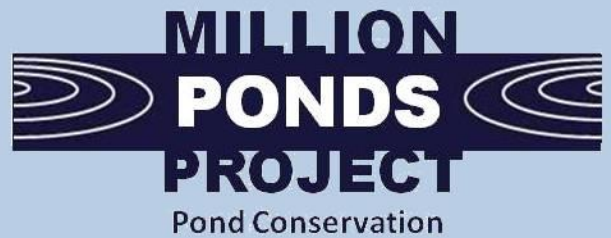


Creating ponds for rare mosses and liverworts



A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Mosses and liverworts

Mosses and liverworts, collectively known as bryophytes, are an incredibly diverse group of plants. There are over 1,000 species in the UK occurring in almost every habitat, from dappled shade in woodlands to almost bare limestone crags. Within these habitats the margins of ponds, lakes and pools provide an important resource for many species because they provide areas of bare wet mud on which bryophytes can germinate (Figure 1).

Unfortunately due to habitat loss, regulation of water levels and declines in the availability of clean unpolluted water, many bryophytes are now seriously threatened (Figure 2). By creating suitable pond habitats we can give rare mosses and liverworts the best chance of recovery.



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Figure 1. Bryophytes growing on bare mud within the pond margin: Norfolk Bladder-moss *Physcomitrium eurystomum* (left) and Lizard Crystalwort *Riccia bifurca* (right).

2. Designing ponds for bryophytes

The spores of mosses and liverworts can readily move to new ponds on the feet of grazing animals and wildfowl. But in order for new ponds to support bryophytes they must have three characteristics:

- **Clean water**, free from high levels of nutrients and pollutants.
- **Fluctuating water levels** which expose the pond margin for at least four months of the year.
- **Bare mineral substrates**, such as sands, clays and peats.

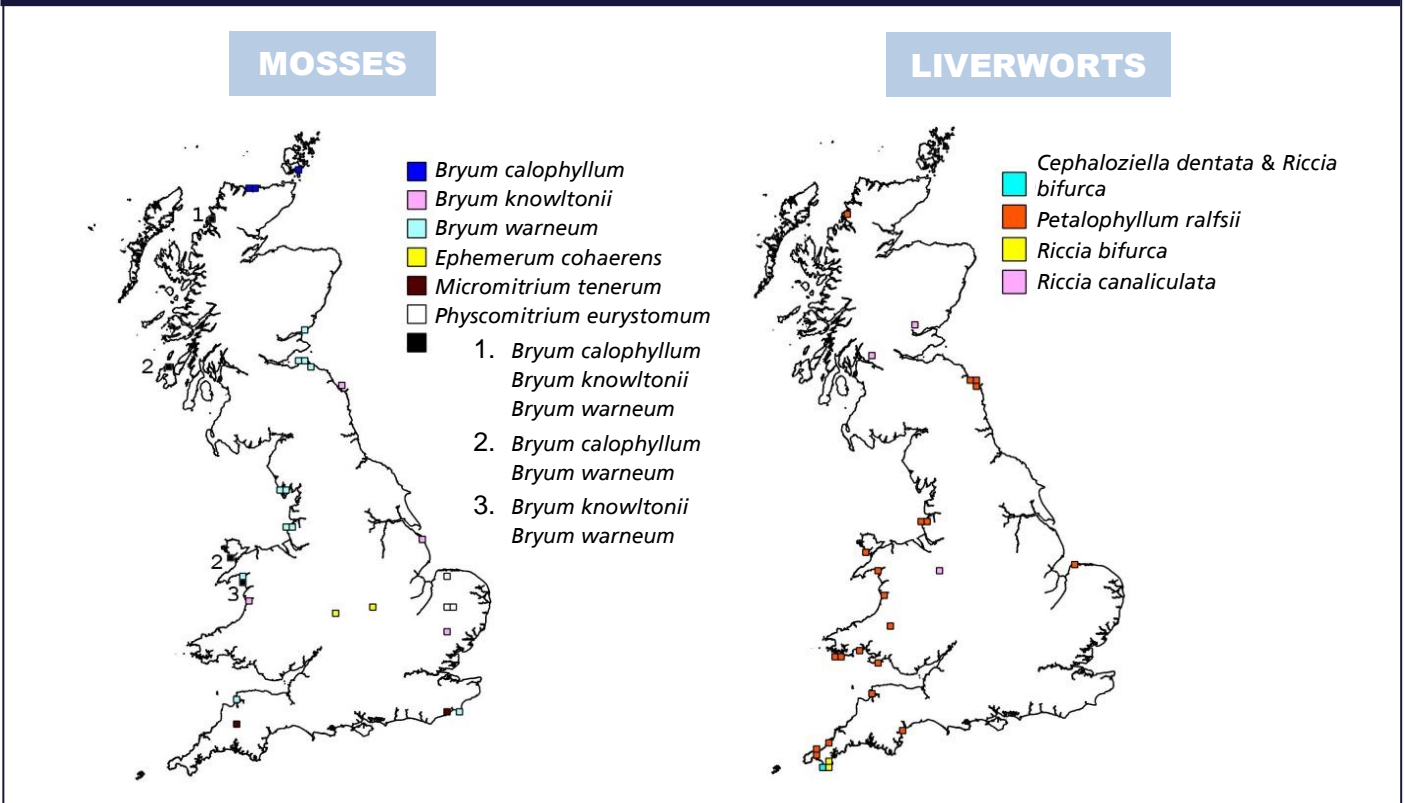
Designing good ponds for mosses and liverworts is about retaining these three features. Being aware of damaging influences in the pond catchment can help to ensure the pond has clean water, whilst grazing can help to maintain open conditions.

Each species will have slightly different habitat requirements dependent on soil pH, the degree to which the pond margin dries out and the surrounding habitat type. Information on the broad habitat requirements of threatened mosses and liverworts are given in Table 2 (at the end of this factsheet).

Key messages

- Clean water is essential for all of our rarest mosses and liverworts. Avoid areas where the adjacent landuse could add nutrients or pollution to surface waters or groundwater.
- On mineral or forestry sites, ensure that waterbodies have bryophyte friendly after uses. If needed, partition the site into areas for recreation and those for wildlife conservation.
- Ensure that all waterbodies whether large or small have very wide shallow margins. This will increase the width of the drawdown zone and optimise the area available for bryophytes.
- Create a complex of ponds of different sizes. This will provide a range of different environmental conditions and support the greatest number of both common and rare mosses and liverworts
- Don't regulate water levels. Many of the bryophytes mentioned in this dossier grow on wet substrates after the water levels have receded. Ponds may dry annually or once every 10-20 years.
- Most ponds require grazing management in order to create the correct vegetation structure for mosses and liverworts. The ratio of ponds to animals and the type of grazing stock will determine grazing pressure.

Figure 2. Distribution of UK BAP mosses and liverworts associated with ponds



Data provided by David Holyoak BBS

3. Pond location

Creating ponds with bryophytes in mind will benefit many species of mosses and liverworts. But to benefit some of the UK's rarest species, ponds should be located within the appropriate habitat type and on a suitable substrate (Table 1).

For many species, ponds should be created adjacent to existing populations or within their historical distribution. The spores of mosses and liverworts can readily move to new ponds on the feet of grazing animals, therefore new ponds should be created within the same grazing unit as existing populations. Alternatively, the spores of many bryophytes can remain viable for many years waiting for suitable conditions to re-occur, so new ponds may trigger germination from existing spores in the soil (Figure 3).



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Figure 3. Millimetre Moss *Micromitrium tenerum* (left), a tiny and very rare moss that completes its full life-cycle within a few weeks after mud is exposed by falling water levels. A single plant of *M. tenerum* (right), showing ripe spores escaping from a capsule. The species survives periods with high water levels through spores persisting in submerged mud.



Table 1. Guide to BAP pond bryophytes based on substrate type and surrounding habitat

| | | pH | | |
|---------|------------------------------|--|---|--|
| | | Mildly acid | Neutral | Mildly alkaline |
| Habitat | Heathland | <i>Bryum schleicheri</i> <i>Riccia canaliculata</i> | | <i>Cephaloziella dentata</i> <i>Riccia bifurca</i> |
| | Grassland | | <i>Micromitrium tenerum</i> <i>Ephemerum cohaerens</i> | <i>Cephaloziella dentata</i> <i>Petalophyllum ralfsii</i> <i>Riccia bifurca</i> <i>Physcomitrium eurystomum</i> |
| | Woodland rides and clearings | <i>Fossombronia foveolata</i> <i>Micromitrium tenerum</i> <i>Atrichum angustatum</i> | | |
| | Dune slack | | | <i>Bryum calophyllum</i> <i>Bryum knowltonii</i> <i>Bryum warneum</i> <i>Petalophyllum ralfsii</i> |

Avoiding sensitive areas

It is vitally important not to dig ponds in areas with existing wildlife or archaeological value. Always seek advice during the design stage to avoid problems later on (see useful contact information at the end of this factsheet).

4. Clean water

The UK's rarest mosses and liverworts are only found on the edge of ponds fed by clean, unpolluted water. One of the main reasons for the decline of these species is the lack of clean water in the British countryside. To create clean water ponds and lakes:

- Make sure ponds have a clean water source such as groundwater, rainwater or clean surface water runoff.
- Avoid any stream and ditch inflows into ponds or lakes (these bring in pollutants, including silt).
- Minimise flooding from rivers.
- Don't allow water to drain in from arable crops, urban areas or roads (either from piped drains or surface-water).
- Prevent any sewage outlets feeding into lakes or pools.
- Try to minimise the presence of large numbers of geese and gulls.
- Don't add topsoil to waterbody margins.
- Where possible, ensure the waterbody surroundings are semi-natural (e.g. unfertilised grassland, wood, scrub, heath or dune habitats).
- In dune habitats avoid areas close to fences and boardwalks. The preservatives in treated wood and the galvanised coating used to prevent rust are highly toxic to bryophyte species.
- Avoid locating ponds near to public paths or open access areas with high levels of public pressure.
- Do not stock wildlife ponds with fish. Species such as carp are bottom feeders and will stir up silt, preventing bryophytes from growing.

For further information, consult [Pond Creation Toolkit Factsheet 5](#) for more information.

5. The pond margin

Ponds come in a huge range of shapes and sizes. They may be as small as a 1m² pool or up to 2ha in size, and may range in depth from a few centimetres to several metres (Figure 4). All natural ponds have fluctuating water levels. Shallow, surface water-fed ponds on sandy or gravel substrates can dry completely on an annual basis. Even permanent ponds drop by half a meter on average during the summer months.

Mosses and liverworts depend on the **drawdown zone** which is exposed when the water levels drop. Many plants find it difficult to grow here because of the repeated wetting and drying cycle. But bryophytes have spores which can remain dormant for many years and can germinate, grow and reproduce very quickly when conditions are just right. To maximise the amount of habitat available for bryophytes this zone should be as broad as possible (Figure 5).



Figure 4. Shallow lake habitat for Norfolk Bladder-Moss *Physcomitrium eurystomum* (left) and a rutted track which supports Warne’s Thread-moss *Bryum warneum* (right). Both are shallow or have shallow margins (<20cm) and a broad drawdown zone which is sparsely vegetated.

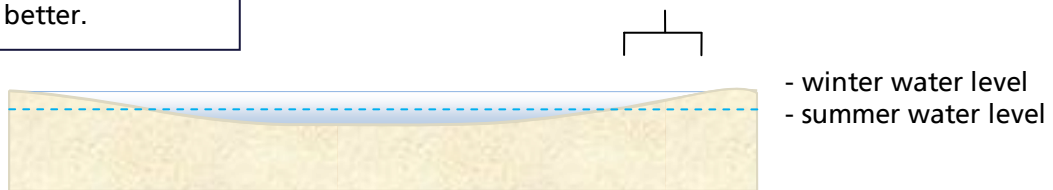
Figure 5: Designing the drawdown zone

To maximise the width of the drawdown zone and to ensure that summer water levels remain close to the soil surface, the pond margin must be as shallow as possible.

Narrow drawdown zone

Good for many pond species but could be better.

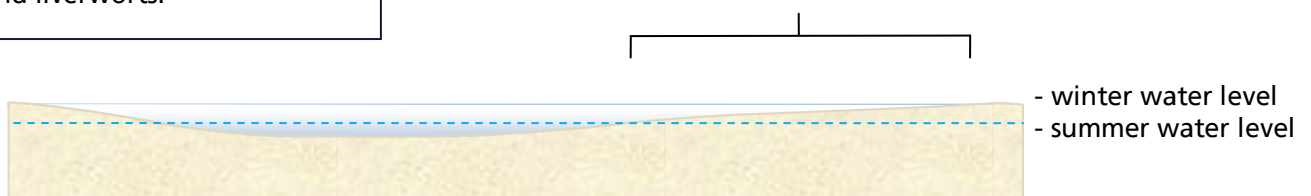
1 in 10 (5°) – a drop in height of 10cm between summer and winter water levels gives a drawdown zone of just 1m.



Broad drawdown zone

Optimum habitat for mosses and liverworts.

1 in 20 (3°) – a drop in height of 10cm between summer and winter water levels gives a drawdown zone of 2m.





6. Inorganic sediments

Many rare mosses and liverworts are poor competitors. They usually occur in newly created habitats where there are bare mineral substrates with few organic sediments and sparse vegetation. As ponds mature, the number of terrestrial and aquatic plants increases, a layer of organic debris builds up on the pond margin and the abundance of rare bryophytes declines. A few simple measures can be taken to extend the length of time that the habitat remains open and suitable for bryophytes.

- **Fluctuating water levels** – Many rare mosses and liverworts live in the drawdown zone of the pond margin because the fluctuating water levels make it difficult for other species to become established.
- **Avoid heavy shade** – Many bryophytes can survive in moderate shade, but the amount of leaf litter produced by overhanging trees can cover-up the bare mineral substrate and make the pond margin unsuitable. In wooded areas, create ponds in clearings or consider coppicing trees along the pond margin. In areas where some tree cover is unavoidable design ponds with a shallow zone beyond the tree cover which is exposed during the summer months (Figure 6).
- **Wave wash** – A particularly useful technique to maintain areas of bare substrate is to use the natural action of wind and waves. As the wind blows over the surface of the pond it will whip up small waves causing erosion on the opposite margin of the pond and clearing the substrate of debris. This will provide new habitat on which the bryophytes can germinate (Figure 7).
- **Grazing** – Light poaching of muddy edges by stock often increases habitat diversity for bryophytes through provision of wetter hollows and drier ridges. However, excessive trampling can be disastrous with no stable niches remaining. Species like Petalwort *Petalophyllum ralfsii* thrive in heavily trampled habitats (e.g. on path edges), whilst other bryophytes such as Warne’s Thread-moss *Bryum warneum* are intolerant of much poaching or trampling.

Figure 6: Designing ponds in woodlands for bryophytes

In woodlands, create ponds in clearings or coppice trees along the pond margin to reduce shade. Alternatively large ponds and lakes can be created which have a drawdown zone extending beyond the shaded area.

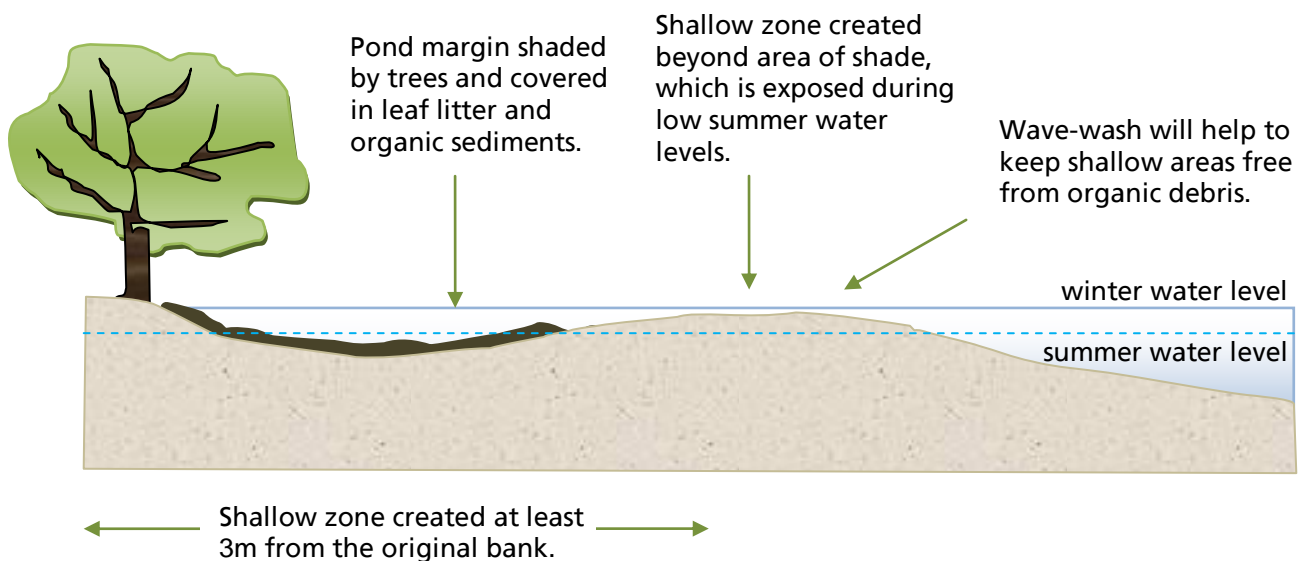
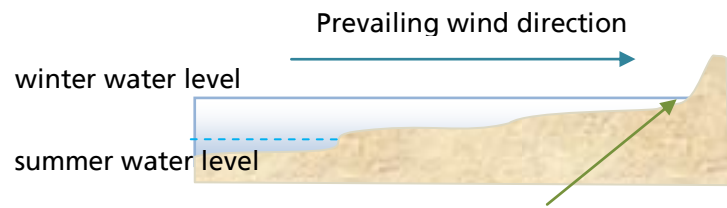
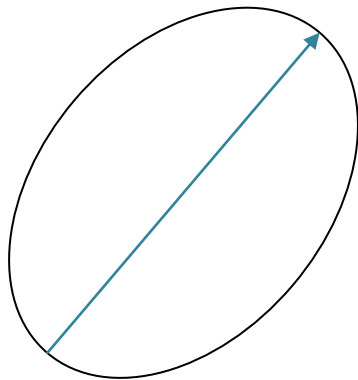


Figure 7: Using wave wash to maintain areas of bare substrate

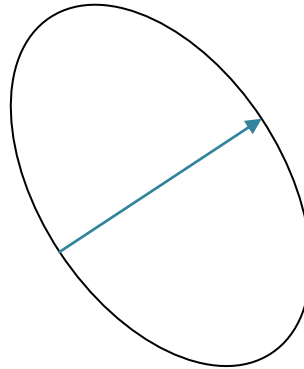
A combination of pond orientation, pond size and the degree of shelter provided by the surrounding habitat will determine how effective wash-wash will be in creating new areas of bare substrate.



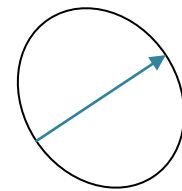
Wave wash during the winter extends the area of the drawdown zone and creates new areas of bare substrate for bryophytes.



Large pond with long fetch
- strong wave wash



Large pond with short fetch
- moderate wave wash



Small pond in exposed landscape with short fetch
- moderate wave wash

7. Pond complexes

The rare bryophytes included in this factsheet are opportunist species which will take advantage of the correct conditions when and where they occur. By creating a complex of ponds of different depths and sizes it is possible to maximise the chances that favourable conditions will occur in some of the ponds in any one year.

Naturally mosses and liverworts would move around a site as some areas matured and new habitats were created, by the erosion of substrate from wind, water or stock movements (Figure 8). Dynamic habitats like these are now becoming a scarce resource because we have constrained the opportunities for habitats to move and develop, by stabilising water levels and preventing small scale erosion. Ideally habitats should be restored to allow them to function naturally, but we can also help to restore the habitat by creating new ponds every once in a while (see *Case study* page 8).



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Figure 8. Female plants of the liverwort Petalwort *Petalophyllum ralfsii* (left), with capsules nearly mature. Typical habitat of *P. ralfsii* in North Devon, at edge of a temporary pool, with vegetation kept very short by low nutrient levels, trampling and intense grazing by rabbits. Petalwort moves between ponds within these trackways wherever conditions are favourable.



8. Site management

Grazing is the only sustainable management option to maintain pond habitats for bryophytes. The choice of grazing animal (cattle, sheep or rabbits) and the density of stock will depend on the habitat type and the species being managed. Where grazing is not a viable option it may be possible to create the correct level of disturbance for some species using vehicles, particularly for those species restricted to habitats on the rutted trackways e.g. bryophytes on the Lizard Peninsula, Cornwall.

Aside from this, little additional management will be required, but there are a number of issues to be aware of and avoided.

- **Regulation of water levels** – drainage, water abstraction, stabilisation of water levels and operations such as intensive forestry can all have disastrous effects on the habitats of bryophytes. Be aware of activities in the surrounding landscape.
- **Heavy disturbance** – from public recreation, e.g. footpaths, fishing, dog walking and feeding waterfowl will severely reduce the quality of the habitat for bryophytes. Partition sites to draw pressure away from sensitive areas. On large sites create different ponds for different user groups.
- **Invasive alien plants** – such as New Zealand Pigmyweed *Crassula helmsii* will spread rapidly over the bare ground provided in these pond edge habitats (Figure 9). They are difficult and expensive to control once they have become established.
- **Shade** – may need to be reduced manually on some sites, especially those which are not grazed. Shaded pools may support bryophytes, but they are unlikely to have many or rare species. However, dappled shade is an important habitat type for many species and it is beneficial to allow some ponds within a site to remain partly shaded. See the [Supplementary Habitat Factsheet: Woodland ponds](#) more information on pond creation in woodlands.



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Figure 9. Habitat for Violet Crystalwort *Riccia huebeneriana* (left) on mud exposed among vascular plants in the inundation zone of a reservoir. Former habitat of *R. huebeneriana* in Sussex (right), now unsuitable because all of the reservoir mud is shaded either by trees or the invasive non-native plant New Zealand Pigmyweed *Crassula helmsii*.

Case study: Pond creation in dune slacks for mosses and liverworts

Most dune slack ponds are erosion features which form when wind-blown depressions cut down below the water table. Ponds will vary according to pond profile, the height of the summer and winter water levels, the pH of the substrate, the age of the blow-out and the level of grazing intensity.

Many dune bryophytes are found on the margins of young dune slack ponds where little other vegetation grows. Here, bare calcareous sand is kept open and damp because of fluctuating water levels. Different species require slightly different conditions, Petalwort *Petalophyllum ralfsii* is found during the winter on damp sand at the very edge of the slack which may dry out completely during the summer months. Warne's Thread-moss *Bryum warneum* occurs where the sand remains damp all year and where winter inundation creates new areas of bare sand.

Damage to dune slack habitats has led to the loss of this important habitat type. Only a few key sites for dune bryophytes remain including the North Northumberland coast, Saltfleetby, Braunton Burrows, Kenfig, Morfa Dyffryn, Newborough Warren and the Sefton Coast. Restoration of dune slacks is helping to create new habitats for many rare mosses and liverworts.



© David Carrington



© David Carrington

Figure 10. Turf stripping and pond creation at Kenfig reserve to create new winter wet bare sand habitat for dune slack species including the BAP liverwort Petalwort *Petalophyllum ralfsii*.

In the **Kenfig SAC**, South Wales, a dune restoration project, with support from Plantlife International, has been underway for the last 10 years. Areas of slack have been scraped and smaller ponds created for bryophyte species and other rare plants including fen orchid *Liparis loeselii* (Figure 10). The key to these new habitats is the removal of species poor turf back to bare mineral substrate, winter flooding and the broad very shallow drawdown zone of these waterbodies.

More ponds are due to be created in the next couple of years with funding from Biffaward through the Million Ponds Project, and in addition, part of the dune is being mobilised to allow the formation of natural slacks once more. It is hoped that similar projects can be repeated in other dune systems.

The **Sefton Coast SAC** in north-west England is another important bryophyte site. Here, work has included "re-profiling" of dune-slack pool edges to recreate habitat for Natterjack Toads *Epidalea calamita*, which coincidentally provides new open habitats for Warne's Thread-moss *Bryum warneum* and Petalwort *Petalophyllum ralfsii*. Small new ponds dug for Natterjack Toads at **Saltfleetby and Theddlethorpe** (Lincolnshire) have also been colonised by Warne's Thread-moss *B. warneum*.



9. Useful contacts and further reading

- Atherton, A., Bosanquet, S. and Lawley, M. (2010) Mosses and liverworts of Britain and Ireland: A field guide. British Bryological Society.
- Holyoak, D. (2003) Plantlife Back From the Brink Management Series: *Looking after rare mosses and liverworts in coastal dune slacks*. Salisbury: Plantlife International.
- Plantlife International (2004) Species dossier for *Sphagnum balticum* baltic bog-moss.
http://www.plantlife.org.uk/uploads/documents/Sphagnum_balticum_dossier2.pdf
- Plantlife International (2004) Species dossier for *Weissia rostellata* beaked beardless-moss.
http://www.plantlife.org.uk/uploads/documents/Weissia_rostellata.pdf
- Plantlife International (2006) Plantlife Back From the Brink Management Series: *Looking after rare mosses and liverworts beside lakes and reservoirs*. Salisbury: Plantlife International.
- Plantlife International (2006) Species dossier for *Petalophyllum ralfsii* petalwort.
http://www.plantlife.org.uk/uploads/documents/Petalophyllum_ralfsii_dossier.pdf
- Plantlife International (2007) Species dossier for *Bryum calophyllum* matted bryum.
http://www.plantlife.org.uk/uploads/documents/Bryum_calophyllum_Species_Dossier.pdf
- Plantlife International (2007) Species dossier for *Bryum warneum* Warne's thread-moss.
http://www.plantlife.org.uk/uploads/documents/Bryum_warneum_SpeciesDossier.pdf

For further information about the Million Ponds Project and to consult other factsheets in the Pond Creation Toolkit, please visit www.pondconservation.org.uk/millionponds or email enquiries to info@pondconservation.org.uk



This factsheet has been written with the advice and expertise of Dr. David Holyoak. Thanks must also go to David Carrington for information on the dune restoration project at Kenfig National Nature Reserve.

Table 2. Broad habitat requirements for rare mosses and liverworts associated with ponds and pools

| Common name | Scientific name | Taxonomic group | UK BAP | Broad habitat requirements | Conservation status and distribution information |
|--------------------------|----------------------------|-----------------|--------|--|--|
| Short-tooth Hump-moss | <i>Amblyodon dealbatus</i> | Moss | | Found in base-rich flushes and sparsely vegetated wet dune slacks. | <i>Nationally scarce</i> Widely scattered and isolated localities in the uplands and on coasts. |
| Constricted Feather-moss | <i>Amblystegium humile</i> | Moss | | On the edge of pools, growing on bare soil and trees. It has also been recorded from stream banks. | <i>Nationally scarce</i> Widely scattered and contracting distribution in a belt from South Yorkshire and Norfolk to Devon. |
| Matted Bryum | <i>Bryum calophyllum</i> | Moss | Yes | A colonist of almost bare, calcareous coastal sand in dune-slacks or hollows in machair, it was recorded in a gravel-pit in 1865. | <i>Endangered</i> Only found in one location in Anglesey and a few scattered locations in Scotland. |
| Round-leaved Bryum | <i>Bryum cyclophyllum</i> | Moss | | Inundation zones beside lakes and reservoirs. | <i>Nationally rare</i> Now known only in Scotland; formerly in English Lake District. |
| A thread-moss | <i>Bryum dyffrynense</i> | Moss | | Damp sand, often closely associated with other rare <i>Bryum</i> including the threatened <i>B. warneum</i> . | <i>Nationally threatened</i> Scattered coastal locations. |
| Knowlton's Thread-moss | <i>Bryum knowltonii</i> | Moss | Yes | Damp calcareous sands in dune-slacks, hollows in machair or the top edge of salt-marshes. | <i>Vulnerable</i> Only recorded from 5 sites in, Wales, North Lincolnshire, West Norfolk, Northumberland and Scotland. |
| Schleicher's Thread-moss | <i>Bryum schleicheri</i> | Moss | Yes | Spring-fed flushes. | <i>Nationally rare</i> Now known only in Scotland; it survives in Stirlingshire and is extinct in Mid-Perthshire. |
| Warne's Thread-moss | <i>Bryum warneum</i> | Moss | Yes | Typically on open, damp calcareous sand in dune slacks. However, large populations have also been recorded from damp substrate beside a few man-made gravel pits and ponds near the coast. | <i>Vulnerable</i> Currently only known from 4 sites in England, 2 in Wales and several Scottish locations. |
| Duval's Thread-moss | <i>Bryum weigeli</i> | Moss | | Found on the margins of base-poor waterbodies in the uplands. | <i>Nationally scarce</i> Restricted to Scotland and NE England (mainly Cumbria) and a few scattered locations in Wales. |



| Common name | Scientific name | Taxonomic group | UK BAP | Broad habitat requirements | Conservation status and distribution information |
|--------------------------|------------------------------------|-----------------|--------|---|--|
| Fine-leaved Feather-moss | <i>Campyliadelphus elodes</i> | Moss | | Winter-wet pools on base-rich sands and calcareous fens and marshes. | <i>Nationally scarce</i> Widespread scattered inland and coastal sites in England and Wales. |
| Golf-club Moss | <i>Catocopium nigratum</i> | Moss | | In England this species is restricted to base-rich dune slacks, especially at springs. | <i>Nationally scarce</i> Now restricted to Anglesey, the Sefton Coast, Co. Durham, North Northumberland and Scotland. |
| Toothed Threadwort | <i>Cephaloziella dentata</i> | Liverwort | Yes | Found in the winter wet depressions of heavily disturbed trackways and temporary pools within serpentine heath. | <i>Critically endangered</i> Restricted to the Lizard Peninsula. |
| Large Hook-moss | <i>Drepanocladus lycopodioides</i> | Moss | | Low nutrient, calcareous dune-slack pools. | <i>Nationally scarce</i> Scattered coastal sites in England and Wales. |
| Chalk Hook-moss | <i>Drepanocladus sendtneri</i> | Moss | | Calcareous dune-slacks and heathland pools and lake edges. | <i>Nationally scarce</i> Scattered coastal sites in England and Wales. |
| Clustered Earth-moss | <i>Ephemerum cohaerens</i> | Moss | Yes | Non-calcareous, bare muds on the edges of lowland ponds, lakes and reservoirs. | <i>Endangered</i> Recent British records are from Northamptonshire and Worcestershire. |
| Beck Pocket-moss | <i>Fissidens rufulus</i> | Moss | | On hard calcareous substrates on the edge of rivers, only occasionally besides lakes and ponds. | <i>Nationally scarce</i> An upland species of the Pennines, south-Wales and Dartmoor. |
| Weedy Frillwort | <i>Fossombronina incurva</i> | Liverwort | | Found in the margins of pools along trackways, roads, mineral sites and dune slacks. | <i>Nationally scarce</i> Scattered locations, but with strongholds in southern England and south Wales. |
| Hooker's Flapwort | <i>Haplomitrium hookeri</i> | Liverwort | | On the margins of winter flooded pools over gravel substrates and in dune slacks. | <i>Nationally scarce</i> Restricted to a few scattered locations in Wales and northern England, but widespread in Scotland. |
| Gillman's Notchwort | <i>Leiocolea gillmanii</i> | Liverwort | | In winter flooded calcareous dune slacks and the margins of fen pools. | <i>Nationally threatened</i> Outside of Scotland this species is found in a handful of sites in northern England. |
| Broad-nerved Hump-moss | <i>Meesia uliginosa</i> | Moss | | Base-rich upland pools and occasionally base-rich dune slack pools. | <i>Nationally scarce</i> Anglesey, the Sefton Coast and the uplands of northern England and Scotland. |
| Millimetre Moss | <i>Micromitrium tenerum</i> | Moss | Yes | Non-calcareous, sparsely vegetated mud on the edge of reservoirs, ponds and lakes. | <i>Critically endangered</i> Currently only known from 2 sites; North Devon and East Sussex. |

| Common name | Scientific name | Taxonomic group | UK BAP | Broad habitat requirements | Conservation status and distribution information |
|------------------------|---------------------------------|-----------------|--------|---|---|
| Ruffwort | <i>Moerckia flotoviana</i> | Liverwort | | Found by shallow limestone flushes, fens and calcareous dune slack pools. | <i>Nationally scarce</i> Coastal sites in Wales, North Devon, northern England and Scotland. |
| Petalwort | <i>Petalophyllum ralfsii</i> | Liverwort | Yes | Found on bare calcareous sand on the very outer-edge of seasonally dry dune slacks. | <i>Nationally scarce</i> Scattered locations in SW England, the Sefton Coast, north Northumberland, north Norfolk, the Welsh coast, and at one site in Scotland. |
| Norfolk Bladder-moss | <i>Physcomitrium eurytomum</i> | Moss | Yes | On sparsely vegetated mud on the inundated margins of meres and ponds. | <i>Critically endangered</i> Was formerly in Hertfordshire, but now restricted to a few sites in Norfolk. |
| Dwarf Bladder-moss | <i>Physcomitrium sphaericum</i> | Moss | | Found on the margins of seasonally fluctuating ponds and lakes. | <i>Nationally threatened</i> Rare in south Wales, the Peak District and the central belt of Scotland. |
| Lizard Crystalwort | <i>Riccia bifurca</i> | Liverwort | Yes | Found on the bare mud of seasonal pools on serpentine heath. Needs very high water quality and heavily disturbed ground. | <i>Endangered</i> A very restricted species, found only on the Lizard Peninsula. |
| Channelled Crystalwort | <i>Riccia canaliculata</i> | Liverwort | Yes | Wet mud on the drawdown zone of reservoirs, lakes and ponds that are mildly acidic and sometimes rich in organic sediments. | <i>Vulnerable</i> Most British sites are at lowland reservoirs in central Scotland; otherwise isolated in Shropshire. |
| Cavernous Crystalwort | <i>Riccia cavernosa</i> | Liverwort | | In the margins of seasonally fluctuating ponds, lakes and reservoirs. | <i>Nationally scarce</i> Scattered throughout England, coastal sites in Wales and E. Scotland. |
| Violet Crystalwort | <i>Riccia huebeneriana</i> | Liverwort | | Nutrient-poor mud at the edge of large ponds, lakes, reservoirs and rivers, exposed in dry summers. | <i>Vulnerable</i> Recorded from over 20 widely scattered sites. |
| Fringed Heartwort | <i>Ricciocarpos natans</i> | Liverwort | | A floating leaved liverwort of calcareous ponds and ditches with high water quality. | <i>Nationally scarce</i> A English lowland species with an easterly distribution. |
| Olive Bog-moss | <i>Sphagnum majus</i> | Moss | | Bog pools. | <i>Vulnerable</i> Outside of Scotland this species is restricted to Northumberland. |
| Cleft Bog-moss | <i>Sphagnum riparium</i> | Moss | | Found on the margins of base-poor fen pools. | <i>Nationally rare</i> Very limited distribution outside of Scotland and northern England. |
| Beaked Beardless-moss | <i>Weissia rostellata</i> | Moss | | Most populations occur near the upper edge of the inundation zone of reservoirs. | <i>Nationally threatened</i> Distributed from Lothian to Anglesey and Dorset, currently known from 26 10km grid squares. |