

# Revision of the bryophyte schedule for the Flora (Protection) Order, 2015



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## Revision of the bryophyte schedule for the Flora (Protection) Order, 2015

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## Executive Summary

Following the publication of the first Red Data List for Ireland's bryophytes (hornworts, liverworts and mosses) in 2012, a revision of the bryophytes listed on the Flora (Protection) Order, 1999 (FPO) was undertaken. The 1999 FPO afforded legal protection to 18 species of bryophytes (4 liverworts and 14 mosses). The 2015 revision extends protection to 65 species (25 liverworts and 40 mosses), which represents 7.9% of the native Irish bryophyte flora. This compares favourably to the proportion of native vascular plants (flowering plants and ferns) currently protected under the FPO (68 species, or 6.8% of the native flora).

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## Introduction

Following the publication of the bryophyte Red List for Ireland in *Rare and Threatened Bryophytes of Ireland* (Lockhart, Hodgetts and Holyoak, 2012a), it was deemed timely to revise the bryophyte list on the Flora (Protection) Order, 1999 (FPO) (S.I. No. 94 of 1999). The 1999 FPO afforded legal protection to 68 vascular plants, 18 bryophytes, 1 lichen and 2 stoneworts. Under the Wildlife Act, 1976, as amended by the Wildlife (Amendment) Act, 2000, it is not allowed, other than with a licence granted by the Minister for Arts, Heritage and the Gaeltacht, to “cut, pick, collect, uproot or otherwise take, injure, damage, or destroy any specimen” of these species; to “purchase, sell, keep for sale, transport for sale or exchange, offer for sale or exchange or be in possession of any such specimen whether alive or dead or the flowers, roots, seeds, spores or any part, product or derivative thereof”; or to “wilfully alter, damage, destroy or interfere with the habitat or environment” of any of the listed species.

The bryophyte Red List identifies the threat status of taxa thought to be of conservation concern in Ireland. It was used as one of the principal means to identify taxa expected to benefit from legal protection. In this paper, threat status abbreviations follow current IUCN convention (IUCN, 2001):

RE – Regionally Extinct  
CR – Critically Endangered  
EN – Endangered  
VU – Vulnerable  
NT – Near Threatened  
DD – Data Deficient  
LC – Least Concern

The following additional abbreviations are used for European threat status, some of which follow the old IUCN convention (IUCN, 1978) modified for the purposes of producing the European bryophyte Red List (European Committee for the Conservation of Bryophytes, 1995):

R – Rare  
RT – Regionally Threatened  
K – Insufficiently Known

Nomenclature and taxonomy follows Hill *et al.* (2008). The main data source was the Irish Red List dataset, a spreadsheet of records for rare and threatened bryophytes in Ireland that underpinned *Rare and Threatened Bryophytes of Ireland* (Lockhart *et al.*, 2012a). This was compiled over the past 15 years using both old records (pre-1970) and records from recent fieldwork (post-1969). All the old records, which largely came from the British Bryological Society (BBS) database, were subjected to critical scrutiny, and this resulted in many corrections and amendments. The BBS database, via the NBN Gateway, was the source of records for those taxa not covered by the Irish Red Data List project.

## Revising FPO bryophytes

### Background

A number of bryophytes in Ireland have been afforded legal protection under domestic and European law. Species that were protected in the Republic of Ireland under the Flora (Protection) Order, 1999 are listed below (Table 1). The 1999 FPO listed 4 liverworts and 14 mosses, and was compiled from the best information available at the time.

Table 1: Bryophytes that were listed on the Flora (Protection) Order, 1999.

| Liverworts   | Current IUCN threat status in Ireland | Comments   |
|--|---------------------------------------|--|
| <i>Leiocolea gillmanii</i>   | VU                                    | Very rare species of damp machair  |
| <i>Leiocolea rutheana</i>  | EN                                    | Very rare and threatened fen species   |
| <i>Petalophyllum ralfsii</i>   | LC                                    | Listed on the Bern Convention Appendix I and the Habitats Directive Annex II |
| <i>Plagiochila heterophylla</i> (as <i>P. atlantica</i> )            | EN                                    | Very rare species of Atlantic woodland                                       |
| Mosses   |                                       |  |
| <i>Bryum calophyllum</i>   | EN                                    | Rare sand dune species   |
| <i>Bryum marratii</i>  | LC                                    | Now known to be much more widespread in Ireland than previously thought      |
| <i>Catoscopium nigratum</i>  | NT                                    | Dunes slacks and machair   |
| <i>Hamatocaulis vernicosus</i> (as <i>Drepanocladus vernicosus</i> ) | NT                                    | Listed on the Bern Convention Appendix I and the Habitats Directive Annex II |
| <i>Leptobarbula berica</i>   | VU                                    | Overlooked: two recent records from masonry                                  |
| <i>Orthotrichum pallens</i>  | EN                                    | Rare epiphyte on sycamore, possibly colonist and transient                   |
| <i>Orthotrichum sprucei</i>  | VU                                    | Lowland riverine species of silt-encrusted tree bases                        |
| <i>Orthotrichum stramineum</i>                                       | VU                                    | Epiphyte and colonist  |
| <i>Paludella squarrosa</i>   | CR                                    | Very rare and threatened; single locality                                    |
| <i>Tortula wilsonii</i> (as <i>Pottia wilsonii</i> )                 | RE                                    | Not seen in Ireland since 1934   |
| <i>Tetraplodon angustatus</i>  | DD                                    | Single transient record  |
| <i>Tortula inclinata</i>   | EN                                    | Very rare coastal plant  |
| <i>Weissia longifolia</i>  | VU                                    | Bare soil patches  |
| <i>Weissia rostellata</i>  | NT                                    | Colonist/shuttle species of reservoir margins                                |



## Choosing candidate taxa

The purpose of the FPO is to afford legal protection to threatened plants that are considered to need specific legislation in order to increase their chances of survival. It is thus a listing over and above that of the Red List as Red Listing is solely an expression of the rarity and threat status of a taxon. Including taxa on lists of species that are protected by law is a matter of conservation action and does not necessarily reflect the status of taxa on the Red List. Nevertheless, those taxa that have been assessed as CR, EN or VU are clearly in danger of disappearing and these were considered in the process of selecting candidates for legal protection. Some taxa that were thought extinct (RE) in Ireland have recently been rediscovered, and these too were considered as candidates for protection. However, many of these extremely rare and threatened taxa are threatened by factors on which FPO listing would have no bearing. Some of them are colonists that crop up unexpectedly in ruderal sites before completing their life-cycle and moving elsewhere. FPO listing would serve little purpose for these plants; their rarity and vulnerability is a result of the overall state of the countryside rather than factors that can be addressed by taxon-specific legal protection.

When considering taxa for listing on the FPO, a factor that was borne in mind was that it should not result in a stifling of field bryology. These days most bryologists are responsible and conservation-aware and collect only as much material as they need to identify a specimen. Indeed, it is often *essential* to collect material in order to effect a reliable identification. Field bryology is, by and large, not a threat to bryophytes, but quite the reverse; it is a vital part of enhancing our understanding of these plants, and therefore contributes to their conservation. There are a very small number of taxa that would be severely impacted by irresponsible collecting (e.g. *Paludella squarrosa*), and these were accordingly included on the FPO, but they are the exception rather than the rule. Habitat damage is by far the more serious threat to most bryophytes, and this was taken into account when selecting taxa for FPO status, because of the phrase stating that it is not allowed to “wilfully alter, damage, destroy or interfere with the habitat or environment” of any listed taxon.

There are currently thought to be *c.* 838 bryophyte taxa in Ireland, inclusive of three recent additions to the flora (*Lophozia perssonii*, *Dialytrichia mucronata* and *Entosthodon pulchellus*) recorded since the 2012 Red List assessments. The majority of these taxa are thought to be native to Ireland (*c.* 13 species possibly alien), are common or widespread and are not especially threatened nor of particular conservation concern. A smaller and more workable subset for the 2015 FPO selection process was therefore derived by confining the list to:

- taxa recorded since 1970 that are listed under European legislation, i.e. Annex II of the EU Habitats Directive;
- taxa listed on the Flora (Protection) Order, 1999;
- taxa recorded since 1970 with a status of CR, EN or VU in Ireland (Lockhart *et al.*, 2012a);
- taxa with a status of RE in Lockhart *et al.* (2012a) but recently re-found, or recorded new to the flora since 2012;
- taxa recorded since 1970 from the Republic of Ireland that are considered threatened at a European or global level, i.e. on the European/global Red List, or Near Threatened or Regionally Threatened in Europe.

This 'candidate' list comprised 187 taxa, or 22% of the native flora (51 liverworts/hornworts and 136 mosses), and was thought to contain all taxa that could be in need of legal protection and that could possibly benefit from FPO listing. The candidate list, together with the data upon which FPO selection criteria were based (legal status, threat status, population numbers, dates last seen) are shown in Appendix I.

## Selecting the FPO list

Only taxa considered taxonomically robust were included in the revised FPO. The candidate list of 187 taxa was therefore reduced by removing 6 taxa thought likely to be subject to taxonomic change in the near future (Table 2).

Table 2: Taxa with uncertain taxonomic status and removed from Flora (Protection) Order consideration.

| Taxon   | Comments   |
|---|--|
| <i>Andreaea megistospora</i>                            | Irish material often intermediate between 'good' <i>A. megistospora</i> & <i>A. rothii</i> |
| <i>Didymodon umbrosus</i>                               | Some taxonomic problems  |
| <i>Ditrichum zonatum</i>                                | Regarded as a variety of <i>D. heteromallum</i> in America                                 |
| <i>Hygroamblystegium humile</i>                         | Status of taxon uncertain  |
| <i>Hymenostylium recurvirostrum</i> var. <i>insigne</i> | Status of taxon uncertain  |
| <i>Pohlia elongata</i> var. <i>greenii</i>              | Some taxonomists do not recognise intraspecific taxa within <i>P. elongata</i>             |

The 181 remaining candidate taxa were then assessed using the following 5 criteria:-

**Criterion 1:** taxon listed on Annex II of the EU Habitats Directive;

**Criterion 2:** taxon listed on the Flora (Protection) Order, 1999;

**Criterion 3:** taxon CR or EN in Ireland (or RE and recently re-found),

≤ 5 populations in Republic of Ireland (1970–2012) and recently seen (1990+);

**Criterion 4:** taxon VU in Ireland, ≤ 10 populations in Republic of Ireland (1970–2012), included on European Red List and recently seen (1990+);

**Criterion 5:** taxon re-evaluated (removed from the old FPO or added to new FPO) on best expert judgement.

Taxa that met any or all of Criteria 1–4 were deemed to be 'short-listed' for the revised FPO. Criterion 5 was then used to re-evaluate the candidate list, using best expert judgement, to pick up additional taxa not automatically selected under Criteria 1–4, or to exclude taxa thought unsuitable for FPO listing. The rationale for the final selection, or non-selection, using Criterion 5 is noted in Table 3 and Appendix I. Several taxa (8) were added to the 2015 FPO largely on the basis that Ireland holds a special responsibility to conserve them. Several more (16) were removed from the list, mainly because they were considered unlikely to benefit from protection under the FPO. A summary of the taxa

added or removed from the short-list, indicating taxa that were delisted from the 1999 FPO, is given in Table 3.

Table 3: Taxa added or removed from the 2015 FPO short-list using Criterion 5 (best expert judgement).

| <b>Liverworts</b>                  | <b>Added or removed from the FPO short-list</b> | <b>Comments</b>   |
|------------------------------------|---|---|
| <i>Bazzania pearsonii</i>          | Added   | In Europe, known only from Ireland and Scotland. Ireland has a special responsibility to protect this species   |
| <i>Lejeunea hibernica</i>          | Added   | Endemic to Europe, known only from Ireland, Madeira (Rare) and the Azores. Ireland has a global responsibility to protect this species  |
| <i>Mastigophora woodsii</i>        | Added   | In Europe, known only from Ireland, the Faroe Islands and Scotland. Ireland has a special responsibility to protect this species  |
| <i>Radula holtii</i>               | Added   | Endemic to Europe, known only from Ireland, Madeira, Canary Islands, the Azores, Portugal, Spain and Scotland. Ireland has a global responsibility to protect this species  |
| <i>Scapania ornithopodioides</i>   | Added   | In Europe, found only in Ireland, the Faroe Islands, Scotland and Norway. Ireland has a special responsibility to protect this species  |
| <b>Mosses</b>                      |   |   |
| <i>Aloina ambigua</i>              | Removed   | Probably a colonist of bare soil, lost from mud capped walls, unlikely to benefit from FPO listing  |
| <i>Aongstroemia longipes</i>       | Removed   | Possibly only a transient occurrence at Pollranny, W. Mayo, its only known location in Ireland  |
| <i>Brachytheciastrum velutinum</i> | Removed   | Although rare, this species has been misidentified in the past, and probably overlooked. Some populations are on impermanent substrata such as tree bark  |
| <i>Bryum marratii</i>              | Removed (FPO 1999)                              | Probably too frequent to merit retention on the FPO, with about 12 new sites discovered since Red Data Book surveys began in 1999   |
| <i>Bryum riparium</i>              | Removed   | Colonist of eroding gullies etc.; little to be gained from FPO listing  |
| <i>Dicranella crispa</i>           | Removed   | This is probably a short-lived colonist species; unlikely to benefit from FPO listing   |
| <i>Didymodon maximus</i>           | Added   | Although there are at least 14 known populations, all are confined to the Dartry Mountains, Sligo/Leitrim. As these are the only populations currently known in Europe, Ireland has a special responsibility to protect them. Elsewhere the species has been recorded from Alaska, arctic Canada, Wrangel Island and Mongolia |

| <b>Mosses (continued)</b>        | <b>Added or removed from the FPO short-list</b> | <b>Comments</b>   |
|----------------------------------|---|---|
| <i>Grimmia anomala</i>           | Removed   | Rare but overlooked species recently recorded new to Ireland; could be vulnerable to collecting but too early to add to the FPO   |
| <i>Hypnum uncinulatum</i>        | Added   | Endemic to Europe, restricted to SW Ireland, central Portugal, S. Spain, the Azores, Madeira and the Canary Islands. Although there are at least 11 localities now known in Ireland, it is Regionally Threatened in Europe and Ireland has a special responsibility to protect this species |
| <i>Leptobarbula berica</i>       | Removed (FPO 1999)                              | Overlooked and probably under-recorded  |
| <i>Orthotrichum pallens</i>      | Removed (FPO 1999)                              | Colonist species, probably temporary from long-distance dispersal   |
| <i>Orthotrichum stramineum</i>   | Removed (FPO 1999)                              | A widespread species in Britain and Europe, but as a colonist and an epiphyte, it tends not to persist at any one site  |
| <i>Philonotis arnellii</i>       | Removed   | Probably a short-lived colonist and unlikely to benefit from FPO listing  |
| <i>Pogonatum nanum</i>           | Removed   | Colonist species, not suitable for FPO listing  |
| <i>Ptilium crista-castrensis</i> | Added   | Although not seen since 1987, this is an attractive species, susceptible to collecting, and might yet be refound at Mweelrea, W. Mayo   |
| <i>Tetraplodon angustatus</i>    | Removed (FPO 1999)                              | Not seen since 1988 and thought to be only a transient occurrence   |
| <i>Tortula wilsonii</i>          | Removed (FPO 1999)                              | A southern species in Europe, reaching its northern limits in Britain and Ireland. Not seen since 1934  |
| <i>Weissia longifolia</i>        | Removed (FPO 1999)                              | On the edge of European range, and possibly a transient colonist in Ireland on open soil patches. Unlikely to benefit from FPO listing  |
| <i>Weissia rostellata</i>        | Removed (FPO 1999)                              | Colonist/shuttle species of reservoirs and riverbanks. Not likely to benefit from FPO listing   |

## Recommendations for FPO listing

Table 4 (below) lists the bryophytes that were selected for inclusion on the 2015 FPO (S.I. No. 356 of 2015) based on the criteria given above. The list includes 65 taxa (7.9% of the native bryophyte flora), comprising 25 liverworts (10.6% of the native liverwort flora) and 40 mosses (6.8% of the native moss flora). A high proportion of the CR taxa (56%) and EN taxa (70%) are represented in the list, as might be expected.

Table 4: Taxa included on the Flora (Protection) Order, 2015.

| Liverworts   | Mosses                           |
|--|----------------------------------|
| <i>Acrobolbus wilsonii</i>                             | <i>Bartramia halleriana</i>      |
| <i>Adelanthus lindenbergianus</i>                      | <i>Brachydontium trichodes</i>   |
| <i>Barbilophozia atlantica</i>                         | <i>Bryum calophyllum</i>         |
| <i>Bazzania pearsonii</i>                              | <i>Bryum intermedium</i>         |
| <i>Cephalozia crassifolia</i>                          | <i>Bryum knowltonii</i>          |
| <i>Cephaloziella massalongi</i>                        | <i>Bryum salinum</i>             |
| <i>Cephaloziella nicholsonii</i>                       | <i>Bryum uliginosum</i>          |
| <i>Geocalyx graveolens</i>                             | <i>Bryum warneum</i>             |
| <i>Gymnomitrium concinnatum</i>                        | <i>Campylostelium saxicola</i>   |
| <i>Gymnomitrium corallioides</i>                       | <i>Catoscopium nigratum</i>      |
| <i>Leiocolea gillmanii</i>                             | <i>Didymodon acutus</i>          |
| <i>Leiocolea rutheana</i>                              | <i>Didymodon maximus</i>         |
| <i>Lejeunea hibernica</i>                              | <i>Ditrichum cornubicum</i>      |
| <i>Lejeunea mandonii</i>                               | <i>Ditrichum lineare</i>         |
| <i>Marchantia polymorpha</i> subsp. <i>montivagans</i> | <i>Ditrichum plumbicola</i>      |
| <i>Mastigophora woodsii</i>                            | <i>Encalypta ciliata</i>         |
| <i>Pallavicinia lyellii</i>                            | <i>Encalypta rhaptocarpa</i>     |
| <i>Petalophyllum ralfsii</i>                           | <i>Entosthodon muhlenbergii</i>  |
| <i>Plagiochila carringtonii</i>                        | <i>Ephemerum cohaerens</i>       |
| <i>Plagiochila heterophylla</i>                        | <i>Ephemerum spinulosum</i>      |
| <i>Radula holtii</i>                                   | <i>Fissidens rufulus</i>         |
| <i>Riccia crozalsii</i>                                | <i>Grimmia atrata</i>            |
| <i>Scapania nimbosa</i>                                | <i>Hamatocaulis vernicosus</i>   |
| <i>Scapania ornithopodioides</i>                       | <i>Hedwigia integrifolia</i>     |
| <i>Southbya tophacea</i>                               | <i>Hygrohypnum duriusculum</i>   |
|  | <i>Hypnum uncinulatum</i>        |
|  | <i>Kiaeria falcata</i>           |
|  | <i>Leptodon smithii</i>          |
|  | <i>Meesia triquetra</i>          |
|  | <i>Meesia uliginosa</i>          |
|  | <i>Molendoa warburgii</i>        |
|  | <i>Myurella julacea</i>          |
|  | <i>Oedipodium griffithianum</i>  |
|  | <i>Orthotrichum sprucei</i>      |
|  | <i>Paludella squarrosa</i>       |
|  | <i>Pohlia andalusica</i>         |
|  | <i>Ptilium crista-castrensis</i> |
|  | <i>Scleropodium touretti</i>     |
|  | <i>Tortella inclinata</i>        |
|  | <i>Ulotia coarctata</i>          |

## Analysis

The purpose of listing taxa on the FPO is different from that of including taxa on Red Lists. There are striking differences between the attributes of the two. A much higher proportion of the FPO taxa are oceanic (c. 40% of FPO taxa vs. c. 22% of Red List taxa), reflecting the importance of taking measures to protect those taxa for which Ireland has an international responsibility. About 8% of the FPO taxa are metallophytes, compared with just over 3% on the Red List. This small group of species is one that is clearly circumscribed by a habitat that is highly restricted and threatened, and therefore very suitable for protection through the FPO. The same applies to taxa of coastal dune systems (c. 11% of FPO taxa vs. c. 5% of Red List taxa) and, to a lesser extent, fens (c. 9% vs. c. 5%). On the other hand, plants of habitats that are not so well-defined or as easily protected by legislation are not so suitable for the FPO, and this is also reflected in the relative proportions of FPO vs. Red List taxa: c. 14% vs. c. 22% of upland rock taxa; c. 3% vs. c. 11% of bare ground taxa, etc.

Another interesting difference is that a much lower proportion of the taxa of calcareous soil and mud wall tops are on the FPO list than are on the Red List (c. 2% vs. c. 4%). This is because most of the habitat has disappeared, and a high proportion of the taxa are Regionally Extinct.

Other habitats are less well represented in the lists, so differences between FPO taxa and Red List taxa are less striking. However, it may be worth noting that taxa slightly less well represented on the FPO than on the Red List include plants of bogs, lowland rocks, rotting wood, wet ground, non-calcareous soil and banks, arctic-alpine habitats and organic detritus. Plants slightly better represented on the FPO include riverine taxa, coastal turf, peaty banks and reservoir margins.

It is also instructive to compare the life strategies (During, 1992) of the FPO taxa with those of the Red List as a whole. A high proportion of the FPO taxa are classified as perennial stayers (c. 41% vs. c. 23% on the Red List, and c. 19% on the Irish list as a whole). This is entirely appropriate, as perennial stayers are much more likely to benefit from FPO listing than shuttle species, colonists or fugitives. They are much more vulnerable to habitat damage and collecting because, by definition, they are less mobile, less likely to recolonise from outside and less likely to survive as a spore bank. They are often specialists of highly restricted and unusual habitats. Conversely, there are a lower proportion of colonists on the FPO list than on the Red List as a whole (c. 12% vs. c. 15%). While the proportions of short-lived shuttle taxa are about the same, the FPO list has a lower proportion of long-lived shuttle taxa than the Red List (c. 7% vs. c. 9%). This is not easy to explain, but presumably long-lived shuttles are relatively mobile, and have an 'insurance policy' whereby they are capable both of staying put to take advantage of prevailing conditions, and also surviving as spores or vegetative propagules if conditions become unfavourable. Short-lived shuttles are more reliant on constant and regular reproductive effort, but lack the ability to survive long as individuals, and therefore might be slightly more vulnerable to change than long-lived shuttles. Short-lived shuttles also tend to grow in more restricted and specialised habitats than long-lived shuttles. The fact that species capable of behaving both as annual shuttles and short-lived shuttles are better represented on the FPO list than on the Red List (c. 8% vs. c. 4%) tends to support this idea.

Finally, we can look at reproductive strategies of the taxa listed on the FPO, as described in BRYOATT (Hill *et al.*, 2007). There is a slightly lower proportion of monoicous taxa on the FPO list than on the Red List as a whole, but very little difference in the proportions of dioicous taxa. The most striking statistic is that the sexuality of almost 6% of the FPO taxa is unknown, against c. 1% of the Red List

taxa, although the proportions of taxa that are not known to produce sporophytes in Ireland are nearly the same. However, only c. 23% of the FPO taxa produce sporophytes in abundance, against a figure of nearly 31% for the Red List taxa as a whole, whereas c. 11% of FPO taxa produce sporophytes occasionally, against c. 7% of Red List taxa. The proportions of 'rare' and 'frequent' production of sporophytes are about the same for both groups. Little can be concluded from this, in view of the small numbers of taxa involved: although reaching 6% of the total, only four FPO taxa have unknown sexuality: *Didymodon maximus*, *Ditrichum plumbicola*, *Mastigophora woodsii* and *Scapania nimbosa*.

## Conclusions

The list of 65 bryophyte taxa (7.9% of the native flora) included on the revised 2015 FPO is broadly comparable to the equivalent proportion of vascular plants (68 species, or 6.8% of the native flora) currently protected in the Republic of Ireland.

A high proportion of the FPO taxa are oceanic in their distribution, reflecting Ireland's international importance for such climatic vegetation. Many are perennial in nature and reliant on so called 'permanent' habitats (e.g. montane heath/rock [19 taxa], coastal dunes/machair [12 taxa], rocks in streams/lakes [9 taxa], mine spoil [6 taxa] and fens [5 taxa]) and the majority of the populations (85%) are included within candidate Special Areas of Conservation, Natural Heritage Areas or proposed Natural Heritage Areas.

It will be necessary to review the FPO from time to time. Taxa are occasionally discovered new to the Irish flora, through survey efforts, and sometimes taxa are added or removed from the checklist through taxonomic revisions. Molecular data from DNA barcoding will be necessary to assess levels of genetic variation within and between populations of species with taxonomic uncertainties, and this will help to overcome barriers to the implementation of conservation strategies. The success, or otherwise, of conservation measures and the ever-changing developmental and environmental pressures on bryophytes will lead to changes in the perceived threat status to bryophytes. On-going monitoring will be required to assess the status and health of populations. A full reassessment of the Red List should be undertaken in 2020, in line with IUCN guidance (IUCN, 2010; Lockhart *et al.*, 2012b). A further revision of the FPO should then follow as the natural outcome.

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## Appendix I. Candidate FPO list

This section gives brief notes on the 187 'candidate' taxa upon which FPO selection criteria were applied (legal status, threat status, population numbers, date last seen). More detailed information on Red List (RE, CR, EN or VU), NT and DD taxa, especially relating to identification, distribution in Ireland, protected sites, ecology and biology, is given in Lockhart *et al.* (2012a).

### Description of the columns:

**Group:** Hornwort (H), Liverwort (L) or Moss (M).

**Taxon name:** Accepted taxon name, mostly follows the British Bryological Society *Census Catalogue* (Hill *et al.*, 2008).

**Chosen for new FPO:** Chosen for inclusion in the revised FPO 2015 schedule.

**Criteria:** *Criterion 1:* Listed on European legislation, i.e. Annex II of the EU Habitats Directive;

*Criterion 2:* Listed on the Flora (Protection) Order, 1999;

*Criterion 3:* CR or EN in Ireland (or RE and recently re-found), ≤ 5 populations in Republic of Ireland (1970–2012) and recently seen (1990+);

*Criterion 4:* VU in Ireland, ≤ 10 populations in Republic of Ireland (1970–2012), included on the European Red List and recently seen (1990+);

*Criterion 5:* Taxon critically re-assessed, on best expert judgement, to add those that do not meet Criteria 1–4 (8 taxa; mostly those for which Ireland has a special responsibility), or to remove those that do meet these criteria but would not benefit from FPO listing (16 taxa; mostly colonists, transients, overlooked/under-recorded).

**Threat status in Ireland (Red Data Book (RDB) 2010):** Follows Lockhart *et al.* (2012a) and IUCN (2001). Key: RE – Regionally Extinct; CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern; DD – Data Deficient.

**Threat status in Europe:** If a taxon is given a status on the former ECCB website <http://www.bio.ntnu.no/users/soder/ECCB/RDBTaxon.php> (Feb 2010), it is marked with an asterisk (\*); otherwise threat status is according to the published *Red Data Book of European Bryophytes* (ECCB 1995), which used the old IUCN threat criteria (IUCN 1978). Key: R – Rare; RT – Regionally Threatened; K – Insufficiently Known. 'Endemic' means endemic to Europe and Macaronesia.

**Populations (localities) RoI 1970–2012 (or later):** Number of populations in the Republic of Ireland according to Lockhart *et al.* (2012a), later records are in parentheses.

**Last seen in RoI from RDB dataset 2010 (or later):** Last seen in the Republic of Ireland according to the 2010 dataset used for Lockhart *et al.* (2012a), later sightings are in parentheses.

**Habitat:** Main habitat or niche according to Lockhart *et al.* (2012a) and Hill *et al.* (2007).

**Comments:** Comments on distribution, rarity, taxonomic status and conservation priority.

## Appendix 1. Candidate FPO list

| Group | Taxon name                        | Chosen for new FPO | Criteria  | Threat status in Ireland (RDB 2010) | Threat status in Europe (* ECCB website) | Populations (localities) RoI 1970–2012 (or later) | Last seen in RoI from RDB dataset 2010 (or later) | Habitat               | Comments  |
|-------|-----------------------------------|--------------------|-----------|-------------------------------------|--|---|---|-----------------------|---|
| H     | <i>Anthoceros agrestis</i>        |                    |           | VU                                  | LC                                       | 1   | 2003  | Ruderal               | Not on European Red List.   |
| L     | <i>Acrobolbus wilsonii</i>        | New FPO            | 4         | VU                                  | NT*, Endemic                             | 7 (8)   | 2006 (2014)                                       | Shaded ravines        | In Europe, known only from Ireland, Scotland, the Faroe Islands, the Azores and Madeira. Ireland has a special responsibility to protect populations of this hyperoceanic species.  |
| L     | <i>Adelanthus lindenbergianus</i> | New FPO            | 4         | VU                                  | VU*                                      | 10  | 2009 (2012)                                       | Mountain heath        | Rare hepatic mat species, found elsewhere in Europe only on Islay & Jura (Scotland). Irish populations are of global importance.  |
| L     | <i>Aneura mirabilis</i>           |                    |           | VU                                  | LC                                       | 10  | 2009  | Wet woodland          | Not on European Red List.   |
| L     | <i>Barbilophozia atlantica</i>    | New FPO            | 3         | EN                                  | LC                                       | 1   | 2007  | Mountain rock         | Very rare (single recent locality) and susceptible to collection.   |
| L     | <i>Barbilophozia barbata</i>      |                    |           | CR                                  | LC                                       | 1   | 1975  | Mountain rock         | Not seen recently.  |
| L     | <i>Bazzania pearsonii</i>         | New FPO            | 5 (added) | VU                                  | R  | 15 (17)   | 2010 (2014)                                       | Montane heath         | In Europe, known only from Ireland and Scotland. Ireland has a special responsibility to protect this species.  |
| L     | <i>Cephalozia crassifolia</i>     | New FPO            | 3         | EN                                  | VU*                                      | 4 (6)   | 2009 (2014)                                       | Shaded woods, oceanic | Known in Europe only from Ireland, Spain, Madeira and the Azores, elsewhere S. America and Caribbean.   |
| L     | <i>Cephalozia loitlesbergeri</i>  |                    |           | VU                                  | LC                                       | 7   | 2009  | Bogs                  | Not on European Red List.   |
| L     | <i>Cephalozia pleniceps</i>       |                    |           | VU                                  | LC                                       | 11  | 2010  | Bogs                  | Too many populations. Not on European Red List.   |
| L     | <i>Cephaloziella integerrima</i>  |                    |           | VU                                  | LC                                       | 3   | 2009  | Mine spoil            | Not on European Red List.   |
| L     | <i>Cephaloziella massalongi</i>   | New FPO            | 4         | VU                                  | R  | 6   | 2009 (2010)                                       | Mine spoil            | Although some doubt has been expressed that this species and <i>C. nicholsonii</i> might not be taxonomically robust, the aggregate species is nonetheless very rare, and confined to a specialist habitat and Ireland has a special responsibility to protect this species.  |
| L     | <i>Cephaloziella nicholsonii</i>  | New FPO            | 4         | VU                                  | R, Endemic                               | 7   | 2009  | Mine spoil            | Although some doubt has been expressed that this species and <i>C. massalongi</i> might not be taxonomically robust, the aggregate species is nonetheless very rare, confined to a specialist habitat and Ireland has a special responsibility to protect it. <i>C. nicholsonii</i> is a European endemic, known only from Ireland, England, Wales and Germany. |
| L     | <i>Cephaloziella rubella</i>      |                    |           | VU                                  | LC                                       | 5   | 2008  | Bogs                  | Not on European Red List.   |

| Group | Taxon name   | Chosen for new FPO | Criteria  | Threat status in Ireland (RDB 2010) | Threat status in Europe (* ECCB website) | Populations (localities) RoI 1970–2012 (or later) | Last seen in RoI from RDB dataset 2010 (or later) | Habitat                                | Comments  |
|-------|--|--------------------|-----------|-------------------------------------|--|---|---|--|---|
| L     | <i>Cephaloziella turneri</i>                           |                    |           | VU                                  | LC                                       | 5   | 2010  | Acidic soil                            | Not on European Red List.   |
| L     | <i>Cladopodiella francisci</i>                         |                    |           | VU                                  | LC                                       | 4   | 2008 (2011)                                       | Peat banks                             | Not on European Red List.   |
| L     | <i>Dumortiera hirsuta</i>                              |                    |           | NT                                  | R  | 17  | 2010 (2014)                                       | Stream banks                           | NT in Ireland.  |
| L     | <i>Fossombronina fimbriata</i>                         |                    |           | VU                                  | R,<br>Endemic                            | 3   | 1987  | Gravel pits                            | Not seen recently (1990+).  |
| L     | <i>Geocalyx graveolens</i>                             | New FPO            | 3         | EN                                  | LC                                       | 4   | 1994  | Peaty banks near the coast             | Very rare, and susceptible to collection. Not seen since 1994.  |
| L     | <i>Gymnomitrium concinnatum</i>                        | New FPO            | 3         | EN                                  | LC                                       | 4   | 2008 (2011)                                       | Mountain rock                          | Rare and currently known from just 4 localities, all in W. Donegal.   |
| L     | <i>Gymnomitrium corallioides</i>                       | New FPO            | 3         | CR                                  | LC                                       | 1   | 2002  | Mountain rock                          | Single locality (Bulbin Mountain, E. Donegal).  |
| L     | <i>Leiocolea gillmanii</i>                             | New FPO            | 2         | VU                                  | LC                                       | 2   | 2009 (2010)                                       | Machair and coastal fens               | Just 2 localities (Lough Doo, Achill, W. Mayo and Rosepenna, W. Donegal), in a rare and threatened habitat.   |
| L     | <i>Leiocolea rutheana</i>                              | New FPO            | 2, 3      | EN                                  | LC                                       | 3   | 2003 (2015)                                       | Fen                                    | Very rare (3 populations), in a threatened habitat and susceptible to collection.   |
| L     | <i>Lejeunea flava</i> subsp. <i>moorei</i>             |                    |           | VU                                  | R,<br>Endemic                            | 11  | 2008 (2014)                                       | Woodland and scrub                     | Too many populations.   |
| L     | <i>Lejeunea hibernica</i>                              | New FPO            | 5 (added) | NT                                  | R,<br>Endemic                            | 17 (19)   | 2010 (2014)                                       | Rocks, boulders in streams, waterfalls | Endemic to Europe, known only from Ireland, Madeira (Rare) and the Azores, so Ireland has a global responsibility. Despite NT status, and the number of populations, this species is included on the FPO. |
| L     | <i>Lejeunea mandonii</i>                               | New FPO            | 3         | EN                                  | R,<br>Endemic                            | 2   | 2006  | Mountain rock                          | Endemic to Europe and Macronesia.   |
| L     | <i>Lophozia opacifolia</i>                             |                    |           | VU                                  | LC                                       | 5   | 2004  | Flushes and by streams                 | Not on European Red List.   |
| L     | <i>Lophozia perssonii</i>                              |                    |           | LC                                  | LC                                       | 1   | 2012  | Calcareous soil                        | Recent discovery; temporary colonist.   |
| L     | <i>Marchantia polymorpha</i> subsp. <i>montivagans</i> | New FPO            | 3         | EN                                  | LC                                       | 1   | 2005 (2013)                                       | Rocks in streams                       | Single locality (Glencar Waterfall, Leitrim).   |
| L     | <i>Marsupella sphacelata</i>                           |                    |           | VU                                  | LC                                       | 6   | 2008  | Montane gravel                         | Not on European Red List.   |

| Group | Taxon name                      | Chosen for new FPO | Criteria  | Threat status in Ireland (RDB 2010) | Threat status in Europe (* ECCB website) | Populations (localities) RoI 1970–2012 (or later) | Last seen in RoI from RDB dataset 2010 (or later) | Habitat                                | Comments   |
|-------|---------------------------------|--------------------|-----------|-------------------------------------|--|---|---|--|--|
| L     | <i>Marsupella sprucei</i>       |                    |           | VU                                  | LC                                       | 10  | 2003  |  | Not on European Red List.  |
| L     | <i>Mastigophora woodsii</i>     | New FPO            | 5 (added) | NT                                  | R  | 17  | 2010 (2014)                                       | Montane heath                          | In Europe, known only from Ireland, the Faroe Islands and Scotland, and although there are at least 17 known populations, Ireland has a special responsibility to protect this species.  |
| L     | <i>Pallavicinia lyellii</i>     | New FPO            | 3         | EN                                  | VU*                                      | 4   | 2009 (2014)                                       | Acid mires                             | Rare, declining in Europe.   |
| L     | <i>Petalophyllum ralfsii</i>    | New FPO            | 1, 2      | LC                                  | VU*                                      | 30  | 2009 (2015)                                       | Machair and dune slacks                | Ireland holds the largest known world populations.   |
| L     | <i>Plagiochila carringtonii</i> | New FPO            | 3         | EN                                  | R, Endemic                               | 2   | 2010  | Mountain heath                         | Subsp. <i>carringtonii</i> is endemic to Europe, found only in Ireland, Scotland and the Faroe Islands.  |
| L     | <i>Plagiochila heterophylla</i> | New FPO            | 2, 3      | EN                                  | R  | 4   | 2009 (2014)                                       | Shaded woods, oceanic                  | In Europe, known only from Ireland, western Britain and France; elsewhere from S. America and Caribbean.   |
| L     | <i>Radula carringtonii</i>      |                    |           | NT                                  | R  | 15  | 2009  | Montane rocks                          | NT in Ireland.   |
| L     | <i>Radula holtii</i>            | New FPO            | 5 (added) | NT                                  | R, Endemic                               | 11 (14)   | 2008 (2014)                                       | Rocks, boulders in streams, waterfalls | Endemic to Europe, known only from Ireland, Madeira, the Canary Islands, the Azores, Portugal, Spain and Scotland. Ireland has a global responsibility to protect this species.  |
| L     | <i>Radula voluta</i>            |                    |           | LC                                  | R  | >18   | 2008 (2010)                                       | Streams, rocks                         | LC in Ireland.   |
| L     | <i>Riccia crozalsii</i>         | New FPO            | 3         | EN                                  | LC                                       | 2   | 2009  | Banks and tracks                       | A southern species, at its northern limit in Ireland, with 2 populations in W. Cork.   |
| L     | <i>Riccia huebeneriana</i>      |                    |           | DD                                  | R  | 1   | 1992 (2011)                                       | Mud, reservoirs                        | Re-found in 2011 so would probably be VU. Although only a single population, this is a colonist species of reservoir mud and there are many tens of thousands of plants (seen in 2011) and the site is not threatened. Not likely to benefit from FPO listing. |
| L     | <i>Scapania curta</i>           |                    |           | VU                                  | LC                                       | 1   | 2010  | Sand pits                              | Single population in a sand pit.   |
| L     | <i>Scapania cuspiduligera</i>   |                    |           | VU                                  | LC                                       | 5   | 2009  | Coastal sand                           | Not on European Red List.  |
| L     | <i>Scapania gymnostomophila</i> |                    |           | VU                                  | LC                                       | 4   | 2008 (2011)                                       | Calcareous rocks and sand              | Not on European Red List.  |
| L     | <i>Scapania nimbosea</i>        | New FPO            | 3         | EN                                  | R  | 4   | 2009  | Mountain heath                         | Known in Europe only from Ireland, Scotland and Norway; elsewhere in Himalaya and China.   |

| Group | Taxon name                         | Chosen for new FPO | Criteria       | Threat status in Ireland (RDB 2010) | Threat status in Europe (* ECCB website) | Populations (localities) RoI 1970–2012 (or later) | Last seen in RoI from RDB dataset 2010 (or later) | Habitat                                       | Comments  |
|-------|------------------------------------|--------------------|----------------|-------------------------------------|--|---|---|---|---|
| L     | <i>Scapania ornithopodioides</i>   | New FPO            | 5 (added)      | VU                                  | LC                                       | >13   | 2010 (2014)                                       | Montane heath                                 | In Europe, found only in Ireland, the Faroe Islands, Scotland and Norway. Ireland has a special responsibility to protect this species. |
| L     | <i>Solenostoma paroicum</i>        |                    |                | NT                                  | NT*, Endemic                             | 9   | 2007  | Rocks by streams                              | NT in Ireland.  |
| L     | <i>Southbya tophacea</i>           | New FPO            | 3              | CR                                  | LC                                       | 2   | 1988 (2011)                                       | Fen and tufa                                  | The Sligo site is the most northerly in the world.  |
| L     | <i>Sphenolobopsis pearsonii</i>    |                    |                | NT                                  | R  | 10  | 2006  | Acidic rocks                                  | NT in Ireland.  |
| L     | <i>Telaranea europaea</i>          |                    |                | NT                                  | R, Endemic                               | 18  | 2010 (2014)                                       | Peaty banks                                   | NT in Ireland.  |
| L     | <i>Tritomaria exsecta</i>          |                    |                | VU                                  | LC                                       | 6   | 2009  | Woodland                                      | Not on European Red List.   |
| M     | <i>Aloina ambigua</i>              |                    | 3, 5 (removed) | EN                                  | LC                                       | 2   | 2007  | Bare soil, quarries, spoil heaps, earth banks | Probably a colonist of bare soil, lost from mud capped walls, unlikely to benefit from FPO listing.                                     |
| M     | <i>Amphidium lapponicum</i>        |                    |                | VU                                  | LC                                       | 4   | 2010  | Montane cliffs                                | Not on European Red List.   |
| M     | <i>Andreaea megistospora</i>       |                    |                | VU                                  | R  | 8   | 2010  | Rocks   | Questions over whether Irish material is taxonomically robust.  |
| M     | <i>Aongstroemia longipes</i>       |                    | 3, 5 (removed) | CR                                  | LC                                       | 1   | 2003  | Sand pit                                      | Possibly overlooked and perhaps only a transient occurrence at Pollranny, W. Mayo, its only known locality in Ireland.                  |
| M     | <i>Arctoa fulvella</i>             |                    |                | VU                                  | LC                                       | 3   | 2004  | Mountain rock                                 | Not on European Red List.   |
| M     | <i>Aulacomnium androgynum</i>      |                    |                | VU                                  | LC                                       | 4   | 2010  | Sandstone scarps                              | Not on European Red List.   |
| M     | <i>Bartramia halleriana</i>        | New FPO            | 3              | RE                                  | LC                                       | 1   | (2014)  | Mountain rock                                 | Single locality (Glendalough, Wicklow), recently rediscovered in Ireland and would probably be assessed as CR or EN.                    |
| M     | <i>Bartramia ithyphylla</i>        |                    |                | VU                                  | LC                                       | 6   | 2007  | Mountain rock                                 | Not on European Red List.   |
| M     | <i>Brachydontium trichodes</i>     | New FPO            | 3              | EN                                  | R  | 3   | 2010  | Rock  | Very rare and known populations should be protected.  |
| M     | <i>Brachytheciastrum velutinum</i> |                    | 3, 5 (removed) | EN                                  | LC                                       | 4   | 2010  | Concrete, wood, shaded wall tops              | Although rare, this species has been misidentified in the past, and probably overlooked.  |
| M     | <i>Bryum caespiticium</i>          |                    |                | VU                                  | LC                                       | 5   | 2009  | Soil  | Not on European Red List.   |

| Group | Taxon name                     | Chosen for new FPO | Criteria       | Threat status in Ireland (RDB 2010) | Threat status in Europe (* ECCB website) | Populations (localities) RoI 1970–2012 (or later) | Last seen in RoI from RDB dataset 2010 (or later) | Habitat                             | Comments   |
|-------|--------------------------------|--------------------|----------------|-------------------------------------|--|---|---|-------------------------------------|--|
| M     | <i>Bryum calophyllum</i>       | New FPO            | 2, 3           | EN                                  | R  | 4   | 2003  | Coastal                             | Rare coastal <i>Bryum</i> .  |
| M     | <i>Bryum elegans</i>           |                    |                | VU                                  | LC                                       | >5  | 2005  | Montane cliffs                      | Not on European Red List.  |
| M     | <i>Bryum gemmiparum</i>        |                    |                | VU                                  | LC                                       | 3   | 2004  | Calcareous soil                     | Not on European Red List.  |
| M     | <i>Bryum intermedium</i>       | New FPO            | 3              | EN                                  | LC                                       | 2   | 2007  | Calcareous soil, dunes, banks, etc. | One of a suite of rare <i>Bryums</i> surveyed by D. Holyoak. Both the RoI populations occur with <i>Bryum uliginosum</i> , and one with <i>B. warneum</i> . Although a colonist, it can occur in a very threatened habitat (coastal dune slacks) and should be protected along with its associate rare <i>Bryums</i> . |
| M     | <i>Bryum knowltonii</i>        | New FPO            | 3              | EN                                  | LC                                       | 1   | 2004  | Rocks by lakes                      | Single locality (Lough Carra, E. Mayo).  |
| M     | <i>Bryum marratii</i>          |                    | 2, 5 (removed) | LC                                  | RT                                       | 16  | 2007  | Coastal                             | Probably too frequent to merit retention on the FPO, with about 12 new sites discovered by D. Holyoak since RDB surveys began in 1999.   |
| M     | <i>Bryum moravicum</i>         |                    |                | CR                                  | LC                                       | 1   | 1979  | Epiphyte                            | Not seen since 1979.   |
| M     | <i>Bryum riparium</i>          |                    | 3, 5 (removed) | EN                                  | R  | 4   | 2008  | Soil, river and stream gullies      | Colonist.  |
| M     | <i>Bryum salinum</i>           | New FPO            | 3              | CR                                  | LC                                       | 1   | 2005  | Coastal                             | Single locality (Derrymore Island, S. Kerry).  |
| M     | <i>Bryum torquescens</i>       |                    |                | VU                                  | LC                                       | 3   | 2010  | Coastal                             | Not on European Red List.  |
| M     | <i>Bryum uliginosum</i>        | New FPO            | 3              | EN                                  | RT                                       | 3   | 2009  | Coastal                             | Species declining across Europe, Ireland's 3 populations are of international importance.  |
| M     | <i>Bryum warneum</i>           | New FPO            | 3              | EN                                  | R  | 4   | 2007  | Coastal                             | Rare coastal <i>Bryum</i> .  |
| M     | <i>Campyliadelphus elodes</i>  |                    |                | NT                                  | RT                                       | 20  | 2007  | Fens                                | NT in Ireland.   |
| M     | <i>Campylopus shawii</i>       |                    |                | NT                                  | R  | 13  | 2009  | Bogs, heath                         | NT in Ireland.   |
| M     | <i>Campylopus subulatus</i>    |                    |                | VU                                  | LC                                       | 8   | 2010  | Soil                                | Not on European Red List.  |
| M     | <i>Campylostelium saxicola</i> | New FPO            | 3              | EN                                  | R  | 3 (4)   | 2006 (2014)                                       | Rock                                | Undoubtedly rare.  |
| M     | <i>Catoscopium nigratum</i>    | New FPO            | 2              | NT                                  | LC                                       | 13  | 2009 (2010)                                       | Coastal and fens                    | Although assessed as NT and with 13 known populations in RoI, it occurs in coastal fens, machair and dune slacks, all very threatened habitats both in Ireland and in Europe.  |

| Group | Taxon name                      | Chosen for new FPO | Criteria       | Threat status in Ireland (RDB 2010) | Threat status in Europe (* ECCB website) | Populations (localities) RoI 1970–2012 (or later) | Last seen in RoI from RDB dataset 2010 (or later) | Habitat                               | Comments  |
|-------|---------------------------------|--------------------|----------------|-------------------------------------|--|---|---|---------------------------------------|---|
| M     | <i>Cinclidium stygium</i>       |                    |                | VU                                  | LC                                       | 7   | 2007  | Fens                                  | Too many populations.   |
| M     | <i>Cyclodictyon laetevirens</i> |                    |                | NT                                  | R  | 13  | 2009 (2014)                                       | Caves, ravines                        | NT in Ireland.  |
| M     | <i>Cynodontium jeneri</i>       |                    |                | VU                                  | LC                                       | 2   | 2008 (2011)                                       | Mountain rock                         | Remote, on rocks, unlikely to benefit from FPO listing.   |
| M     | <i>Daltonia splachnoides</i>    |                    |                | LC                                  | NT*                                      | 29  | 2009  | Epiphyte                              | LC in Ireland.  |
| M     | <i>Dicranella crispa</i>        |                    | 3, 5 (removed) | EN                                  | LC                                       | 2   | 2006  | Soil, banks, stream gullies           | This is probably a short-lived colonist species, unlikely to benefit from FPO listing.  |
| M     | <i>Dicranodontium asperulum</i> |                    |                | VU                                  | K  | 2   | 2005  | Montane block scree                   | Not on European Red List.   |
| M     | <i>Dicranodontium uncinatum</i> |                    |                | VU                                  | LC                                       | 9   | 2010  | Montane block scree                   | Not on European Red List.   |
| M     | <i>Didymodon acutus</i>         | New FPO            | 3              | EN                                  | LC                                       | 3   | 2008  | Coastal                               | All 3 recent records are from coastal dune sites and potentially threatened.  |
| M     | <i>Didymodon maximus</i>        | New FPO            | 5 (added)      | NT                                  | R  | >14   | 2005 (2012)                                       | Limestone cliffs, ledges and crevices | Although there are at least 14 known populations, all are confined to the Dartry Mountains, Sligo/Leitrim. As these are the only populations currently known in Europe, Ireland has a special responsibility to protect them. Elsewhere the species has been recorded from Alaska, Canada, Wrangel Island and Mongolia. |
| M     | <i>Didymodon tomaculosus</i>    |                    |                | VU                                  | K, Endemic                               | 5   | 2004  | Arable fields                         | Not on European Red List.   |
| M     | <i>Didymodon umbrosus</i>       |                    |                | VU                                  | R  | 6   | 2010  | Soil, bricks, mortar, gardens         | Possible introduction. Weedy colonist and status of taxon uncertain.  |
| M     | <i>Discelium nudum</i>          |                    |                | NT                                  | RT                                       | 8   | 2005  | Clay banks                            | NT in Ireland.  |
| M     | <i>Ditrichum cornubicum</i>     | New FPO            | 3              | CR                                  | EN*, Endemic                             | 1   | 2009  | Mine spoil                            | Endemic to Britain and Ireland and confined to a specialist habitat.  |
| M     | <i>Ditrichum lineare</i>        | New FPO            | 3              | CR                                  | LC                                       | 1   | 1999  | Mine spoil                            | Similar to <i>D. cornubicum</i> , so included on FPO.   |
| M     | <i>Ditrichum plumbicola</i>     | New FPO            | 3              | EN                                  | NT, Endemic                              | 4   | 2009 (2012)                                       | Mine spoil                            | Endemic to Europe, known only from Ireland, Britain and Germany; confined to a specialist habitat.  |

| Group | Taxon name  | Chosen for new FPO | Criteria | Threat status in Ireland (RDB 2010) | Threat status in Europe (* ECCB website) | Populations (localities) RoI 1970–2012 (or later) | Last seen in RoI from RDB dataset 2010 (or later) | Habitat                            | Comments   |
|-------|---|--------------------|----------|-------------------------------------|--|---|---|------------------------------------|--|
| M     | <i>Ditrichum zonatum</i>                              |                    |          | EN                                  | LC                                       | 7   | 2008  | Mountain rock                      | Status of taxon uncertain.   |
| M     | <i>Drepanocladus sendtneri</i>                        |                    |          | NT                                  | RT                                       | 20  | 2006  | Fens                               | NT in Ireland.   |
| M     | <i>Encalypta alpina</i>                               |                    |          | VU                                  | LC                                       | 3   | 2003 (2012)                                       | Montane cliffs                     | Not on European Red List.  |
| M     | <i>Encalypta ciliata</i>                              | New FPO            | 3        | CR                                  | LC                                       | 1   | 2005  | Mountain rock                      | Single locality in RoI (Galtee Mountains, Limerick).   |
| M     | <i>Encalypta rhaptocarpa</i>                          | New FPO            | 3        | CR                                  | LC                                       | 1   | (2012)  | Calcareous rock and soil           | Single locality in RoI (Arroo Mountain, Leitrim).  |
| M     | <i>Entosthodon muhlenbergii</i>                       | New FPO            | 3        | RE                                  | LC                                       | 1   | (2012)  | Walls                              | Population very vulnerable. Refound after 150 years at Glanworth, E. Cork (first record 1852).   |
| M     | <i>Entosthodon pulchellus</i>                         |                    |          | NE                                  | LC                                       | 1   | (2011)  | Soil                               | Recent discovery. Insufficient data.   |
| M     | <i>Ephemerum cohaerens</i>                            | New FPO            | 4        | VU                                  | CR*                                      | 7   | 2007  | Mud, turloughs, lakes, river banks | A rare species in Ireland, occurs in threatened habitats (one site is a turlough) and listed as CR in Europe.  |
| M     | <i>Ephemerum crassinerviium</i> subsp. <i>sessile</i> |                    |          | NT                                  | R  | 5   | 2005  | Mud, river banks                   | NT in Ireland.   |
| M     | <i>Ephemerum spinulosum</i>                           | New FPO            | 3        | EN                                  | NE                                       | 1   | 2003  | Mud, river banks                   | Very rare, known elsewhere in Europe only from single locations in Northern Ireland, Spain and Germany. Probably overlooked.   |
| M     | <i>Fissidens exilis</i>                               |                    |          | VU                                  | LC                                       | 8   | 2010  | Soil                               | Not on European Red List.  |
| M     | <i>Fissidens fontanus</i>                             |                    |          | VU                                  | LC                                       | 4   | 2009  | Rivers, lakes                      | Not on European Red List.  |
| M     | <i>Fissidens monguillonii</i>                         |                    |          | NT                                  | R  | 8   | 2009 (2010)                                       | Mud                                | NT in Ireland.   |
| M     | <i>Fissidens polyphyllus</i>                          |                    |          | VU                                  | LC                                       | 5   | 2008  | Riverbanks                         | Not on European Red List. Large populations occur in Glengarriff, W. Cork.   |
| M     | <i>Fissidens rivularis</i>                            |                    |          | VU                                  | LC                                       | 3   | 2008  | Rivers, lakes                      | Not on European Red List.  |
| M     | <i>Fissidens rufulus</i>                              | New FPO            | 3        | EN                                  | LC                                       | 2   | 2001 (2011)                                       | Rocks in streams                   | Further survey is desirable. D. Holyoak examined a specimen from Ederamone, E. Donegal, and noted that the material was partly intermediate with <i>F. crassipes</i> . |



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|-------|---|--------------------|-------------------|-------------------------------------|--|---|---|---------------------|---|
| M     | <i>Fissidens serrulatus</i>                             |                    |                   | VU                                  | LC                                       | 2   | 2008  | Riverbanks          | Not on European Red List.   |
| M     | <i>Glyphomitrium daviesii</i>                           |                    |                   | LC                                  | R,<br>Endemic                            | 12  | 2005  | Rocks               | LC in Ireland.  |
| M     | <i>Grimmia anomala</i>                                  |                    | 3, 5<br>(removed) | EN                                  | LC                                       | 2 (3)   | 2009 (2012)                                       | Rocks by lakes      | Overlooked as <i>G. hartmanii</i> , but <i>G. anomala</i> is probably rare in RoI. Re-assessment would downgrade to VU.   |
| M     | <i>Grimmia atrata</i>                                   | New FPO            | 3                 | EN                                  | R  | 1   | 2002  | Mountain rock       | Single locality (Aghla More, W. Donegal).   |
| M     | <i>Grimmia dissimulata</i>                              |                    |                   | VU                                  | LC                                       | 2   | 2004  | Calcareous rock     | Not on European Red List.   |
| M     | <i>Grimmia lisae</i>                                    |                    |                   | LC                                  | R  | >20   | 2008  | Siliceous rock      | LC in Ireland.  |
| M     | <i>Grimmia orbicularis</i>                              |                    |                   | VU                                  | LC                                       | 6   | 2010  | Walls               | Not on European Red List.   |
| M     | <i>Hageniella micans</i>                                |                    |                   | NT                                  | RT                                       | 16  | 2005  | Flushed rocks       | NT in Ireland.  |
| M     | <i>Hamatocaulis vernicosus</i>                          | New FPO            | 1, 2              | LC                                  | VU*                                      | 14  | 2009  | Fen                 | On Annex II of the Habitats Directive, occurs in threatened habitats.   |
| M     | <i>Hedwigia ciliata</i> var. <i>ciliata</i>             |                    |                   | VU                                  | LC                                       | 1   | 2007  | Lakeshore boulders  | Single population on boulders, should be safe in SAC, remote and not especially threatened. Not on European Red List.   |
| M     | <i>Hedwigia integrifolia</i>                            | New FPO            | 4                 | VU                                  | R  | 7   | 2010  | Mountain rock       | Rare and possibly declining.  |
| M     | <i>Hygroamblystegium humile</i>                         |                    |                   | EN                                  | LC                                       | 3   | 2009  | Swamps, lake shores | Status of taxon uncertain.  |
| M     | <i>Hygrohypnum duriusculum</i>                          | New FPO            | 3                 | CR                                  | LC                                       | 1 (2)   | 2003 (2014)                                       | Rocks in streams    | Two localities (Mweelrea, W. Mayo, 2003; Coomloughra, S. Kerry, 2014).  |
| M     | <i>Hymenostylium recurvirostrum</i> var. <i>insigne</i> |                    |                   | NT                                  | R  | 17  | 2005 (2008)                                       | Calcareous crags    | Status of taxon uncertain; NT in Ireland.   |
| M     | <i>Hypnum uncinulatum</i>                               | New FPO            | 5 (added)         | NT                                  | RT,<br>Endemic                           | 11 (15)   | 2006 (2014)                                       | Woodland            | This species is a European endemic, restricted to SW Ireland, central Portugal, S. Spain, the Azores, Madeira and the Canary Islands. Although there are at least 11 localities now known in Ireland, the species is threatened in Europe and therefore Ireland has a special responsibility to protect it. |

| Group | Taxon name                            | Chosen for new FPO | Criteria          | Threat status in Ireland (RDB 2010) | Threat status in Europe (* ECCB website) | Populations (localities) RoI 1970–2012 (or later) | Last seen in RoI from RDB dataset 2010 (or later) | Habitat             | Comments  |
|-------|---------------------------------------|--------------------|-------------------|-------------------------------------|--|---|---|---------------------|---|
| M     | <i>Isopterygiopsis muelleriana</i>    |                    |                   | VU                                  | LC                                       | 2   | 2009  | Montane crags       | In remote mountains and not particularly threatened. Not on the European Red List.  |
| M     | <i>Kiaeria falcata</i>                | New FPO            | 3                 | CR                                  | LC                                       | 1   | 2001  | Mountain rock       | Single locality (Binnacally, W. Donegal).   |
| M     | <i>Leptobarbula berica</i>            |                    | 2, 5 (removed)    | VU                                  | LC                                       | 3   | 2010  | Walls               | Overlooked and probably under-recorded. Not on European Red List.   |
| M     | <i>Leptodon smithii</i>               | New FPO            | 3                 | EN                                  | LC                                       | 2   | 2007  | Epiphyte and walls  | A southern species on the edge of its range in Ireland, usually an epiphyte of mature trees, although found on the walls of the Cathair Chomain monument in Clare.            |
| M     | <i>Meesia triquetra</i>               | New FPO            | 3                 | RE                                  | LC                                       | 1   | (2012)  | Fen                 | Very rare, thought extinct (Bellacorick Iron Flush, 1957) but re-found in Sligo in 2012. Susceptible to collection.   |
| M     | <i>Meesia uliginosa</i>               | New FPO            | 3                 | EN                                  | LC                                       | 1   | 2002  | Coastal             | Single locality (Rosepenna, W. Donegal).  |
| M     | <i>Molendoa warburgii</i>             | New FPO            | 4                 | VU                                  | R, Endemic                               | 2   | 2003  | Montane crags       | Very rare in Ireland, and although widespread in Scotland, it is rare and endemic in Europe.  |
| M     | <i>Myurella julacea</i>               | New FPO            | 3                 | EN                                  | LC                                       | 2   | 2003  | Mountain rock       | Just 2 localities (Bulbin Mountain, E. Donegal; Gleniff, Sligo).  |
| M     | <i>Oedipodium griffithianum</i>       | New FPO            | 3                 | CR                                  | LC                                       | 1   | 2003  | Mountain rock       | Single locality (Mweelrea, W. Mayo).  |
| M     | <i>Orthotrichum pallens</i>           |                    | 2, 3, 5 (removed) | EN                                  | LC                                       | 2   | 2005  | Epiphyte, colonist  | Colonist species, probably temporary from long-distance dispersal. Not suitable for FPO.  |
| M     | <i>Orthotrichum sprucei</i>           | New FPO            | 2, 4              | VU                                  | R  | 7   | 2009 (2014)                                       | Epiphyte, perennial | Occurs in alluvial woods and on riverside tress, rare and threatened habitat.   |
| M     | <i>Orthotrichum stramineum</i>        |                    | 2, 5 (removed)    | VU                                  | LC                                       | 9   | 2009  | Epiphyte            | A widespread species in Britain and Europe, but as a colonist and an epiphyte, it tends not persist at any one site. On balance, would not benefit from retention on the FPO. |
| M     | <i>Oxyrrhynchium schleicheri</i>      |                    |                   | CR                                  | LC                                       | 1   | 1979  | Woodland banks      | Not seen since 1979.  |
| M     | <i>Paludella squarrosa</i>            | New FPO            | 2, 3              | CR                                  | LC                                       | 1   | 2003 (2015)                                       | Fen                 | Single locality (W. Mayo) and susceptible to collection.  |
| M     | <i>Paraleptodontium recurvifolium</i> |                    |                   | NT                                  | R  | 13  | 2010  | Rock ledges         | NT in Ireland.  |

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|-------|--|--------------------|----------------|-------------------------------------|--|---|---|------------------------------------|--|
| M     | <i>Philonotis arnellii</i>                 |                    | 3, 5 (removed) | EN                                  | LC                                       | 1   | 2001  | Banks, tracks, paths               | Probably a short-lived colonist and unlikely to benefit from FPO listing.  |
| M     | <i>Philonotis cernua</i>                   |                    |                | CR                                  | R  | 1   | 1987  | Montane heath                      | Not seen since 1987.   |
| M     | <i>Philonotis rigida</i>                   |                    |                | VU                                  | LC                                       | 6   | 2004  | Rocks                              | Not on European Red List.  |
| M     | <i>Philonotis tomentella</i>               |                    |                | VU                                  | LC                                       | 4   | 2008  | Mountain rock                      | Not on European Red List.  |
| M     | <i>Plagiopus oederianus</i>                |                    |                | CR                                  | LC                                       | 1   | 1970  | Mountain rock                      | Not seen since 1970.   |
| M     | <i>Plagiothecium cavifolium</i>            |                    |                | VU                                  | LC                                       | 3   | 2009  | Montane crags                      | Not on European Red List.  |
| M     | <i>Plagiothecium curvifolium</i>           |                    |                | VU                                  | LC                                       | 3   | 2010  | Woodlands                          | Not on European Red List.  |
| M     | <i>Plagiothecium laetum</i>                |                    |                | VU                                  | LC                                       | 2   | 2003  | Woodlands                          | Not on European Red List.  |
| M     | <i>Plagiothecium latebricola</i>           |                    |                | VU                                  | LC                                       | 1   | 2001  | Woodlands                          | Not on European Red List.  |
| M     | <i>Plagiothecium platyphyllum</i>          |                    |                | VU                                  | LC                                       | 3   | 2007  | Montane crags                      | Not on European Red List.  |
| M     | <i>Pogonatum nanum</i>                     |                    | 3, 5 (removed) | EN                                  | LC                                       | 3   | 2010  | Tracks, ditches, wheel ruts        | Colonist species and unlikely to benefit from FPO listing.   |
| M     | <i>Pohlia andalusica</i>                   | New FPO            | 3              | EN                                  | LC                                       | 5   | 2009  | Mine spoil                         | One of a group of specialist mine-spoil species.   |
| M     | <i>Pohlia elongata</i> var. <i>greenii</i> |                    |                | EN                                  | LC                                       | 2   | 2005  | Mountain cliffs                    | Status of taxon uncertain.   |
| M     | <i>Pohlia filum</i>                        |                    |                | VU                                  | LC                                       | 5   | 2003  | Sand pits                          | Not on European Red List.  |
| M     | <i>Pseudocalliergon lycopodioides</i>      |                    |                | VU                                  | RT                                       | 15  | 2007  | Turloughs, calcareous lake margins | Although Regionally Threatened in Europe, where its habitat is highly threatened and in strong decline, it still has too many (15) populations in Ireland to warrant FPO listing.                  |
| M     | <i>Pseudocalliergon trifarium</i>          |                    |                | VU                                  | LC                                       | 8   | 2009  | Fens                               | Not on European Red List.  |
| M     | <i>Ptilium crista-castrensis</i>           | New FPO            | 5 (added)      | CR                                  | LC                                       | 1   | 1987  | Montane heath                      | Not seen since 1987, despite searching in known locality. Nevertheless, this is an attractive species, susceptible to collecting, and might yet be refound in the north-facing corrie at Mweelrea. |
| M     | <i>Racomitrium canescens</i>               |                    |                | VU                                  | LC                                       | 1   | 2006  | Coastal dunes                      | Not on European Red List.  |

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|-------|---|--------------------|----------------|-------------------------------------|--|---|---|---|---|
| M     | <i>Racomitrium elongatum</i>                      |                    |                | VU                                  | LC                                       | 1   | 2007  | Heathy gravel                           | Not on European Red List.   |
| M     | <i>Racomitrium macounii</i> subsp. <i>alpinum</i> |                    |                | VU                                  | LC                                       | 3   | 2003  | Rocks                                   | Not on European Red List.   |
| M     | <i>Rhabdoweisia fugax</i>                         |                    |                | VU                                  | LC                                       | 4   | 2008 (2011)                                       | Rocks                                   | Not on European Red List.   |
| M     | <i>Schistidium agassizii</i>                      |                    |                | VU                                  | LC                                       | 2   | 2002  | Rocks in rivers                         | Not on European Red List.   |
| M     | <i>Schistidium platyphyllum</i>                   |                    |                | VU                                  | LC                                       | 6   | 2009 (2011)                                       | Rocks                                   | Not on European Red List.   |
| M     | <i>Schistidium trichodon</i>                      |                    |                | VU                                  | K  | 1   | 2005  | Rocks                                   | Not on European Red List.   |
| M     | <i>Scleropodium touretii</i>                      | New FPO            | 3              | EN                                  | LC                                       | 3   | 2008  | Coastal grassland                       | A coastal grassland species, rare and possibly declining, as its habitat is threatened. |
| M     | <i>Scopelophila cataractae</i>                    |                    |                | VU                                  | NE                                       | 3   | 2009  | Mine spoil                              | Not on European Red List.   |
| M     | <i>Seligeria oelandica</i>                        |                    |                | VU                                  | K  | 8   | 2005 (2012)                                       | Tufaceous rock                          | Not on European Red List.   |
| M     | <i>Sematophyllum demissum</i>                     |                    |                | NT                                  | R  | 16  | 2009  | Woodlands                               | NT in Ireland.  |
| M     | <i>Sematophyllum substrumulosum</i>               |                    |                | VU                                  | NE                                       | 4   | 2008  | Woodlands                               | Not on European Red List.   |
| M     | <i>Sphagnum affine</i>                            |                    |                | VU                                  | LC                                       | 3   | 2005  | Bogs                                    | Not on European Red List.   |
| M     | <i>Sphagnum flexuosum</i>                         |                    |                | VU                                  | LC                                       | 3   | 2002  | Bogs and fens                           | Not on European Red List.   |
| M     | <i>Sphagnum warnstorffii</i>                      |                    |                | VU                                  | LC                                       | 6   | 2003 (2010)                                       | Fens                                    | Not on European Red List.   |
| M     | <i>Syntrichia virescens</i>                       |                    |                | DD                                  | LC                                       | 1   | 2009  | Tarmac                                  | DD in Ireland.  |
| M     | <i>Tetraplodon angustatus</i>                     |                    | 2, 5 (removed) | DD                                  | LC                                       | 1   | 1988  | Dung                                    | Not seen since 1988; possibly a transient occurrence.                                   |
| M     | <i>Thuidium recognitum</i>                        |                    |                | VU                                  | LC                                       | 3   | 2002  | Calcareous grasslands and coastal dunes | Not on European Red List.   |
| M     | <i>Timmia norvegica</i>                           |                    |                | VU                                  | LC                                       | 13  | 2005 (2012)                                       | Montane crags                           | Too many populations; not on European Red List.   |
| M     | <i>Tomentypnum nitens</i>                         |                    |                | VU                                  | LC                                       | 18  | 2009 (2012)                                       | Fens                                    | Too many populations; not on European Red List.   |

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|-------|---------------------------|--------------------|----------------|-------------------------------------|--|---|---|--------------------------------|---|
| M     | <i>Tortella inclinata</i> | New FPO            | 2              | EN                                  | LC                                       | 1   | 1987  | Coastal                        | Not seen since 1987, despite searching in its known locality (Keel, W. Mayo). This species is retained on the FPO as it's possible that it could be refound with further survey work. |
| M     | <i>Tortula cuneifolia</i> |                    |                | CR                                  | LC                                       | 0   | 1966  | Coastal tracks                 | Not seen since 1966.  |
| M     | <i>Tortula lanceola</i>   |                    |                | CR                                  | LC                                       | 1   | 1978  | Banks and paths                | Not seen since 1978.  |
| M     | <i>Tortula modica</i>     |                    |                | VU                                  | LC                                       | 12  | 2010  | Soil                           | Too many populations; not on European Red List.   |
| M     | <i>Tortula wilsonii</i>   |                    | 2, 5 (removed) | RE                                  | LC                                       | 0   | 1934  | Coastal paths, banks           | A southern species in Europe, reaching its northern limits in Britain and Ireland. Not seen since 1934.   |
| M     | <i>Ullota coarctata</i>   | New FPO            | 3              | CR                                  | RT                                       | 1   | 2005 (2014)                                       | Epiphyte                       | A very rare epiphyte of willow and hazel, thought to be declining in Europe.  |
| M     | <i>Weissia longifolia</i> |                    | 2, 5 (removed) | VU                                  | NE                                       | 2   | 2005  | Banks, paths, disturbed ground | On the edge of European range, and possibly a transient colonist in Ireland on open soil patches. Unlikely to benefit from FPO listing.   |
| M     | <i>Weissia perssonii</i>  |                    |                | LC                                  | R  | 20  | 2008 (2010)                                       | Coastal turf                   | LC in Ireland.  |
| M     | <i>Weissia rostellata</i> |                    | 2, 5 (removed) | NT                                  | R, Endemic                               | 5   | 2003  | Mud, reservoirs, river banks   | Colonist/shuttle species of reservoirs, river banks. Not likely to benefit from FPO listing.  |
| M     | <i>Weissia rutilans</i>   |                    |                | VU                                  | LC                                       | 2   | 2007  | Soil                           | Not on European Red List.   |