Two large patches were found at a single locality on Ben Lawers during a survey in 1996, but the only record from Tarmachan was in 1966. No specific threats have been identified, but its extreme rarity means that it is potentially vulnerable to small changes in the environment. The sites have both SSSI and NNR status. This species is widely distributed in the arctic and montane regions of both hemispheres, although it is rare in the Southern Hemisphere.

Total no. of hectads: 2 1970 onwards: 1

Hypnum vaucheri Lesq.
Vaucher's feather-moss
Status in Britain: *VULNERABLE*. WCA Schedule 8
Status in Europe: *Not threatened*

This glossy yellow to brownish-green pleurocarp can be distinguished from other species of *Hypnum* by the julaceous shoots with imbricate leaves and the relatively small size of the alar cells. In Britain it grows on sloping, irrigated, calcareous schist or metamorphosed limestone at moderate to high altitude along with other calcicolous bryophytes, including *Distichium capillaceum*, *Neckera crispa*, *Pseudoleskeella catenulata*, *Tortella tortuosa* and *Tortula subulata*. Elsewhere in Europe it can also occasionally grow on thin soils. Sporophytes have not been seen in Britain.

H. vaucheri is restricted to the Ben Lawers and Meall nan Tarmachan ranges in Mid Perthshire (Perry and Fitzgerald 1963) and to a site above Loch Loch in East Perthshire. It is locally frequent at Loch Loch, occurring as sizeable patches along a 250-m length of crag (Long and Rothero 1995–96). It grows as smaller, more scattered patches in its Ben Lawers and Tarmachan populations. The sites are within SSSIs, and two are also within an NNR. There are no clear threats, although sites could conceivably suffer damage from a catastrophic event such as a major rockfall. The British populations were surveyed recently as part of the Scottish Cryptogamic Conservation Project 1993–1995. Further populations were located on Ben Lawers and Tarmachan in 1996. This species is widely distributed and fairly frequent in arctic, boreal and montane regions of the Northern Hemisphere.

Total no. of hectads: 3 1970 onwards: 3

Leptodontium gemmascens (Mitt. ex Hunt) Braithw.
Status in Britain: *VULNERABLE*
Status in Europe: *Rare.*

This is a small yellow-green acrocarp with coarsely toothed leaves, the upper ones producing very distinctive ball-like clusters of gemmae at the apices. The natural habitat for this species is decaying vegetation, such as the bases of grass and rush tussocks in areas of acid grassland and heathland (Driver 1982), but it is perhaps most characteristic of thatched roofs in a suitable state of decay. Observations suggest that at some sites it may eventually be out-competed by *Ceratodon purpureus* and *Syntrichia ruralis* (*Tortula ruralis*). Sporophytes are unknown in Britain but gemmae are always present.

At one time this species was widely distributed across southern England but it has decreased with the decline in decayed thatch. Four of the eight post-1970 sites for this species have been on thatch, in Dorset, North Somerset, West Sussex and North Wiltshire: one of these is within an LNR and another (on the roof of Thomas Hardy's cottage in Dorset) is owned by the National Trust. It has been found on decaying vegetation in semi-natural habitats at sites in Hertfordshire (frequent within about 2,500 m^2), Middlesex (at least 30 colonies within about 200 m^2) and East and West Suffolk (two sites, at one of which it occurs over a wide area). Three of the sites are within SSSIs and two are also Wildlife Trust reserves. The Hampshire site was destroyed in the late 1970s when the thatched roof was replaced by slate. Populations on thatch are precarious because of the constant threat of roof repairs, or replacement of the thatch with slates or tiles. Covering thatch with galvanised iron chicken wire seems to make it unsuitable for this species. At its semi-natural sites, the main threat to *Leptodontium gemmascens* is probably from burning, since this removes the decaying vegetation on which it grows. Scrub encroachment may also be a threat. *L. gemmascens* is the subject of a Biodiversity Action Plan. This species has a western distribution in Europe, extending from Denmark to the Pyrenees. There is also a record from Marion Island in the Indian Ocean, but it is likely that this is an error for the closely related *L. proliferum* Herz. which occurs elsewhere in the Southern Hemisphere.

Total no. of hectads: 34 1970 onwards: 9

Lescuraea saxicola (Bruch, Schimp. & Gümbel) Milde
Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

Lescuraea saxicola is a small pleurocarp with imbricate leaves. It can be distinguished from related species by its small size and slightly plicate leaves. This species was recorded from two sites in the Breadalbane Mountains in Mid Perthshire, where it occurred on calcareous mica schist rocks at altitudes above 700 m, but has not been seen at either site since 1911 and seems to be extinct. It may have been collected to extinction by botanists, but suitable habitat still occurs in abundance and it might perhaps be rediscovered. This plant is widely distributed in arctic and montane regions of Europe, Asia and North America.

Total no. of hectads: 2 1970 onwards: 0

Micromitrium tenerum (Bruch & Schimp.) Crosby

Millimetre moss
Status in Britain: *CRITICALLY ENDANGERED.* WCA Schedule 8
Status in Europe: *Vulnerable*

This is a minute ephemeral acrocarp with immersed capsules, resembling some species of *Ephemerum* both in morphology and ecology. It can be distinguished by its untoothed, nerveless leaves and the completely spherical capsule, without an apiculus. *Micromitrium tenerum* grows on non-calcareous mud at the edges of lowland ponds and lakes, sometimes with other rare specialist species such as *Riccia huebeneriana* and *Ephemerum cohaerens*. It produces sporophytes in the autumn and occurs in greatest abundance following a dry summer, when pond margins are well exposed. Since 1850 this species has been recorded from a total of nine British sites in West Kent, Surrey (Wallace 1947) and West and East Sussex (Wallace 1950), with an outlying site on Anglesey. Since 1950 it has been seen at only three localities, in West Sussex and Anglesey. The only post-1970 site (the Anglesey one, where it was recorded in 1971 but has not been seen since) is within an SSSI.

Always a rare species, this moss has declined to apparent extinction in its south-eastern stronghold because of the practice of keeping lake levels permanently high for fishing, thus removing its habitat. A large-spored 'shuttle species' (During 1992), it is unlikely to be very mobile, relying instead on the irregular exposure of mud at the water's edge at a limited number of sites. Survey of the Anglesey site is required urgently and remedial management measures should be considered for at least some of the south-eastern sites. This species is known only from a few countries in western and central Europe and it is rare everywhere. It has also been reported from central and eastern Asia and western North America.

Total no. of hectads: 10 1970 onwards: 1

Mielichhoferia elongata (Hoppe & Hornsch. ex Hook.) Hornsch.

Status in Britain: *VULNERABLE*
Status in Europe: *Insufficiently known*

This is a small, glossy, pale green acrocarp with crowded, fragile shoots up to *c.*1 cm long, which form compact, swelling tufts and cushions. The leaves are oval and imbricate. Species of *Pohlia* are similar, but none has the distinctive habit and colour of *Mielichhoferia elongata*. There is some disagreement between taxonomists over whether *M. elongata* should be regarded as a species distinct from *M. mielichhoferiana*, but the two taxa appear as different entities in the census catalogue (Blockeel and Long 1998). *M. elongata* is confined to shaded acidic rocks that are rich in heavy-metal sulphides. It is therefore very rare, occurring at only two sites in Britain (one of which straddles two hectads), in North-east Yorkshire (Pigott 1958) and South Aberdeenshire (Coker 1968, 1971), the latter site being an SSSI. Sporophytes appear to be rare but were recorded at the Aberdeenshire site in 1994. The Aberdeenshire population is large and *M. elongata* is spread over at least seven different sub-populations with some pure stands covering areas of at least 40 x 30 cm (Long and Rothero 1995–96). There is evidence that the species may have declined slightly at the Yorkshire site, but it is still reasonably abundant there, growing in about eight discrete localities (J M Blackburn, pers. comm.). Amateur and student geologists regularly visit this site, but erosion does not seem to be a significant threat. It is possible that the minerals at both sites may at some point attract some mining interest. The Aberdeenshire population was surveyed recently as part of the Scottish Cryptogamic Conservation Project 1993–1995. *M. elongata* is widespread but rare in Europe and also occurs in North America.

Total no. of hectads: 3 1970 onwards: 3

Mielichhoferia mielichhoferiana (Funck.) Loeske
(*M. mielichhoferi* (Hook.) Wijk & Margad.)
Alpine copper-moss
Status in Britain: *VULNERABLE*. WCA Schedule 8
Status in Europe: *Not threatened*

Closely related to *Mielichhoferia elongata*, *M. mielichhoferiana* differs in its longer leaves with narrower leaf cells. It is much less distinct in appearance from species of *Pohlia* and the shoots form only small tufts. Its ecology is apparently very similar to that of *M. elongata*, growing on shaded acidic rocks that are rich in heavy-metal sulphides, but it may be less tolerant of copper (Coker 1971). Sporophytes have not been reliably recorded in Britain. *M. mielichhoferiana* has been found at two sites in Britain, in South Aberdeenshire and Argyll. It shares the South Aberdeenshire site with *M. elongata*, but it grows much less abundantly, as isolated shoots or tufts (Coker 1968; Long and Rothero 1995–96). This is within an SSSI. The other site is on Beinn Dorain, Argyll, but here *M. mielichhoferiana* is poorly localised, and it is not clear whether the plant is within the SSSI or not. It was last recorded there in 1971. Threats are the same as for *M. elongata* although, as a less conspicuous species, botanical collecting may be less significant. The Aberdeenshire population was surveyed recently as part of the Scottish Cryptogamic Conservation Project 1993–1995. It is widespread but rare in Europe and also occurs in Siberia and North America.

Total no. of hectads: 2 1970 onwards: 2

Myurella tenerrima (Brid.) Lindb.
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

Myurella tenerrima is similar to *M. julacea*, but it can be distinguished by its less closely imbricate leaves with a reflexed apiculus, its pale or yellowish-green colour and a tendency to form larger patches. Like *M. julacea*, it is a plant of calcareous rocks and soil in montane areas, growing only at altitudes above 600 m on east- or south-facing mica-schist cliffs. Sporophytes are very rare.

This species has been recorded recently only on the Ben Lawers and Meall nan Tarmachan massifs in Mid Perthshire, where five populations were found during a survey in 1996, some of them reasonably extensive, with *M. tenerrima* locally abundant and forming large cushions. There are no obvious threats to these populations, all of which are within an SSSI and an NNR. It has also been recorded at two sites in Angus, but has been seen at neither for more than 30 years. This is an arctic–alpine species that is widely distributed in the northern and montane parts of Europe, north Africa, Asia and North America.

Total no. of hectads: 5 1970 onwards: 2

Neckera pennata Hedw.

Status in Britain: *EXTINCT*
Status in Europe: *Vulnerable*

A robust and beautiful pleurocarpous moss with complanate leaves, *Neckera pennata* can form large brackets on tree trunks. Like *N. crispa* and *N. pumila*, the leaves are transversely undulate, but *N. pennata* differs in the more gradually tapering leaves and the immersed capsule. The only British record is from Fothringham in Angus, where it grew on the trunk of a beech tree. It was seen only once, in 1823, and is now almost certainly extinct. The reason for its extinction is unclear. Although it is possible — indeed likely — that the whole plant was collected, it may have been nothing more than a casual colonist, in which case it might not have persisted anyway. The species is widespread but declining severely elsewhere in Europe, and also occurs in temperate and tropical regions throughout the world.

Total no. of hectads: 1 1970 onwards: 0

Orthodontium gracile Schwägr. ex Bruch, Schimp. & Gümbel

Status in Britain: *VULNERABLE*
Status in Europe: *Endangered*

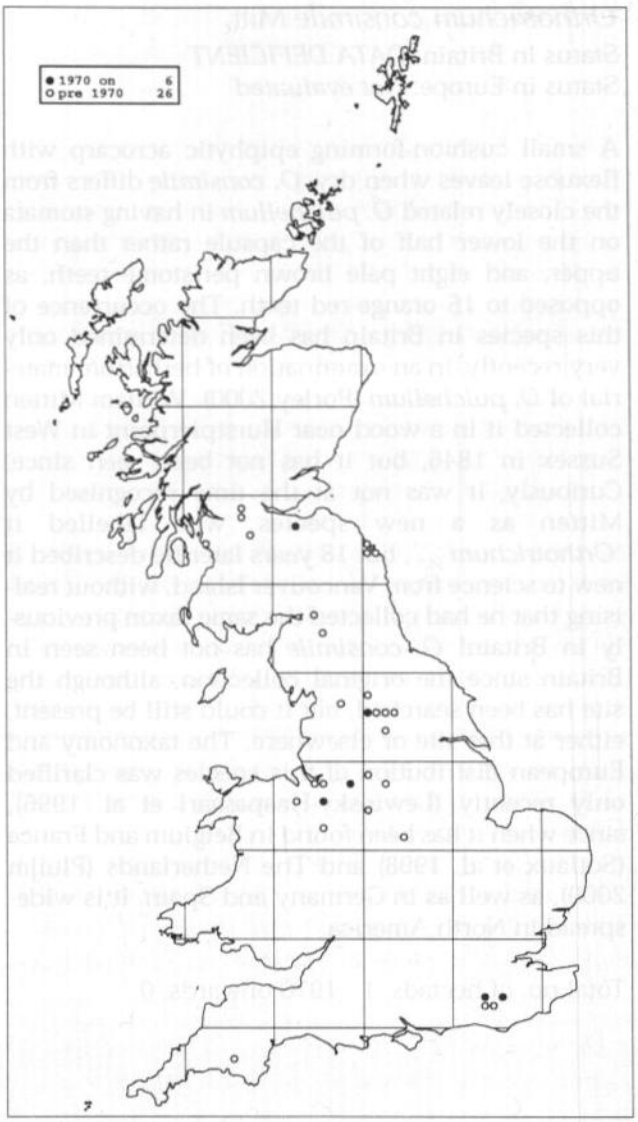
This acrocarpous moss grows as yellowish-green cushions less than 1 cm tall, very similar to the much commoner *Orthodontium lineare*. Both species superficially resemble *Dicranella* and related plants in having very narrow, lanceolate leaves, but they differ in their long, thin leaf cells and quite different sporophytes. *O. gracile* is distinguished from *O. lineare* by being paroecious, having smooth (not finely papillose) peristome teeth and completely lacking a dorsal stereid band in the leaves. Also, the capsule tends to be smooth rather than striate, pale and relatively long necked. Sporophytes are frequent in both species. *O. gracile* occurs most frequently on lowland shaded, acid rocks, particularly sandstones and gritstones, either on ledges or rock faces, but can also, rarely, grow on peaty or sandy soils at the bases of trees and on rotting wood.

Once widely distributed in Britain from South Devon and East Sussex north to Stirlingshire, *O. gracile* was most frequent in the northern Midlands and the south Pennines. It has apparently declined substantially over the last 150 years. There are post-1970 records from Alderley Edge in Cheshire; Roslin Glen in Midlothian, where it may still occur; and from a small number of sites on the Weald sandrocks of East Sussex (Paton 1954). It has been relocated at only three of the Weald sites during recent (1998–1999) survey work. *O. gracile* was recently (1999–2000) also refound at one of its old sites in Wharfedale (Mid-west Yorkshire), where it is very local on sandstone rocks and a dead oak trunk, and at two further sites in Cheshire, on the Peckforton Hills, on sandstone rocks and walls. Most of these sites are within SSSIs (the Peckforton Hills sites are not), although one is designated on geological grounds. Recent work has failed to detect *O. gracile* at its sites in Northumberland, Staffordshire and Shropshire, or at other historical sites in Cheshire.

The decline of this species in Britain may be related to the invasion of its habitat by *O. lineare*. This introduced species, first discovered in Britain in 1922, is now frequent throughout the British range of *O. gracile*. However, at its most recently surveyed sites, the two species are growing together apparently without either having the upper hand. The true status of *O. gracile* is blurred by the difficulty of differentiating the two species in the field. An EN project is currently underway to attempt to determine the status of this plant in England. *O. gracile* is also the subject of a Biodiversity Action Plan. Current work includes relocating populations and

marking them with transponders to facilitate long-term monitoring. *O. gracile* will be one of the first species to be used in determining protocols for the *ex-situ* conservation of the UK's most threatened bryophytes. This UK initiative will be carried out at RBG Kew and is funded by EN, CCW and SNH. RBG Kew is also using molecular techniques to gain an understanding of genetic variation within and between populations of *O. gracile*. Results from this research will be used in devising sampling strategies for *ex-situ* conservation, and will be instrumental in guiding any potential reintroductions. The Friends of Kew fund this work as the only bryophyte in their Threatened Plant Appeal. In Europe this species is confined to Britain, Ireland and north-western France, but elsewhere it is widespread in warm temperate and tropical areas. Recent survey work on the sandstone exposures of Luxembourg's Petite Suisse region failed to locate any *O. gracile* but, interestingly, *O. lineare* was also a rare plant there.

Total no. of hectads: 32 1970 onwards: 6



Orthotrichum consimile Mitt.

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not evaluated*

A small cushion-forming epiphytic acrocarp with flexuose leaves when dry, *O. consimile* differs from the closely related *O. pulchellum* in having stomata on the lower half of the capsule rather than the upper, and eight pale brown peristome teeth, as opposed to 16 orange-red teeth. The occurrence of this species in Britain has been determined only very recently, in an examination of herbarium material of *O. pulchellum* (Porley 2000). William Mitten collected it in a wood near Hurstpierpoint in West Sussex in 1846, but it has not been seen since. Curiously, it was not at the time recognised by Mitten as a new species, who labelled it '*Orthotrichum* ...', but 18 years later he described it new to science from Vancouver Island, without realising that he had collected the same taxon previously in Britain! *O. consimile* has not been seen in Britain since the original collection, although the site has been searched, but it could still be present, either at that site or elsewhere. The taxonomy and European distribution of this species was clarified only recently (Lewinsky-Haapasaari et al. 1996), since when it has been found in Belgium and France (Sotiaux et al. 1998) and The Netherlands (Pluijm 2000), as well as in Germany and Spain. It is widespread in North America.

Total no. of hectads: 1 1970 onwards: 0

Orthotrichum gymnostomum Bruch ex Brid.

Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

This is a small yellow–green acrocarp with blunt, ovate leaves, unlike the narrower leaves of most other British *Orthotrichum* species. The leaf margins are strongly incurved, distinguishing it from the other broadleaved species of the genus, *O. obtusifolium*, which has almost plane leaf margins. At its only British site, *O. gymnostomum* grew on the trunk of an aspen in an area of open pine–birch woodland, on a north-facing slope at an altitude of about 250 m. This occurrence may have been no more than casual, resulting from a wind-blown spore from continental Europe. Elsewhere in Europe it is most frequent on aspen, but it also grows on other deciduous trees. No sporophytes were found on the British plant, but gemmae were present on the surface of the leaf.

This species is known from a single site in Easterness (within an NNR), where one tuft of about 15 stems was found in 1966 (Perry and Dransfield 1967). It has been looked for since but never refound, and it is possible that the entire population was collected. Similar habitats are not uncommon in the area. This moss has a scattered distribution throughout northern and central Europe and is also reported from south-western Asia, Afghanistan and Newfoundland.

Total no. of hectads: 1 1970 onwards: 0

Orthotrichum obtusifolium Brid.

Blunt-leaved bristle-moss
Status in Britain: *ENDANGERED*. WCA Schedule 8
Status in Europe: *Not threatened*

Related to *Orthotrichum gymnostomum*, *O. obtusifolium* is also a small yellow–green acrocarp with broad, blunt leaves but it has a flat or only slightly recurved leaf margin. It is an epiphyte, usually found on ash, elm and elder, but also on oak and willow, and rarely on rotting wood. Elsewhere in Europe it is frequent on poplar *Populus*. It favours trees in open positions, such as on waysides and in parklands. Sporophytes are unknown in Britain but gemmae are almost always present (Goode et al. 1993).

This species was once widespread in southern central England and also known as a rarity in northern England, but had disappeared completely from these areas by the 1920s (Adams and Preston 1992; Jones 1991). A single tuft of *O. obtusifolium* was discovered growing on an elder twig in West Norfolk in 1989 but, although the elders at this locality and at nearby sites have been searched repeatedly, no further plants have been found. Other relatively recent records are from north-east Scotland, where the species was recorded from three sites in Angus in the 1960s and from single sites in Moray (1977) and North Aberdeenshire (1990) (Long and Rothero 1995–96). It grew on elm at four out of five of these Scottish sites. None of the post-1970 sites for this species has any designated site protection.

The decline of *O. obtusifolium* in England is almost certainly attributable to air pollution, to which many *Orthotrichum* species are susceptible. Levels of SO_2 have now decreased in most areas, but too late for a recovery of this species in England, at least in the short term. Pollution is less likely to constitute a threat to the Scottish populations, but the threat from Dutch elm disease is more serious. The species is the subject of a Biodiversity Action Plan. This moss is widespread in the boreal regions of Europe, Asia and North America.

Total no. of hectads: 27 1970 onwards: 3

Orthotrichum pallens Bruch ex Brid.

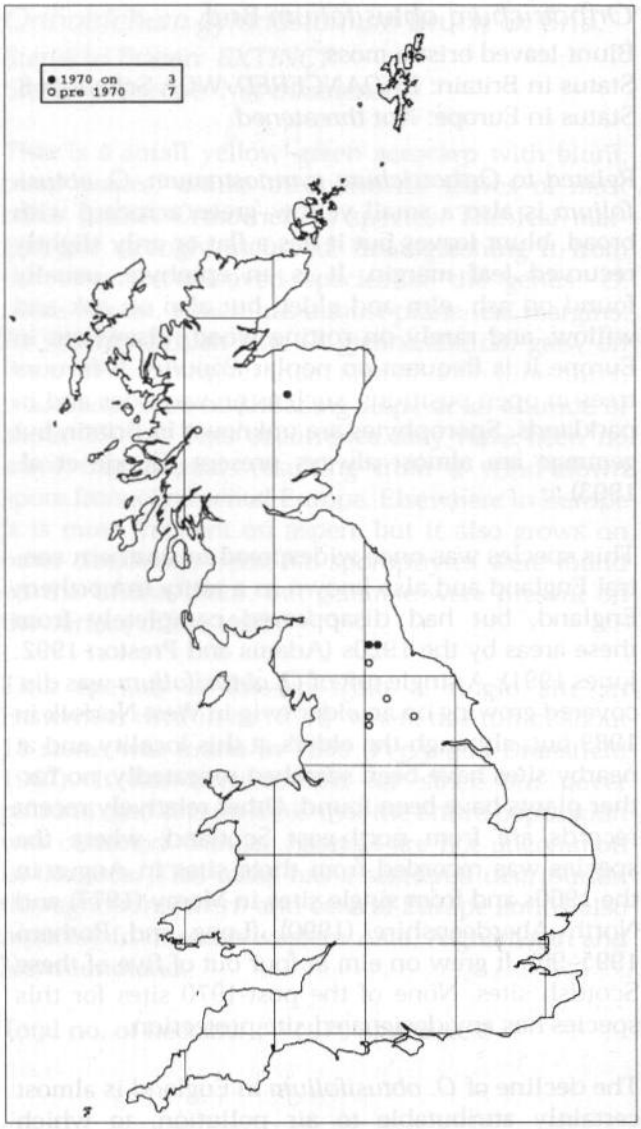
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This is a small, loosely tufted acrocarpous moss which is similar in general appearance to many other members of this rather critical genus. It has lanceolate, dull green leaves and emergent capsules. Its pale, naked calyptra is distinctive in the field, but separation from related species is principally by microscopic details of the sporophyte. Capsules are common, produced in the summer. This species is an epiphyte of well-lit trees with base-rich bark such as ash, elm, sycamore, willow and elder. Elsewhere in Europe it has occasionally been reported from dry acidic and basic rocks.

Always a rare plant, *Orthotrichum pallens* has been recorded at scattered sites in northern England and a very few stations in Scotland. The main concentration of records is from Mid-west and North-west Yorkshire. However, the past and present distribution of the species remains imperfectly known because of confusion with other species of the genus, including *O. affine*, *O. tenellum*, *O. stramineum* and *O. pulchellum*. A report from Derbyshire in 1989 is erroneous, as also are several of the records made in Scotland since 1945. There is a substantiated record from Moray in 1983 and one from Westerness in 1961. Very recently (1999), *O. pallens* has been found at three new sites in Weardale, Co. Durham, where it grows as small tufts on ash, elm, willow and elder, associated with other species of *Orthotrichum*, *Pylaisia polyantha* and *Syntrichia laevipila*.

The decline of *O. pallens*, at least in England, must be attributed primarily to SO_2 pollution, and its recent occurrence in Co. Durham may therefore be related to the decline in this pollutant. Many pollution-sensitive species of lichen have also increased occurrences recently for this reason (Gilbert 2000). The loss of elm trees to Dutch elm disease may also have contributed to the decline of this moss. Other potential threats are the felling of host trees and pollution from herbicide and fertiliser spray drift. *O. pallens* is the subject of a Biodiversity Action Plan. It is widely distributed throughout most of Europe and also occurs in Asia and North and Central America.

Total number of hectads: 10 1970 onwards: 3



Orthotrichum pumilum Sw.

(*Orthotrichum schimperi* Hammar)
Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Not threatened*

A small, pale green acrocarp forming tufts up to 5 mm tall, *Orthotrichum pumilum* is distinguished from other members of the genus by its compact habit, smooth calyptra, and the base of the capsule tapering abruptly into the short seta. This species grows as an epiphyte on deciduous trees with base-rich bark such as ash and elm, particularly in open situations. Sporophytes are common.

O. pumilum has been over-recorded in the past, but specimens have been correctly identified from seven sites in West Suffolk, East Norfolk, Northamptonshire, Angus and Kincardineshire. The record from Angus in 1966 was from an elm, and it is not known whether the tree has succumbed to Dutch elm disease. The most recent records were both from Kincardineshire, at Fettercairn in 1995, where it was growing on walnut trees with the lichen *Parmelia subargentifera*, and at Edzell in 1996. These sites have no statutory site protection. Threats to *O. pumilum* include felling, air pollution and agricultural spray drift. Where colonies still exist, planting appropriate new trees in the vicinity should be encouraged in order to provide suitable habitats in the future. *Ex- situ* cultivation and trans-plantation experiments should be considered if this can be achieved without endangering existing colonies. *O. pumilum* is widespread in Europe, north Africa, Macaronesia, Asia and North America.

Total number hectads: 7 1970 onwards: 2

Paludella squarrosa (Hedw.) Brid.

Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

This large and beautiful species is easily recognised by its yellowish-green squarrose leaves and densely tomentose stems. It is a plant of rich fens, usually associated with small sedges and 'brown moss' communities. *Paludella squarrosa* persisted in Britain as a glacial relict, but had become restricted to three sites in Cheshire and North-east and South-east Yorkshire by the 19th century. It was last seen in 1916 and is now almost certainly extinct. It disappeared from at least two of the sites because of drainage. Only one of the British herbarium specimens seen has sporophytes.

P. squarrosa was found in Co. Mayo, new to Ireland, in 1998 (Lockhart 1999).

This species is widespread but declining elsewhere in northern and central Europe; it is now extinct in The Netherlands and endangered in northern and western Germany. It is still relatively frequent in Fennoscandia. It also occurs in northern Asia, Greenland and northern North America.

Total no. of hectads: 3 1970 onwards: 0

Paraleucobryum longifolium (Hedw.) Loeske

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This handsome moss forms silky, whitish-green cushions on the steep sides of boulders in the mountains. It is very likely to be confused with *Dicranum fuscescens* which also has long, finely-pointed leaves and occurs in similar situations. However, *Dicranum fuscescens* has a darker colour and a much narrower nerve, the nerve in *Paraleucobryum longifolium* filling almost the whole of the base of the leaf, a feature clearly visible with a hand lens. All sites are associated with large areas of block scree and, in the eastern Highlands, the species is also associated with coire lochans.

This species has been recorded from 10 sites in the eastern Grampians and the Breadalbane mountains, but has not been seen at some of these for many years. It was also previously recorded from a site in Dumfriesshire, but is now almost certainly extinct there, as it has not been seen for over 80 years. At one time *P. longifolium* was considered to be extinct in Britain, but it has been seen recently in some six localities in the Cairngorms, Glen Clova (Angus) and the Lawers NNR (Mid Perthshire). Populations are usually small, although on Ben Lawers and in Glen Clova cushions can be very locally frequent. There are no obvious threats to this species, but the small size of most of the populations, and its occurrence in an essentially transitory habitat, give cause for some concern. All recent sites are within SSSIs and all but one are within NNRs. *P. longifolium* is widely distributed in northern Europe and in the more mountainous areas farther south. It has a similar arctic–alpine distribution throughout the Northern Hemisphere, reaching south in the mountains to Madeira, the Himalayas, Japan and the southern USA.

Total no. of hectads: 8 1970 onwards: 6

Philonotis cernua (Wilson) D.G. Griffin & W.R. Buck

(*Bartramidula wilsonii* Bruch, Schimp. & Gümbel)
Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Rare*

This is a small, pale green acrocarp that produces almost spherical capsules on a characteristically curved seta. It grows on peaty soils among *Calluna* or in screes in upland areas, and is often associated with previously burnt areas. Recorded associates include *Bryoerythrophyllum ferruginascens* (*Barbula ferruginascens*) and *Funaria hygrometrica*. Most populations fruit abundantly.

Philonotis cernua is widely, but very sparsely distributed in the highland areas of Britain and Ireland. In Britain there are seven recorded sites in Gwynedd (Merioneth), Angus, Argyll, the Outer Hebrides, Westerness and West Ross. It was last seen at its Angus site in 1869 (Duncan 1966), when it was reported to be very rare. Recent surveys of the Gwynedd site (Hill 1988), where it was last seen in 1931, have failed to relocate the plant. The last record from the Outer Hebrides was made in 1948, when the population was reported to be a single, but extensive, patch. The most recent record is from Glen Nevis in 1961. The reasons for the rarity of this species are not known. A large-spored species, it may reappear at some of its sites if the conditions become appropriate. The only confirmed European sites for this species are in Britain and Ireland. Elsewhere it has a highly disjunct distribution, occurring in Bioko (Fernando Po), Yunnan and eastern North, Central and South America.

Total no. of hectads: 7 1970 onwards: 0

Philonotis marchica (Hedw.) Brid.

Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

Like other British *Philonotis* species, this is a pale green acrocarp with more-or-less lanceolate, toothed, leaves with a long, pointed apex. It differs from most other species of the genus in having only distal mamillae on the leaf cells. *P. arnellii* has smooth cells at least in the lower half of the leaf, although it may have distal mamillae in the upper half (Field 1963). This species grows on wet, somewhat base-rich sandstone rocks and soil slumps, sometimes with the thalloid liverworts *Conocephalum conicum* and *Pellia endiviifolia*. Sporophytes have never been seen in Britain.

P. marchica grows only near Shanklin in the Isle of Wight (Field 1978; Smith 1974; Townsend 1980), where two separate and relatively large populations were located during the most recent survey in 1995. The area has no designated site protection. It was formerly also known from a site in North-west Yorkshire but has not been seen there for over 80 years. The main threats to this species are leisure developments, coastal protection schemes causing stabilisation of the soil and subsequent growth of coarse vegetation, and spread of exotic trees and other plants. This moss is widespread throughout most of southern and central Europe but rare in the north. It also occurs in Macaronesia, north Africa, Asia and the Americas.

Total no. of hectads: 2 1970 onwards: 1

Physcomitrium eurystomum Sendtn.

Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This is a small (up to 3 mm tall) ephemeral acrocarp with broadly ovate, pointed leaves with large, thin-walled cells. *Physcomitrium eurystomum* differs from other *Physcomitrium* species by the toothed leaves, short, flat-topped capsule on a relatively long seta and the large spores. *P. eurystomum* is a very rare species in Britain. It has been found at four sites in West Norfolk, in Breckland meres fed by calcareous water from the chalk, and at the edges of two of the Tring reservoirs in Hertfordshire, where it grows on fine, damp or drying mud (Ducker and Warburg 1961). It is not usually found on mud which is exposed annually, but may be present in abundance in the driest summers when the water level drops to reveal less frequently exposed mud, containing the spore bank. *P. eurystomum* is one of the plants following what is described by During (1979, 1992) as a shuttle strategy: the time from spore germination to sporophyte production is only about two or three months, and the large spores are then shed directly onto the mud where they remain in the spore bank until conditions once again become suitable for growth.

The two sites with post-1970 records of *P. eurystomum*, both Breckland meres, are within SSSIs and one of them is also a Wildlife Trust reserve. Since this species is dependent on periodic fluctuations in the water level, a falling water table might be a threat if it leads to a significant reduction in the periods when the meres are flooded. This species has a scattered distribution throughout central and southern Europe, north to Denmark. It is also present in Asia and Africa.

Total no. of hectads: 4 1970 onwards: 2

Pictus scoticus C.C. Towns.
Status in Britain: *DATA DEFICIENT.* Endemic
Status in Europe: *Insufficiently known.* Endemic

This species forms golden-brown, shining mats, with stems up to 3 cm long, on the bark of a rowan *Sorbus aucuparia* on a limestone outcrop. It is known only from the type collection in East Perthshire where it was discovered in 1979. It is possible that the plant has been overlooked elsewhere, but it is likely to be very rare. However, the taxonomic status of this plant requires further study, and it is likely to remain in the *Data Deficient* category until this is done. Survey work in 1995 failed to refind the plant at its type locality. *Pictus scoticus* is apparently endemic to Scotland and is the subject of a Biodiversity Action Plan.

Total no. of hectads: 1 1970 onwards: 1

Plagiobryum demissum (Hook.) Lindb.
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This acrocarpous moss forms dense cushions on sheltered soil in crevices or on overhanging turfs on strongly calcareous boulders or crags. It is only likely to be confused with *Plagiobryum zieri*, from which it differs in being less julaceous and having narrower leaves with an excurrent nerve and a red–brown rather than silvery colour to the older patches. It resembles a small *Bryum*, but this is superficial and can be resolved with a handlens, the lax cells being distinctive. It can occur on rocks and crags of all aspects, but seems to require a degree of shelter. On the Lawers NNR (Mid Perthshire) it is most frequent on the underside of soil overhanging ledges, the turf held in place by vascular plants, a habitat where competition is restricted. Sporophytes are produced frequently.

P. demissum is recorded from scattered montane sites across the Central Highlands but is centred on the Breadalbane hills. It has not been seen recently at a number of its former localities, but this is a plant that is easily overlooked and may well still be present: indeed, it is likely that it is under-recorded in the Breadalbane area in general. Stands tend to be small, up to 20 x 6 cm, and isolated, probably because suitable habitat is similarly disjunct. Most sites for this species are in a habitat that is relatively transitory and the greatest threat is if this habitat becomes even more fragmented. All sites would appear to be on SSSIs and the best populations are probably on the Lawers NNR. *Plagiobryum demissum* is an arctic–alpine species, widespread in the northern and montane regions of Europe, Asia, North America and Greenland.

Total no. of hectads: 10 1970 onwards: 3

Plagiothecium piliferum (Sw. ex Hartm.) Bruch, Schimp. & Gümbel

Hair silk-moss

Status in Britain: *CRITICALLY ENDANGERED.* WCA Schedule 8

Status in Europe: *Not threatened*

This small, glossy, pale green pleurocarp has complanate shoots and concave leaves. It differs from other *Plagiothecium* species by the leaf narrowing abruptly to a long, filiform apex. *Pseudotaxiphyllum elegans* (*Isopterygium elegans*) and *Isopterygiopsis muelleriana* also have complanate shoots and a fine leaf apex, but neither has the decurrent leaf bases characteristic of *Plagiothecium* species. *P. piliferum* grows on rocks and among boulders at altitudes above 700 m. It is a plant of acid habitats in continental Europe, but both of the British sites are predominantly calcareous; the associated species in a herbarium specimen from one Scottish site suggest that it grew on a calcareous substrate. Sporophytes mature in summer.

This species has been recorded from Caenlochan in Angus and Ben Lawers in Mid Perthshire. It was last seen in Angus in 1939 and in Perthshire in 1903. The Lawers site is within an NNR and the Caenlochan site within an SSSI. Neither appears to be threatened, although the high density of deer at Caenlochan is causing some erosion on crags. In spite of repeated bryophyte surveys at Ben Lawers, this species has not been refound there (Long and Rothero 1995–96). However, further survey work at Caenlochan is needed before it can be considered to be extinct. This moss is found scattered in the northern and the more montane parts of Europe. It is also recorded from Asia and western North America.

Total no. of hectads: 2 1970 onwards: 0

Pohlia crudoides (Sull. & Lesq.) Broth.

Status in Britain: *VULNERABLE*

Status in Europe: *Not threatened*

This is a medium-sized, glaucous green, cushion-forming acrocarp, reddish below, with a red stem and rather narrow, pointed leaves. *Pohlia crudoides* differs from the similar *P. cruda* in its narrower leaf cells and lack of a metallic sheen when dried. Sporophytes have never been seen in Britain. At its only British site, below the east face of Sgurr nan Conbhairean in Easterness, where it was discovered in 1968 (Wallace 1972), *P. crudoides* was found in rock crevices at about 900 m altitude. It has not been seen since. The locality has no designated site protection and no threats have been identified. This is an arctic species which occurs in Svalbard, Fennoscandia and northern Russia and is not uncommon in northern Sweden. It is also reported from northern Asia, North America and Greenland.

Total no. of hectads: 1 1970 onwards: 0

Pohlia obtusifolia (Brid.) L.F.Koch
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

Pohlia obtusifolia is a pale green acrocarp with reddish stems, similar in appearance to the common *P. nutans* but with relatively shorter, wider and less sharply pointed leaves, which are markedly decurrent, and larger spores. It grows in base-rich flushes at high altitudes on mountain summits and on wet calcareous rock ledges and crevices on north or east facing cliffs.

This species has been recorded from seven mountains in the Scottish Highlands in Easterness, Mid Perthshire, Westerness and West Ross. Although rare, threats to *P. obtusifolia* are probably few, except those facing arctic–alpine vegetation in general such as global warming. It is conceivable that erosion from hillwalkers may pose a threat on the more popular hills. Although not seen on Ben Lawers for a number of years — in spite of extensive recent bryological survey work — it may still be present somewhere on the massif. Previous records were from the north-east face of the mountain, where it appears to have been present in some abundance. It is widespread in northern and montane parts of Europe, Asia, North America and Greenland.

Total no. of hectads: 8 1970 onwards: 4

Pseudoleskeella nervosa (Brid.) Nyholm
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This is a small dull green pleurocarp, which is usually easily recognised by the abundant dwarf axillary deciduous branches crowded at the shoot apices. It was first recorded in Britain from rocks on Ben Lawers (Dixon and Jameson 1896) but, according to Rothero (1998b), this and all subsequent records except one are erroneous and based upon specimens of *Pseudoleskeella rupestris* (*P. catenulata* var. *acuminata*). The only correctly named material is from a small limestone outcrop on the shore of a small loch to the south of Braemar (South Aberdeenshire). It was found in 1977 (and again more recently) at an altitude of a little over 700 m amongst a very large population of *P. catenulata*. As it is known in Britain from only a single restricted population, its status must be regarded as *Vulnerable*, but the only obvious threat to it is from collection. It is widespread in continental Europe, both as an epiphyte and on calcareous rocks, from the subalpine to the low alpine zone. It is also known from northern and central Asia and from North America.

Total no. of hectads: 1 1970 onwards: 1

Pterygoneurum lamellatum (Lindb.) Jur.

Status in Britain: *EXTINCT*
Status in Europe: *Vulnerable*

This small acrocarpous moss is similar to species of *Tortula*, but it can be distinguished by the conspicuous longitudinal lamellae on the upper surface of the nerve. A short hair-point is often present at the leaf apex. The smaller and more widespread *Pterygoneurum ovatum* differs in microscopic details of the sporophyte and the larger spores. The natural habitat of this ephemeral species is bare, calcareous soil on banks, often with species of *Aloina* and *Tortula*. However, in the 19th century the plant was widely established on mud-capped limestone walls. Sporophytes are produced abundantly.

P. lamellatum was once widespread in southern and eastern England, with a single Scottish site in Falkirk. The species was probably always rare, except in the Cotswolds, but it has decreased dramatically since 1920 with the decline in mud-capped limestone walls. Jones (1953) noted that there had been no recent records of this plant in Berkshire and Oxfordshire even then. It was last seen in Cambridgeshire in 1970 and is now almost certainly extinct in Britain. The disappearance of mud-capped walls is the main reason for the decline of this species, which was last recorded in this habitat in 1918. More recently, *P. lamellatum* probably disappeared from Cambridgeshire because of the invasion of coarse vegetation and scrub. The last site where the species was recorded was a working quarry which provided sufficient disturbance to keep the habitat open. Open habitats supporting several uncommon ephemeral bryophytes (e.g. *Lophozia perssonii*, *Tortula vahliana*) remained at this site for several years after *P. lamellatum* was last recorded, but the quarry is now disused and the area where the plant occurred is at risk of becoming overgrown, in spite of remedial management by the local Wildlife Trust. *P. lamellatum* occurs across Europe from Ireland (where it is also extinct) and Spain to the former USSR, in central Asia and in arctic and arid regions of North America.

Total no. of hectads: 34 1970 onwards: 1

Racomitrium himalayanum (Mitt.) A.Jaeger

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Insufficiently known*

Racomitrium himalayanum is a typical member of the genus, growing in coarse patches on open rock surfaces in the mountains. It resembles *R. fasciculare* in colour and *R. heterostichum* in habit, but the combination of large, spreading patches, often decaying at the centre, short branches and the flexuose hair point when dry are all good field characters. Microscopically, the elongate cells in the upper part of the leaf are a good confirmatory character. Also useful is the fact that *R. himalayanum* is a strong calcicole: its preferred habitat would seem to be the exposed slabby surfaces of large boulders in scree and, less frequently, similar sites on crags. This species is apparently limited to the band of calcareous schists which is centered on the Breadalbane hills. All sites are above 700 m, and *R. himalayanum* reaches over 1,100 m on Ben Lawers (Mid Perthshire). The species has not been seen at its Argyll site — Beinn Dorain ('Ben Douran') — since 1908, when H H Knight discovered it there, but it may well still be present.

As the taxonomy of this plant has only recently been clarified (Frisvoll 1988, Blockeel 1991), records are scant. There are confirmed records from some six localities, including several populations in the Ben Lawers area, and it is to be expected that further records will be made from calcareous rocks in the Breadalbane hills. Little is known about the abundance of the plant except on the Lawers NNR where *R. himalayanum* was found to be locally frequent on rocks in the richest parts of the reserve, with some patches reaching 50 cm in diameter. No fruiting plants were seen on the Lawers NNR but sporophytes are reportedly frequent. The plant is *Not threatened* at Lawers, but further information is needed about its other localities. *R. himalayanum* would appear to be an alpine species which, outside of Scotland, is known only from the Himalayas, Tibet and Yunnan.

Total no. of hectads: 4 1970 onwards: 3

Rhynchostegium rotundifolium
(Brid.) Bruch, Schimp. & Gümbel
Round-leaved feather-moss
Status in Britain: *CRITICALLY ENDANGERED.*
WCA Schedule 8
Status in Europe: *Rare*

Rhynchostegium rotundifolium is a medium-sized, dull green pleurocarp with oval leaves which have a single nerve reaching about halfway to the apex. The broad leaves and short, wide leaf cells separate it from *Brachythecium* and other species of *Rhynchostegium*. *R. rotundifolium* is a calcicole, growing on stones and trees in shady hedgebanks. Sporophytes are common, produced in winter.

This species has been seen recently at two sites, in East Sussex and East Gloucestershire. The Sussex population is restricted to an area of about half a square metre on the bole of an old coppiced hedgerow ash. In Gloucestershire, it grows as a number of small scattered colonies on an old field maple *Acer campestre* and limestone rocks in a wall and hedgebank. It was formerly also known from North Somerset (a poorly localised site somewhere 'near Wells'), where it has not been seen for over 75 years. One of the extant sites for this species is an SSSI but the other site has no designated site protection.

The main threats to this species are the removal of shade through trimming of branches or felling, and agricultural spray drift. Indeed, the Sussex colony has declined following removal of surrounding vegetation in an apparent 'tidying up' exercise. In Gloucestershire, roadworks or repairs to the wall on which *R. rotundifolium* grows could damage the site. Collecting by botanists is also a significant threat, as the remaining populations are very small. An *ad hoc* translocation was undertaken a number of years ago at the East Sussex site but without success. However, a Biodiversity Action Plan has been written for *R. rotundifolium*, and further work on translocation is one of the options suggested in the plan. This moss has a scattered distribution across central Europe from Britain and France to the Caucasus and has also been recorded from Japan.

Total no. of hectads: 3 1970 onwards: 2

Rhytidiadelphus subpinnatus (Lindb.) T.J.Kop.
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This medium-sized or rather large pleurocarp is similar to the very common 'lawn moss' *Rhytidiadelphus squarrosus* but differs in its softer appearance, with its leaves non-sheathing and patent rather than sheathing and squarrose. *R. subpinnatus* grows, insofar as its ecology is understood in Britain, on damp grassy banks in acid woodland. Sporophytes are very rare in this dioecious species and had not been found in Britain until a single example was observed in one of the Welsh populations recently. However, as it was growing in a mixed stand with *R. loreus*, it is possible that it was of hybrid origin (D T Holyoak, pers. comm.).

R. subpinnatus is a poorly known species in Britain, and many older records were errors for *R. squarrosus*. However, it seems to be genuinely rare. There are authenticated records in Britain from 12 sites in Cheshire, Derbyshire, Mid-west and North-west Yorkshire, West Lancashire, Westmorland, Carmarthenshire and Gwynedd (Merioneth). It has been seen at less than half of these since 1950 and there are only two post-1970 records, from Lancashire and Gwynedd. Although overlooked, the decline is likely to be real, as many old records are from areas where *Rhytidiadelphus* species have been reduced by air pollution. No other threats have been identified. This is a circumboreal species distributed throughout most of Europe except the Iberian Peninsula. It is also recorded from the Azores, Asia and North America.

Total no. of hectads: 12 1970 onwards: 2

Saelania glaucescens (Hedw.) Broth.

Blue dew-moss
Status in Britain: *VULNERABLE*. WCA Schedule 8
Status in Europe: *Not threatened*

Saelania glaucescens is a glaucous, blue–green acrocarp with narrowly lanceolate, pointed leaves. The glaucous pruina that covers the leaves is caused by a coating of microscopic waxy rods, giving the plant an appearance unlike that of any other moss. *S. glaucescens* grows on damp, shaded rock or skeletal soils on calcareous mica schist at altitudes between 600 and 800 m (Coker 1971; Long and Rothero 1995–96; McVean and Ratcliffe 1962). Sporophytes are frequent and produced in the summer.

S. glaucescens is restricted to scattered populations in Coire Fee and Glen Doll, Angus, and a single population in Glen Feshie, Easterness, each consisting of a small number of stands (aggregations of individual stems) covering an area of a few square centimetres. The Easterness site has not been surveyed since 1965. Both sites are within NNRs. The total number of plants is small, and circumstantial evidence suggests that *S. glaucescens* may have declined significantly over the years, a decline for which collecting by botanists may have been responsible: the plant is relatively conspicuous and attractive and there is a large amount of material in herbaria. Fortunately this threat is now considerably less than it once was. The dispersed nature of the populations means that it is likely to survive rock falls even if individual plants are destroyed. The Angus populations were surveyed as part of the Scottish Cryptogamic Conservation Project 1993–1995. This species is widespread in Europe and in the rest of the Northern Hemisphere, although becoming more montane in the south. It also grows in southern Africa (it is a common plant in the high Drakensberg mountains) and New Zealand.

Total no. of hectads: 2 1970 onwards: 1

Scorpidium turgescens (T.Jensen) Loeske

Large yellow feather-moss
Status in Britain: *VULNERABLE*. WCA Schedule 8
Status in Europe: *Not threatened*

This is a large, glossy yellow-green to greenish-brown pleurocarp with sparsely branched and swollen stems up to 25 cm long. Like those of *Scorpidium scorpioides*, the leaves are broadly oval, blunt-tipped, concave and imbricate. *S. turgescens* differs in its straighter, non-falcate leaves with a different cell structure. In Britain this species is known from small calcareous *Carex saxatilis* mires below a late-lying snow patch at about 990 m altitude (Birks and Dransfield 1970; Long and Rothero 1995–96). At the lower margins of the mires, *S. turgescens* grows in more open vegetation approaching the *Thalictrum alpinum–Juncus triglumis* subcommunity of *Carex demissa –Saxifraga aizoides* mire (NVC type M11a). Elsewhere in Europe it has also been recorded from seasonally wet calcareous rocks, rills and lake edges. Sporophytes are unknown in Britain and rare in Europe.

S. turgescens is restricted to two flushes — one large and one small — in a single bealach in the Ben Lawers massif (Mid Perthshire), where it is abundant over an area of about 25 m². The site lies within an SSSI and an NNR. Fossil evidence demonstrates that the species is a glacial relict, much more widespread in the last glacial and late-glacial period (Birks and Dransfield 1970). A record from Cader Idris, Gwynedd (Merioneth), in 1922 is thought to be incorrect.

Although *S. turgescens* is not under immediate threat, this could change quickly if there were to be any damage to the flushes through desiccation or physical damage from trampling by walkers: it is within 5 m of a popular walkers' route. The population was surveyed as part of the Scottish Cryptogamic Conservation Project 1993–1995. This moss is found at predominantly low altitudes in northern Europe and in mountainous areas farther south. It also occurs in Asia, North America, Ecuador and Bolivia.

Total no. of hectads: 1 1970 onwards: 1

Seligeria brevifolia (Lindb.) Lindb.

Status in Britain: *VULNERABLE*
Status in Europe: *Insufficiently known*

This is a minute acrocarp, the leafy shoots being only about 1 mm tall; although narrow-leaved, it has shorter and broader leaves than most species of the genus. *Seligeria brevifolia* differs from the closely related *S. pusilla* in the rectangular exothecial cells, which are regularly arranged in rows. The peristome teeth are also rather large in relation to the size of the capsule. *S. brevifolia* occurs on moist vertical rock surfaces and beneath sheltered overhangs, sometimes growing vertically downwards. In Britain it has been recorded at altitudes between 380 and *c.* 920 m. Evidence from Britain and elsewhere in Europe indicates that it has no preference for particular rock types; the substrates in Britain include acid sandstone and volcanic tuff. The rock is usually base-rich, although sometimes only weakly so. Sporophytes are abundant and produced in late summer.

This moss is restricted to a few scattered sites in England, Wales and Scotland (Hill 1980). In Wales it occurs in the Snowdon massif in Gwynedd (Caernarvonshire), where three colonies have been found (Hill 1988). Only a single very small colony is known in England, in the Peak District of Derbyshire. These sites are within SSSIs. The species has also been detected recently in herbarium material from two sites in Scotland. One of these is an old record, which cannot be satisfactorily localised, from 'Glen Lochy' (possibly Glen Lochay in Mid Perthshire) in 1841. The other is from Ben Ledi in West Perthshire in 1971. It has also been found very recently on Glas Tulaichean in East Perthshire. There are no apparent threats to this species other than the small size of the populations[1].

S. brevifolia is little known but apparently rare in Europe, recorded from only a few localities in Iceland and Fennoscandia, and in the Alps of Germany and Switzerland. It is also found in Siberia and eastern North America.

Total number of hectads: 4 1970 onwards: 4

Seligeria campylopoda Kindb.

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Insufficiently known*

Seligeria campylopoda is a tiny moss very similar to *S. recurvata*, differing principally in the narrow nerve with the leaf lamina distinct almost to the apex, whereas in *S. recurvata* the much stouter nerve forms a long subulate point. *S. campylopoda* grows on hard calcareous rock in shaded habitats. Although first collected in 1892, near Chepstow, *S. campylopoda* was first reported as a British moss in 1994 (Gos and Ochyra 1994). It is fully described, along with an account of its occurrence in Britain, by Blockeel et al. (2000). It has been recorded at four sites, one on chalk-covered flints in a wood in Buckinghamshire, and the others on Carboniferous Limestone in the Wye Valley in Monmouthshire and West Gloucestershire. *S. campylopoda* was seen at one of the Wye Valley sites, which is within an SSSI, in 1995 and 1996 but its occurrence there is reported to be very restricted. On the 1996 visit to this site, it was found growing at ground level on an embedded stone, a habitat which is likely to retain moisture during dry weather (Blockeel et al. 2000). This rather specialised habitat requirement may explain why the moss is so rare there. *S. campylopoda* is a highly disjunct species occurring in North America, Europe and Russian Siberia, but rare over most of its range.

Total number of hectads: 3 1970 onwards: 1

[1] The counts exclude the old Scottish record, which is inadequately localised.

Seligeria carniolica (Breidl. & Beck) Nyholm
(*Trochobryum carniolicum* Breidl. & Beck)
Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Endangered*. Endemic

Seligeria carniolica is a minute but distinctive dark green acrocarp with leaves that taper abruptly from a short, broad base to a very long, narrow apex. The short, wide-mouthed capsule is borne on a straight or curved seta, which, like that of *S. oelandica*, is very stout. That species, however, has much shorter leaves. This moss grows on shaded, periodically wet calcareous sandstone or impure limestone at streamsides at altitudes between 150 m and 250 m. Sporophytes, which are produced in summer, are frequent.

S. carniolica has been seen at only two localities in Britain. Collected in 1948 in Scotland by Miss E M Lobley, it was growing by the Black Burn, Newcastleton, Roxburghshire, on a limestone outcrop (at 225–275 m), associated with *Seligeria recurvata*, *Gyroweisia tenuis* and *Tetrodontium brownianum* (Warburg 1948). The locality was revisited several times by Miss Lobley and also by Warburg and others. None of them could refind *S. carniolica* or even the rock on which it had been growing. They reluctantly concluded that there had been a substantial fall of part of the streambank, carrying the rock outcrop with it. Further visits need not be discouraged, but provisionally one must regard this plant as extinct in Scotland. In May 1964 Miss Lobley and others found *S. carniolica* in South Northumberland on calcareous boulders in a sparsely wooded stream, sometimes submerged and sterile, sometimes at high levels and fertile (Lobley 1965). It is still present in small quantity at this site, where there are several colonies scattered along the length of the stream. Neither this nor the Scottish site has any designated site protection.

This moss is potentially threatened by changes in the immediate catchment area affecting the chemistry of the water in the stream where it grows; for example, afforestation, agricultural run-off, or overgrazing. Any disturbance to, or felling of, the streamside trees could open up the site, disrupting the humidity and shade — and extreme drought is likely to imperil this plant. Some of the streambank is poached by cattle and, although this does not present an immediate threat, could affect the moss if it became more severe. Because of the limited size of the population, collecting is also a possible threat. *S. carniolica* is the subject of a Biodiversity Action Plan. This species is a European endemic otherwise known only from a few sites in Norway (Oppland) (Coker 1983), Sweden (Gotland), Switzerland (Lake Zürich), France (Jura), Germany (Bavaria) and the former Yugoslavia (Carpathians), with only a single site in each country apart from Yugoslavia, where it is known from three sites. The populations are all thought to be small, although the French one extends over 100 m on a steep streambank. Many of the localities are in areas that are thought to have remained ice-free during the last glacial stage, and it has been suggested that the plant is a preglacial relic.

Total no. of hectads: 2 1970 onwards: 1

Seligeria diversifolia Lindb.

Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

Seligeria diversifolia is a minute acrocarpous moss of base-rich rocks. It is related to the widespread species *S. recurvata* and the very rare *S. campylopoda* but differs from both in the straight or slightly flexuose seta. It is distinctive also in the strongly differentiated perichaetial leaves, and in the elongate sterile shoots with leaves of even size. Sporophytes are common. This species is restricted to single sites in North-east Yorkshire and Westerness. It was reported in Yorkshire in 1971 on base-rich rocks in woodland at an altitude of about 150 m near Ampleforth, where *S. recurvata* occurs in some quantity (Crundwell and Nyholm 1973). Confirmation of this record is highly desirable. The original plants are reported and illustrated as having unusually long leaves and it has never been refound in subsequent searches at this locality. In Scotland, *S. diversifolia* was collected in 1984 on a vertical calcareous rock face on Beinn Riabhach (*c.* 400 m) in Glen Nevis. Morphologically these plants are much more typical of the species.

No immediate threats to the species have been identified, but it is poorly known in Britain and more precise information about the populations is required. *S. diversifolia* appears to be rare throughout its range. It is known from Svalbard, Fennoscandia, the Alps, the Caucasus, Siberia, northern North America and east Greenland.

Total number of hectads: 2 1970 onwards: 2

Sematophyllum demissum (Wilson) Mitt.

Status in Britain: *ENDANGERED*
Status in Europe: *Rare*

This slender pleurocarp grows on humid, shaded, acidic or mildly basic rocks in low altitude wooded valleys, frequently on intermittently irrigated, sloping faces of boulders and rock slabs. *Sematophyllum demissum* has a western distribution and is confined in Britain to Gwynedd (Caernarvonshire and Merioneth), where it currently occurs at five sites and has apparently disappeared from one other, where it was recorded in the 19th century. Four of the five extant sites are SSSIs and two of these are also NNRs. It is much more frequent in the south-west of Ireland.

The uncontrolled spread of *Rhododendron* is probably the single most serious threat to this species in Wales (Hill 1988). Excessive grazing and other unsympathetic woodland management may also be threats at some sites. Over-collection is a potential threat, especially at the most well-known locality. The distribution of *S. demissum* in Europe as a whole is less oceanic than in Britain and Ireland, with most records from central Europe and scattered occurrences in more western areas. It is the subject of a Biodiversity Action Plan. Elsewhere it is reported from north Africa, south-west Asia, Japan and eastern North America.

Total no. of hectads: 5 1970 onwards: 4

Sematophyllum substrumulosum (Hampe) E.Britton
Status in Britain: *DATA DEFICIENT*
Status in Europe: *Not threatened*

Sematophyllum substrumulosum is a pleurocarpous moss superficially similar to *Hypnum resupinatum*, but it can be identified as a *Sematophyllum* by the few, greatly enlarged alar cells. It is considerably larger than the other two British species of the genus. It was discovered new to Britain in 1995 on Tresco in the Isles of Scilly, growing on the upper surface of a leaning, dead trunk of Monterey pine *Pinus radiata* at the edge of a conifer plantation (Holyoak 1996a). Its distribution includes southern Europe, the Azores, the Canary Islands and Madeira, which suggests that its occurrence in the Isles of Scilly might be a natural range extension. However, it is also possible that it is an introduction, as it grows close to the famous Abbey Gardens on Tresco. It is included here on the basis that it is certainly a rarity in Britain and the case for its status as a native plant is at least credible. However, it would not be reasonable to include it in the Red List on the present level of information.

Total no. of hectads: 1 1970 onwards: 1

Sphagnum balticum (Russow) C.E.O.Jensen
Baltic bog-moss
Status in Britain: *ENDANGERED*. WCA Schedule 8
Status in Europe: *Not threatened*

This is a slender, brownish or orange-coloured *Sphagnum* related to *S. fallax* (*S. recurvum* var. *mucronatum*) but with spreading stem leaves and only three (occasionally four) branches per fascicle. *S. balticum* is a species of oligotrophic to slightly mesotrophic raised bogs or, more rarely, blanket bogs. It forms carpets in the wetter areas, typically occurring by bog pools and channels, in peat cuttings and in the hollows of hummock–hollow complexes. It is mainly a lowland species, but reaches an altitude of 660 m in Scotland. Sporophytes are unknown in Britain and are rare throughout its range, except locally in the Arctic.

This species has been recorded from seven widely scattered sites in Cheshire, South Northumberland, South-west Yorkshire, Ceredigion (Cardiganshire), South Aberdeenshire, Dumfriesshire and Abernethy Forest in Easterness, where it was discovered in 1996 (close to *S. majus*). However, it has not been seen for over a century at the Cheshire site and recent survey work has failed to detect it in Ceredigion, where part of the area in which it used to occur is now overgrown with *Molinia* and no longer suitable for it. The Dumfriesshire site has been afforested, and it is unlikely that the species survives there. It may also have disappeared from its site in Yorkshire.

Threats to the remaining sites for this species include habitat damage, particularly from drainage, afforestation and lowering of the water table. Indiscriminate collecting of *Sphagnum* for horticultural purposes may be a threat at some sites, and peat extraction is a threat at the Thorne Moors site in Yorkshire. Two of the sites where the species has been recorded since 1970 are within SSSIs, while the Abernethy site lies just outside the SSSI. The Aberdeenshire and Dumfriesshire sites were surveyed as part of the Scottish Cryptogamic Conservation Project 1993–1995 (Long and Rothero 1995–96). It is the subject of a Biodiversity Action Plan. In Europe, this is a widespread species with a northern distribution, extending south to the Alps and the former Yugoslavia. It is also present in northern Asia, North America and Greenland.

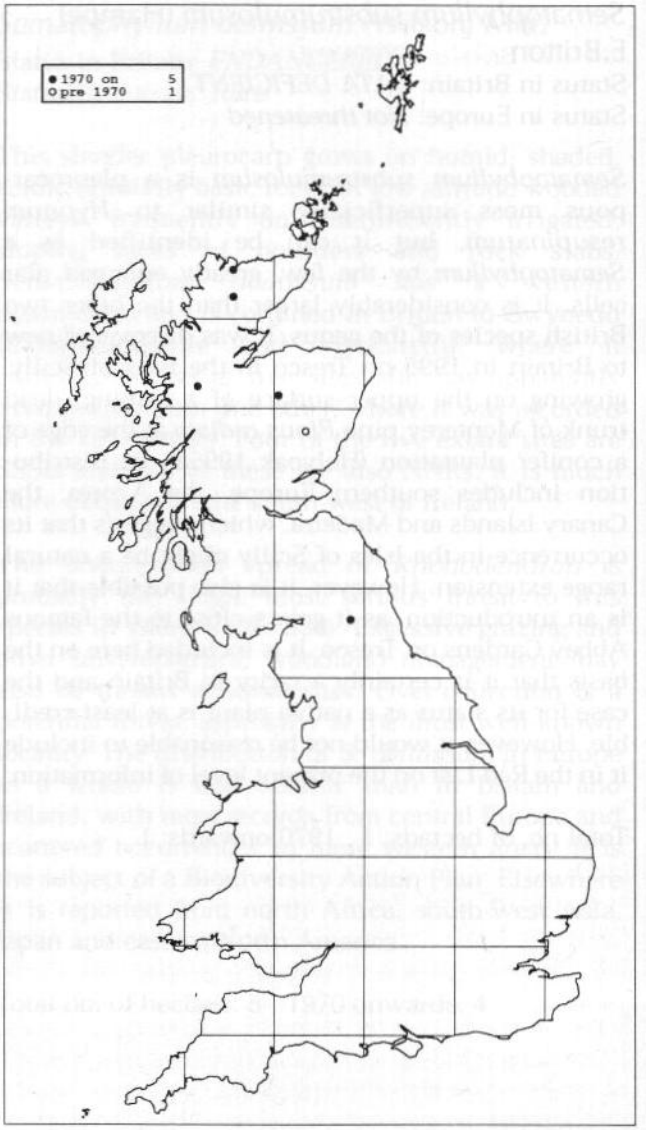
Total no. of hectads: 7 1970 onwards: 3

Sphagnum majus (Russow) C.E.O.Jensen
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This is a large *Sphagnum* closely related to the common *S. cuspidatum*, and resembling it closely in its 'drowned kitten'-like appearance. It differs in its dingy olive-green colour, rather than the lighter green of *S. cuspidatum*, and the presence of many unringed pores on the dorsal surface of the branch leaf hyaline cells. Like *S. cuspidatum*, it grows in very wet places in mires, usually submerged in boggy hollows or at the margins of small lochs. Sporophytes have been found only once in Britain.

S. majus has been recorded recently in seven localities, two very close together in the pine woodland of Glen Affric, Easterness, two by small lochs near Abernethy Forest, two in the flows of West Sutherland, and one in a valley bog in South Northumberland. It has not been seen since 1947 at a further locality in Glen Lee, Angus. The species may be potentially threatened by eutrophication and changes in the water table at its smaller and more fragile sites, such as the Northumberland bog, which is, however, an SSSI. *S. majus* may be overlooked in the north, particularly in the extensive and under-explored Flow Country of Caithness and Sutherland. The first record from this area was made more or less at random, and there is plenty of apparently suitable ground available. This site is not specially protected and may be under threat from road works. The second record from the area, made in 1999 on an SSSI, may represent the largest British population (A G Payne, pers. comm.), but the site needs more study. The small localities in Glen Affric and Abernethy Forest, three of which are also within SSSIs, may be subject to eventual desiccation and natural succession. Whether to control this is desirable, or whether to rely on larger-scale management of the areas to maintain a more dynamic system, should be considered. *S. majus* is a boreal species, relatively frequent in Fennoscandia but becoming rare and scattered to the south.

Total no. of hectads: 6 1970 onwards: 5



Sphagnum obtusum Warnst.

Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

Sphagnum obtusum can be a difficult species to identify, separable from *S. fallax* and related species mainly by the smaller pores in the leaf cells. Very little is known about its habitat in Britain except that it grew on the now largely vanished deep peat bogs of the west Lancashire plain. In Europe it can occur in carr at the edges of oligotrophic bogs, but is more usually found in pools in mesotrophic to eutrophic mires or by streams and lake margins. This species was recorded from two sites in South and West Lancashire but was eliminated by drainage and is now almost certainly extinct: it was last seen in Britain in 1911. A continental species, it has a scattered distribution throughout northern, central and eastern Europe south to the former Yugoslavia, and also occurs in Asia and North America.

Total no. of hectads: 2 1970 onwards: 0

Sphagnum skyense Flatberg

Status in Britain: *DATA DEFICIENT*. Endemic
Status in Europe: *Insufficiently known*. Endemic

Sphagnum skyense is a large species resembling robust *S. subnitens* but differing in a number of rather critical characters, including having mainly four branches per fascicle, relatively broad stem leaves, large hyalocysts (hyaline leaf cells) and the presence of pores in the stem cortex. Sporophytes are unknown. It grows among dwarf shrubs, pleurocarpous mosses and other *Sphagna* in north-west-facing, wet heathland in Strath Suardal on Skye, where it is locally frequent over a rather restricted area, but may have been overlooked elsewhere. Discovered in 1987 (Flatberg 1988), it has not been seen since, in spite of searching, all candidate material proving to be robust *S. subnitens*. Although the locality is predominantly acidic, there is some base-rich flushing from the local limestone, and this may have a bearing on the ecology of *S. skyense*. Although spruce has been planted extensively, and fairly recently, just to the north-east of the *S. skyense* locality, this probably does not constitute a threat. Current management includes light cattle grazing and, providing the grazing remains light and further conifers are not planted, there are probably few or no major threats to the site. *S. skyense* is apparently endemic to Britain, but may be conspecific with *S. junghuhnianum* Dozy & Molk., which occurs in Asia and British Columbia.

Total no. of hectads: 1 1970 onwards: 1

Syntrichia norvegica F.Weber

(*Totrula norvegica* (F.Weber) Wahlenb. ex Lindb.)
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This is an acrocarpous moss (very occasionally up to 10 cm tall but usually much smaller) forming lax patches which are reddish-brown when dry, becoming yellowish-green above when moist. Resembling *Syntrichia ruralis* in its habit and long, toothed hair point, it is easily distinguished by the reddish hair point throughout its length. *S. norvegica* is a calcicolous species of rock crevices and soil among rocks, usually mica-schist or limestone, at altitudes over 800 m. Stands are most frequent on ledges, or the tops of rocks, under overhangs where there is considerable shelter. Sporophytes are unknown in Britain.

This species has been recorded from five localities in South Aberdeenshire, Mid Perthshire and Westerness. Recent survey work (1996) located five small populations on the Ben Lawers and Meall nan Tarmachan massifs. When dry, plants can be very hard to spot, even if large: this probably means that further stands will be found. No threats to the species have been identified but the small and scattered nature of the stands must give rise to some concern. All the currently known populations occur within SSSIs. This arctic–alpine species has a wide distribution in Europe, reaching north Africa and Macaronesia. It also occurs in southern Africa, Asia, North America and Greenland.

Total no. of hectads: 5 1970 onwards: 3

Tayloria lingulata (Dicks.) Lindb.

Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

This medium-sized acrocarp grows in dense, dark green tufts and has large, lax leaf cells. The capsule is erect, and the lack of a swollen base (apophysis) distinguishes the genus from *Splachnum*. The other British *Tayloria* — *T. tenuis* — has strongly toothed leaves, whereas those of *T. lingulata* are more-or-less entire. *T. lingulata* grows in base-rich flushes, usually above 600 m in altitude. Sporophytes are frequent and produced in summer.

T. lingulata has been recorded from about 15 sites in Angus, Argyll, East and Mid Perthshire, South Aberdeenshire and Stirlingshire in the Scottish Highlands. It has been confirmed in recent years at only four of these but it may persist at some of the other sites: it often grows in small quantities and may therefore be overlooked. A bryophyte survey on Ben Lawers and Meall nan Tarmachan in 1996 found *T. lingulata* to be locally frequent, and occasionally abundant, in a number of flushes in the area. Specific threats are few, although it is possible that the removal of grazing and subsequent birch regeneration may be a problem for the flushes at Morrone. An arctic–alpine species, *T. lingulata* occurs throughout northern Europe and in mountain ranges farther south, and also occurs in Siberia, N. America and Greenland.

Total no. of hectads: 11 1970 onwards: 5

Tayloria tenuis (Dicks.) Schimp.

(*T. longicollis* (Dicks.) Dixon)
Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Not threatened*

Tayloria tenuis is a dark green, acrocarpous tuft-forming moss with broadly oval leaves that are pointed, widest above the middle and coarsely toothed. The leaf cells are large and lax. *T. lingulata* differs in having more-or-less untoothed leaves. *T. tenuis* grows on damp, decaying vegetation in the uplands. It is usually montane but descends to about 100 m in Caithness. Sporophytes are frequent and produced in summer.

This species has been recorded from about 16–20 scattered sites in the Scottish Highlands. It has been seen at only one of these, within an SSSI in Caithness, since 1970 and has been recorded in only six hectads since 1900. It has been searched for during recent surveys but without success. Although this species has declined catastrophically, the reasons for the decline are not known. A survey of all its past sites is needed urgently. This arctic–alpine species is widespread in northern Europe and scattered in mountain ranges farther south. It also occurs in Asia and North America, but details of its world distribution are uncertain because of confusion with *T. serrata* (Hedw.) Bruch, Schimp. & W. Gümbel.

Total no. of hectads: 17 1970 onwards: 1

Tetrodontium repandum (Funck) Schwägr.

Status in Britain: *CRITICALLY ENDANGERED*
Status in Europe: *Not threatened*

This species, together with *Tetrodontium brownianum* and *Tetraphis pellucida*, is one of the few British mosses with only four peristome teeth. Both *Tetrodontium* species are very small (stems up to 2 mm long, considerably smaller than *Tetraphis pellucida*), with narrow protonemal leaves that are much more numerous than the broader stem leaves, and erect capsules borne on straight setae up to 4 mm long. *T. repandum* has shorter protonemal leaves (to 0.5 mm) than *T. brownianum* (to 2.5 mm), and often has flagelliform shoots at the base of the stem (absent in *T. brownianum*). *T. repandum* grows downwards beneath moist sandstone or gritstone overhangs. Sporophytes are not known in Britain but plants reproduce vegetatively by means of the slender flagelliform shoots.

The only confirmed records for this species, from East Sussex and North-east Yorkshire, were both made in the 1950s (Appleyard 1956). The latter population was not refound when the site was searched in 1990, but this plant is very small and inconspicuous and may well still be present. Very little is known about the British populations and it is therefore impossible to assess threats with any accuracy. New survey work is needed urgently at both sites. This moss is rather rare and scattered throughout central and northern Europe. It also occurs in the Caucasus, south-east Asia, western North America and Newfoundland.

Total no. of hectads: 2 1970 onwards: 0

Thamnobryum angustifolium (Holt) Nieuwl.
Derbyshire feather-moss
Status in Britain: *CRITICALLY ENDANGERED*. WCA Schedule 8. Endemic
Status in Europe: *Critically Endangered*. Endemic

This is a medium-sized, pale green, dendroid pleurocarp with shoots up to 4 cm long, often encrusted with calcareous material below. It can be distinguished from the common *Thamnobryum alopecurum* by the structure of the branch leaves, which are narrower, very strongly toothed, parallel-sided and have a broad nerve (Furness and Gilbert 1980; Hodgetts and Blockeel 1992; Holt 1886). The leaves of *T. cataractarum* are less strongly toothed but have an even broader nerve. *T. angustifolium* grows on a shaded limestone rock face in a wooded ravine, where it is inundated for much of the year by a torrent of water that emerges from a small cave just above it. The water flow, and the moss, often dry out completely in the summer. Sporophytes are unknown. The entire world population of this moss is restricted to a single site in Derbyshire, within an SSSI, where the main colony covers about 3 m^2 on a single rock face, with small subsidiary colonies on boulders in the stream bed just downstream.

T. angustifolium is at risk because of the extremely restricted extent of the population. Collecting by botanists is a significant threat, as the plant is conspicuous, the population very small and the site well known. The size of old herbarium specimens suggests that the shoots are now smaller than they used to be, perhaps because of over-collecting. Reduction in water flow, due perhaps to lowering of the water table or climatic changes, is also a serious threat. The overall extent of the plant was reduced during 1996 and 1997 by drought, when the water flow from the cave was much diminished from the norm. However, it was flowing well again in late 1997 and regular monitoring is now underway to determine whether the plant is recovering. Initial observations suggest that it is doing so, with fresh green shoots appearing from areas that had appeared dead following the drought. Irresponsible activities relating to caving may be a significant threat to this species. For example, large areas of rock are sometimes excavated in order to make small caves more accessible, and there is known to be an interest among cavers in finding the source of the stream that emerges at the *Thamnobryum* site. A notice has been placed at the entrance to the cave alerting cavers to the proximity of a rare plant and EN is monitoring the situation carefully. Water pollution may also be a potential threat. *T. angustifolium* is a prime candidate for taking into cultivation as an insurance against disappearance from its only known site. A Biodiversity Action Plan has been written for this species, and it is included on a list of the world's most threatened bryophytes (Hallingbäck and Hodgetts 2000). *T. angustifolium* is endemic to Derbyshire.

Total no. of hectads: 1 1970 onwards: 1

Thamnobryum cataractarum N.G.Hodgetts & Blockeel

Status in Britain: *VULNERABLE*. Endemic
Status in Europe: *Vulnerable*. Endemic

Like other species of *Thamnobryum*, this is a dendroid pleurocarp. Similar to *T. angustifolium*, it is darker green in colour, with less strongly toothed leaves and a broader nerve. The leaves are usually much eroded, the plant becoming a tangled mass of blackish stems and branches. It seems to be most closely related to *T. fernandesii*, a Madeiran endemic (Hodgetts and Blockeel 1992).

Essentially aquatic, this moss forms a pure zone on steeply sloping rocks 10–25 cm below summer water level in a swiftly flowing stream in a deep ravine on Ingletonian grits and shales, where there is some calcareous influence from the Carboniferous Limestone. It also occurs just below the water surface with *Rhynchostegium riparioides*, *Cinclidotus fontinaloides* and *Fissidens rufulus*, and as isolated shoots just above the surface, amongst a sward consisting mainly of *Thamnobryum alopecurum*.

This species is known only from its type locality in the Craven district of Mid-west Yorkshire, a well-known beauty spot within an SSSI, where it is very locally frequent (Hodgetts and Blockeel 1992). There are no known current threats to the species but, as with other aquatics, there is always a concern that the plant could be affected by water pollution from upstream. Any reduction in water flow could also threaten it. There is a limestone quarry very close to the site, and regular monitoring should take place to detect any disruptive influence this might have on the local hydrology. *Ex-situ* conservation is also suggested. As an apparently endemic species, it is the subject of a Biodiversity Action Plan. This species is endemic to Yorkshire.

Total no. of hectads: 1 1970 onwards: 1

Timmia austriaca Hedw.

Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

Timmia austriaca is a large, dark green acrocarp that superficially resembles a *Polytrichum*. The leaves are long, narrow and toothed, and have a sheathing base. It differs from the slightly more frequent *T. norvegica* in having a non-papillose, toothed nerve and smooth leaf cells. *T. austriaca* grows in dry calcareous turf and rock crevices, often on north- or east-facing limestone or schist, usually above 600 m in altitude but descending to 200 m in Angus. Sporophytes are unknown in Britain.

This species is restricted in Britain to seven sites in East and Mid Perthshire and Angus in the Scottish Highlands. Post-1970 records are restricted to three small stands, which were located during survey work in 1996, at a single site within the Ben Lawers SSSI, and a further colony consisting of a small number of stems on Glas Tulaichean. No threats have been identified. This is an arctic–alpine species, widespread in northern Europe and scattered in mountain ranges farther south. It also occurs in Asia and North America.

Total no. of hectads: 6 1970 onwards: 2

Tortella limosella (Stirt.)
P.W.Richards & E.C.Wallace
Status in Britain: *EXTINCT.* Endemic
Status in Europe: *Extinct.* Endemic

This species is a small acrocarp apparently closely related to *Tortella flavovirens* and *T. inclinata*, differing in its reflexed leaves and larger, unipapillose cells. The leaf has the typical *Tortella* cell distribution, with a hyaline base ascending up the margin and a sharp dividing line between this and the green cells. The only record is from a sandy sea shore 'west of Arisaig' in Westerness where it was collected in 1906 by J Stirton but has never been refound, in spite of searching. There are no obvious reasons to explain its apparent extinction. *T. limosella* was endemic to Scotland.

Total no. of hectads: 1 1970 onwards: 0

Tortula cernua (Huebener) Lindb.
(*Desmatodon cernuus* (Huebener) Bruch & Schimp.)
Flamingo moss
Status in Britain: *ENDANGERED.* WCA Schedule 8
Status in Europe: *Rare*

Very distinctive when fertile, this is a small green acrocarp with a drooping or horizontal capsule on a long wavy seta. Colonies sometimes cover large areas of disturbed calcareous ground. However, microscopic features are necessary to distinguish it when sterile. No other British species of *Tortula* has bordered and clearly denticulate leaves. However, these characters are shared with species of the genus *Hennediella*, but these have broader leaves and erect capsules. In practice *T. cernua* is readily identified in the field because it is usually produces abundant sporophytes.

T. cernua is a plant of bare, highly calcareous soils, particularly on the Magnesian Limestone. It grows typically by paths, at the base of walls and about spoil heaps, generally where there is some protection from desiccation. Many localities are in or near limestone quarries. In Cheshire the species was found in old lime beds, and in Yorkshire it formerly occurred on lime deposited by water pumped from a colliery. There is an anomalous record from an area of Millstone Grit moorland in Yorkshire, where the most likely explanation is that *T. cernua* was growing on imported lime. The species is unknown in natural habitats in Britain and behaves as a ruderal, often recorded in association with two common weedy bryophytes, *Funaria hygrometrica* and *Leptobryum pyriforme*. Consequently it is soon eliminated by the growth of coarse vegetation, and many of its occurrences have been impermanent. However, it has been known continuously for about 70 years in one part of the Don valley in South-west Yorkshire. At this and possibly other sites, competition from other species is reduced to some extent by the highly calcareous nature of the substrate.

The species is almost restricted to the Magnesian Limestone in Yorkshire, just extending into Nottinghamshire, and has been reported from a total of about 12 sites. There is a single record from Cheshire. Although the species may colonise suitable habitats as they come and go, there is evidence of a decline in recent years, and the three post-1970 records are all from South-west Yorkshire. One of these sites is within an SSSI, but the others have no designated site protection.

The main threat to *T. cernua* is the reduction in suitable habitat as quarries become overgrown or are infilled. Landscaping of a spoil heap caused the loss of one population in the Don valley in the 1980s. The lack of freshly turned soil at the extant sites is

a threat, as the species has large spores and may not be very mobile. Continuity of its habitat within rather small areas is important to its survival. Clearance of scrub and scraping or turning of ground at the known sites are likely to prove beneficial. *T. cernua* is the subject of a Biodiversity Action Plan.

T. cernua has a scattered distribution in northern and central Europe, and across northern and central Asia, North America and Greenland. Its natural habitat is on calcareous soil among rocks. It becomes more montane at the southern edge of its range.

Total number of hectads: 9 1970 onwards: 3

Tortula cuneifolia (Dicks.) Turner

Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Tortula cuneifolia is a small acrocarpous species with broadly oval, untoothed, unbordered leaves, widest above the middle and with smooth cells. The nerve sometimes projects at the leaf tip in a yellowish point. This plant grows in open habitats such as earth banks, walls, hedgebanks, ledges on cliffs and in old quarries, on bare soil, rock crevices and loose stony material. Sporophytes are common and produced in spring. *T. cuneifolia* has been recorded from widely scattered localities in southern Britain, north to East Suffolk and Anglesey. Most of the localities are on or near the coast, but it has also been recorded from several inland sites in the past. All the post-1970 sites for this species are coastal, and most have no designated site protection, although one is both an SSSI and an NNR, and the National Trust owns another. All recent records are confined to the south-west, with four from the south coast of East Cornwall and South Devon, one on the North Devon coast and two from Gwynedd (Caernarvonshire and Merioneth).

The reasons for the apparent decline of this species are not clear. Some populations may have been lost as a result of the sites becoming overgrown, but this is unlikely to be the sole explanation. However, it is possible that the perceived decline is not real, as *T. cuneifolia* may be an ephemeral plant of unpredictable occurrence, perhaps not persisting at any one place for very long but colonising new sites as suitable habitat becomes available. If this is the case, the metapopulation would be difficult to track over time. However, the plant has certainly been long persistent at some of its Cornish sites. *T. cuneifolia* has a Mediterranean–Atlantic distribution, extending north to Ireland, Britain and Belgium, south to north Africa and east to western Asia.

Total no. of hectads: 42 1970 onwards: 7

Tortula leucostoma (R.Br.) Hook. & Grev.

(*Desmatodon leucostoma* (R.Br.) Berggr.)
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

Tortula leucostoma is a small acrocarpous moss growing in open patches, or as scattered stems on calcareous mineral soil on ledges or in crevices of limestone crags. In its montane habitat it is not likely to be confused with other species of *Tortula*, but the gradually tapering leaves with a pale marginal band and the usually erect seta are useful confirmatory characters. At its two localities, stands occur in rather open sites, one with a broadly westerly aspect and the other facing south-east, at altitudes between 450 and 540 m; at both sites the preferred habitat is quick to dry. Plants are short-lived, probably annual, but sporophytes are common.

This species is restricted to the Braemar and Glen Shee area of the Eastern Highlands, where there are three populations within 25 km, two of which are in the same glen and all on the same geological formation. There are no specific threats to this species, and population levels seen during a survey in 1996 do not give rise to concern. *T. leucostoma* requires a very specific habitat, so climatic changes, which might affect that habitat, are probably the greatest threat. All populations are on SSSIs. *T. leucostoma* is an arctic–alpine species with a scattered distribution throughout the mountains of northern and central Europe and frequent in parts of the Alps. It is also recorded from north and east Asia, northern North America and Greenland.

Total no. of hectads: 2 1970 onwards: 2

Tortula wilsonii (Hook.) R.H.Zander

(*Pottia wilsonii* (Hook.) Bruch & Schimp.)
Status in Britain: *ENDANGERED*
Status in Europe: *Not threatened*

Tortula wilsonii is a small acrocarpous moss with obovate–lanceolate leaves that are widest above the middle, with untoothed, recurved margins, and an excurrent nerve. The erect capsule is widest about half way up, lacks a well-developed peristome and has a long-beaked lid. The small, strongly papillose leaf cells and spore size are also important characters. This moss grows on bare ground on banks, tracksides and among rocks, almost always by the sea. Sporophytes are common in winter and spring.

In Britain it is concentrated in south-west England, but with scattered sites around the coast north to South Lancashire and east to East Norfolk. It also occurs at a few inland sites. It appears to have declined markedly, perhaps catastrophically, in Britain, especially near the edge of its range, but the reasons for this are not known. In the past decade it has apparently disappeared even from several Cornish sites where it has been known for many years (D T Holyoak, pers. comm.). This Mediterranean–Atlantic species occurs along the Atlantic fringe of Europe from Britain and Ireland to Spain, and in the Mediterranean and Black Sea regions east to Romania and south-west Asia. It also occurs in British Columbia, Canada.

Total no. of hectads: 54 1970 onwards: 6

Trematodon ambiguus (Hedw.) Hornsch.
Status in Britain: *EXTINCT*
Status in Europe: *Not threatened*

Trematodon ambiguus is a small acrocarp characterised by the long, subulate leaf apex and the very unusual capsule, which has a thick neck at least half the length of the main, spore-producing part. At its only British site, on the lower slopes of Schiehallion in Mid Perthshire, a single tuft of *T. ambiguus* was collected in 1883 with *Bryum pallens* on bare, wet soil on a moorland path. Elsewhere in its range it grows in a variety of open, wet, disturbed habitats, such as streamsides, waysides and bare places in pastures. It has never been refound, either on Schiehallion or anywhere else in Britain, and it may have been nothing more than a casual occurrence. This species occurs throughout northern and central Europe and is widespread in southern and eastern Asia and northern North America.

Total no. of hectads: 1 1970 onwards: 0

Weissia condensa (Voit) Lindb.
(*Weissia tortilis* (Schwägr.) Müll.Hal.)
Status in Britain: *VULNERABLE*
Status in Europe: *Not threatened*

This small green acrocarp is nevertheless often larger than most British and Irish *Weissia* species (shoots 5–15 mm long). *W. condensa* has the narrow, pointed, leaves with incurved margins characteristic of the genus, but it may be distinguished by the thick, often reddish, leaf nerve, the dehiscent, exserted capsule without a peristome and the relatively small spores. Sporophytes are frequent in the spring. This species grows on bare ground, on soil in rock crevices and in sparse turf on dry south-facing slopes, usually on chalk or limestone and often near the sea. The loose tufts often become detached from the soil and this may aid the spread of the plant.

W. condensa has a markedly southern distribution in Britain, with scattered records from about 20 sites from South Devon to East Kent, with an isolated record from Berwickshire. It has been recorded at only four sites since 1970, two in close proximity on chalk cliffs in Dorset, one on the West Sussex Downs and one on the East Kent chalk cliffs. Two of the recent sites are within SSSIs. Although it may still occur at some of the other sites, it seems certain that this species has declined enormously over the last 30–40 years. The main threat is competition from coarse vegetation and scrub at sites which are now ungrazed, or grazed less intensively than they once were. This applies to many downland sites, particularly since myxomatosis started to affect the rabbit population. The general increase in nutrient loading that has taken place in recent years in southern England has also favoured the coarse grasses. *W. condensa* is widespread in southern and central Europe, extending eastwards into south-west Asia and southwards to north Africa and Macaronesia.

Total no. of hectads: 19 1970 onwards: 4

Weissia levieri (Limpr.) Kindb.
Status in Britain: *ENDANGERED*
Status in Europe: *Rare*

This small acrocarp — a relatively recent addition to the British flora (Warburg 1960) — forms compact green tufts. Its distinguishing features are the plane or slightly incurved leaves, and the capsule, which is unique among British and Irish species of the genus in being both immersed among the leaves on a very short seta and dehiscent. *Weissia levieri* grows on bare, calcareous soil and in rock crevices on sunny south-facing limestone slopes near the sea.

There are records of *W. levieri* from four sites in Britain: on Brean Down and Sand Point in North Somerset, and Worms Head and Port Eynon Point on the Gower Peninsula, Glamorgan. However, it has not been seen since the 1960s at its Welsh sites. As this species requires open turf, encroachment of scrub and coarse vegetation due to insufficient grazing pressure and nutrient enrichment may be a threat. *W. levieri* has a predominantly Mediterranean distribution, but is rare and recorded from only a small number of sites in western France, Spain, Italy, the former Yugoslavia, the former USSR, Algeria and the Canaries.

Total no. of hectads: 4 1970 onwards: 2

Weissia mittenii
(Bruch, Schimp. & Gümbel) Mitt.
Status in Britain: *EXTINCT.* Endemic
Status in Europe: *Extinct.* Endemic

This small acrocarpous moss had an indehiscent capsule held just clear of the leaves on a short seta, and perichaetial leaves larger than the stem leaves. It was a pioneer species on damp, non-calcareous muddy or sandy clay soils in fallow fields, woodland rides and on roadside banks. It may have been of hybrid origin, the most likely parents being *Weissia multicapsularis* (q.v.) and *W. rostellata*, but it was never recorded with both putative parents. Sporophytes were produced frequently but these were often deformed. This species was endemic to England, where it was recorded from six sites in Surrey and East and West Sussex. It was last seen in 1920. The reasons for its extinction are unknown. Although extinct, it was not listed as such in the European *Red Data Book* because of its possible hybrid origin.

Total no. of hectads: 5 1970 onwards: 0

Weissia multicapsularis (Sm.) Mitt.
Status in Britain: *ENDANGERED*
Status in Europe: *Endangered*. Endemic

This is a small acrocarpous moss but, with shoots up to 1.5 cm tall, often larger than many species of *Weissia*. The leaves are long and narrow, with the perichaetial leaves becoming abruptly longer than the lower leaves. The indehiscent capsule is spherical with a pointed tip and immersed among the perichaetial leaves. The similar *W. sterilis* has clustered short branches on the fertile stems, whereas *W. multicapsularis* is not, or hardly, branched. This is an ephemeral moss of disturbed, non-calcareous loamy, clayey, muddy or sandy clay soils. In Cornwall it occurs on banks and tracksides on sea cliffs, Cornish 'hedges' and at the edges of fields. It has also been recorded from woodland rides, old quarries and fallow fields.

The main concentration of records of *W. multicapsularis* is in East and West Cornwall, where it has been recorded at 13 sites but seen recently at only three. Survey work in 1999 (Holyoak 1999b) indicated a total cover of less than 0.01 cm^2 at one of the Cornish site, 17.6 cm^2 at the second and *c.* 62 cm^2 at the third. Comparing 1999 data to data collected in 1998, it was found that, while some patches of *W. multicapsularis* had appeared, several others had been completely or almost completely concealed beneath grasses. Elsewhere, it has been seen since 1950 at two sites in South Devon and Monmouthshire, but only in Monmouthshire since 1970. It was formerly recorded from Cheshire (two sites), Berkshire, East and West Sussex, Herefordshire, East Kent and Oxfordshire. The sites where the species has been recorded since 1970 have no designated site protection.

The main threat to this species is lack of disturbance, grazing or other management, which leads to the colonisation of its open habitats by competing vegetation. *W. multicapsularis* also needs nutrient-poor soils, and appears to be consistently absent from nutrient-enriched, disturbed soils. Holyoak (1999b), reporting on the Cornish populations, believed '...it was apparent that most of the population will soon be lost unless unshaded soil surfaces are maintained through deliberate management.' In the same report, he also postulated that:

> The reduced competition from vascular plants at all three sites can apparently be attributed to occurrence together of thin free-draining soils, exposure to coastal winds, summer drought and poverty of nutrients, while rabbit-grazing is an additional factor... It is possible that *W. multicapsularis* actually requires lower nutrient levels than these common colonists (*Barbula convoluta*, *Bryum bicolor*, etc.), but more likely that owing to its poorer spore dispersal from cleistocarpous capsules and longer-lived perennial habit it is less efficient as a colonist and slower growing, so unable to take advantage of temporary substrates. (Holyoak 1999b)

W. multicapsularis is the subject of a Biodiversity Action Plan which is currently driving intensive fieldwork to attempt to find populations of this species in Cornwall (Holyoak 1999b). Outside Britain this species has been recorded only once from western France.

Total no. of hectads: 20 1970 onwards: 4

Weissia squarrosa (Nees & Hornsch.) Müll.Hal.

Status in Britain: *ENDANGERED*
Status in Europe: *Rare*. Endemic

Weissia squarrosa is a small acrocarpous moss similar to the common *W. microstoma*, with narrowly lanceolate leaves with incurved margins and a narrow-mouthed capsule, without any peristome teeth, borne on a long seta. It is distinguished by the often decumbent stems with widely-spreading leaves and the presence of distant-leaved innovations. An ephemeral species, *W. squarrosa* grows on damp, usually non-calcareous clayey soils at field edges, bare places in fallow fields and grassy banks, woodland rides, canal banks and around the edges of pools and reservoirs. Sporophytes are frequent, produced in the spring.

This species was once widely scattered and locally frequent in Britain north to Westmorland, Yorkshire and Fife. However, it has suffered a serious decline and within the last 40 years has been seen at only 14 sites scattered over the south of England and Wales. Only two post-1970 sites are known, one by a reservoir in Buckinghamshire with no designated site protection, and the other in a Kent woodland, where a large population was discovered in 1999, covering a bank for a length of about 50 m within an SSSI.

Some sites have almost certainly been lost through agricultural improvement. The reasons for its loss from other sites are not clear, but the species requires open soil surfaces and some colonies may have become overgrown by competing vegetation. Although ephemeral and perhaps somewhat mobile, *W. squarrosa* has relatively large spores, and colonies may therefore be less mobile than many of the more opportunist species, most of which have smaller spores that can be carried more easily in the wind. Sites of old records should therefore be investigated. This species has a scattered distribution in northern and central Europe, reaching north to southern Fennoscandia.

Total no. of hectads: 49 1970 onwards: 2

Zygodon forsteri (Dicks ex With.) Mitt

Knothole moss
British Status: *ENDANGERED*. WCA Schedule 8
Status in Europe: *Vulnerable*

This acrocarpous moss forms shining dark blackish-green colonies up to 5 mm tall, although the tips of the shoots appear whitish on drying out. It resembles other epiphytic *Zygodon* species in its rather short, pointed leaves which spread out very quickly on being moistened, but differs in its darker colour, less cushion-forming habit, large smooth leaf cells and the capsule being widest above the middle. *Z. forsteri* is virtually confined to ancient groves of formerly pollarded wood–pasture beech trees on acid soils in fairly open, well-lit sites, although it has been recorded (only once in each case) on maple *Acer* and silver birch *Betula pendula*. The largest populations — often producing thousands of sporophytes — occur on sickly trees, both spears and pollards, that have hollow trunks or high bosses that fill up with dead leaves and rainwater. This forms an infusion that trickles down the trunk from a fissure, forming a seepage-track, which can survive for as much as 10–20 years until the reservoir springs a leak. Numerous other satellite colonies occur in small patches on the rims of callused knotholes or tiny hollows in knarled projections on exposed roots, preferentially colonising the grooves cut by grey squirrels that siphon the water through the patches for several days after rainfall. These patches are ephemeral, disappearing in dry years, and are often scraped off by squirrels. After a wet autumn *Z. forsteri* can suddenly colonise numerous additional trees, but these colonies rapidly disappear after a dry summer. In France and Germany, beech is again the major host, although *Z. forsteri* is occasionally found on elm and maple. Farther south and east in Europe it seems to be found on a range of *Quercus* species, *Populus*, *Ulmus*, hop-hornbeam *Ostrya* and walnut *Juglans*, almost always below a seeping wound.

This species is now restricted to Burnham Beeches in Buckinghamshire (Little 1967), Epping Forest in South Essex and the New Forest in South Hampshire (Proctor 1961), all within SSSIs. It has also been recorded, once only, from both South Somerset and Worcestershire, but has not been refound for over 80 years in these counties. In Burnham Beeches it was found on 11 huge pollarded beech trees in the 1960s, and on 10 trees in 1994, always on knarled roots or knotholes — except for one tree with an extensive seepage-track — strung out in a line along the slopes of the central valley. The colonies are, however, ephemeral, moving around from tree to tree from one year to the next. The latest information on the Burnham Beeches population (Rumsey 2000) is that *Z. forsteri* is grow-

ing on 21 trees, although it has disappeared from four of the trees on which it was reported in the early 1990s. Colonies on 15 of the trees were producing sporophytes in February–March 2000, but invertebrate grazing had destroyed 30% of the capsules.

In Epping Forest, *Z. forsteri* was estimated to occur on 20–30 trees in 1984 (Adams 1984). Exhaustive mapping in 1988 located 19 host trees — five sickly seepage-track trees, and 14 others with knarled roots or knotholes (K J Adams, pers. comm.). The commonest associates of *Z. forsteri* on the seepage tracks are *Neckera complanata*, (otherwise absent in the Forest, suggesting that acid rainfall may be neutralised by the leaf infusion), and *Z. viridissimus*. The bulk of the localities occur along a hill ridge in Great Monk Wood. Here tens of thousands of sporophytes were produced on the seepage-track trees before the hurricane of 1987, when three of these trees had their tops blown off, removing their reservoirs. Since then the population has crashed, only three trees now being known to harbour the moss (K J Adams, pers. comm.). Furthermore, up until the late 1980s, because of atmospheric SO_2 pollution, *Z. forsteri* had little competition from other epiphytic mosses. Subsequently, improvements in air quality have led to a luxuriant growth of common mosses, in particular *Amblystegium serpens* and *Brachythecium rutabulum*, at the expense of *Z. forsteri*. In addition, large numbers of suitable trees have been blown down, resulting in dense birch and beech sapling thickets around the surviving trees. In the long term, pollarding of new spear trees is urgently needed to keep the habitat open, and it doubtful that the population in Epping Forest will survive the bottleneck. Of the tens of thousands of beech pollards in Epping Forest only a handful of dying trees are in the right condition at any one time to sustain the main seepage track colonies.

In the New Forest the true extent of the population is unknown. In the 1950s six host trees were known — three seepage-track and three knothole sites. In 1994, there were no populations on the grove of ancient beech pollards near the Rufus Stone, but a substantial colony still occurred on a tree with a seepage-track at the head of a small valley nearby. The finding of a colony in Rockram Wood some 2 km to the north-east in 1994, however, suggests that it may be more widespread in the New Forest than formerly realised.

At all three localities the mainstay colonies occur on ancient beech pollards, too old to be repollarded and reaching the end of their lives. Felling of these sickly trees must be avoided, even if they do not harbour colonies, as the species is relatively mobile over a restricted area. A long-term conservation strategy should involve pollarding of areas of new spear beech trees to replace those gradually lost through senescence, and keeping the light intensity at the right level by suppressing tree-fall patch scrub development. Because of the small size of populations, collecting is a significant threat. It is the subject of a Biodiversity Action Plan. *Z. forsteri* has been reported from scattered localities, most of them in western Europe, but extending to Madeira, Algeria, Bulgaria and Greece.

Total no. of hectads: 6 1970 onwards: 3

Zygodon gracilis Wilson

Status in Britain: *ENDANGERED*. WCA Schedule 8
Status in Europe: *Vulnerable*

Zygodon gracilis is a green tuft-forming acrocarp much larger than the other British species of the genus, growing 2–6 cm tall, with lanceolate, pointed leaves. The upper leaves are sharply toothed towards the apex, further distinguishing it from other members of the genus. The natural habitat of this species is on dry, open outcrops or loose rocks of Carboniferous Limestone. However, it has only rarely been recorded in this habitat, and is usually found on old dry limestone walls, closely associated with other calcicoles such as *Neckera crispa* and *Tortella tortuosa*. It has been found with sporophytes only once in Britain, in 1866.

Z. gracilis is recorded from about eight stations in the Craven district of Mid-west Yorkshire (Malham, Ingleborough and Pen-y-ghent), although it has not been refound at several of these for many years and only two — in the Ingleborough and Pen-y-ghent areas — since 1970. Both of these sites support several cushions of the plant, on drystone walls. A 19th century record from Connemara in Ireland is thought to be an error. The most recent sites for this species are within SSSIs. The growth of rank vegetation has reduced or eliminated some populations in the past. Wall repairs are potentially damaging if due care is not taken, and run-off from metal fencing wire (which is often run along the top of drystone walls) may also be inimical to the species. It is therefore important that steps should be taken to locate extant colonies and record the precise locations, so that this information can be communicated at the local level. Collecting is a possible threat at the post-1970 site because of its accessibility. It is the subject of a Biodiversity Action Plan. *Z. gracilis* is also a rare species outside Britain, occurring in the mountains of central Europe and western North America.

Total no. of hectads: 4 1970 onwards: 2