

UK Biodiversity Group

Tranche 2 Action Plans

Plants and Fungi



THE RT HON JOHN PRESCOTT MP
DEPUTY PRIME MINISTER AND SECRETARY OF STATE FOR THE
ENVIRONMENT, TRANSPORT AND THE REGIONS

Dear Deputy Prime Minister

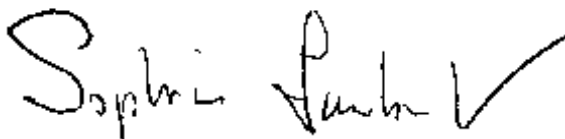
BIODIVERSITY ACTION PLANS

I am writing to you in my capacity as Chairman of the United Kingdom Biodiversity Group (UKBG) about the latest group of 75 species action plans which UKBG have completed and published in the present volume. The volume contains two helpful introductions by the Chairman of the groups which edited the plans. Also included are species statements for three lichens which have not been found in the UK over the past 10 years. Should they be rediscovered, an action plan will then be prepared.

This is the third volume in the Tranche 2 Action Plan series, which builds on the publication of the first tranche of plans in 1995. Volumes I and II were published last year, and we expect to produce three further volumes this year, including one dealing with coastal and marine species and habitats.

The new action plans are accompanied by a table showing their indicative costings so that those charged with implementation are clear about the scale of the financial consequences. As the phase of plan preparation draws to a close, UKBG will focus more sharply both on action plan implementation and the degree to which targets and objectives are actually being achieved. This will inevitably further highlight those policies and practices which will require changes if the plans are to be a success. There will be implications here for Government but for many other sectors also. The responses to last year's consultation paper *Making Biodiversity Happen* demonstrated that many sectors want to play their part in carrying forward biodiversity policies. They look to Government to give a lead by acting in a more biodiversity-friendly way itself and to the biodiversity experts, both inside and outside Government, to explain how, in practical ways, they can 'do their bit' for biodiversity.

On behalf of UKBG, I commend to you and your ministerial colleagues the action plans set out in this volume.

A handwritten signature in black ink, reading 'Sophia Lambert' followed by a large checkmark.

SOPHIA LAMBERT

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1. Background

- 1.1 This is the third volume in the series of UK Biodiversity Group Tranche 2 Action Plans. It contains action plans for priority species (listed in Annexes 2 and 3) across a wide range of groups in the plant and fungus Kingdoms. In the following two sections, some of the main issues arising from the preparation of the action plans, and pertinent to their implementation, are described by the lower plants and vascular plants editing group Chairmen.

2. Introduction to the lower plants

- 2.1 The ‘lower plants’ represent a large and diverse array of organisms. They comprise fungi, lichens, bryophytes (liverworts and mosses) and algae. Fungi and lichens are not true plants at all but are placed in their own separate taxonomic Kingdom. Collectively, these groups include over 37,500 taxa in the UK, including 20,000 terrestrial and marine algae. Not all of these species have been considered for plan production - for example, only the larger fungi, and stoneworts (dealt with in section 3 below) among the algae, were considered.
- 2.2 Many lower plants are difficult for non-specialists to tell apart yet the UK is outstanding in Europe for the richness and variety of our assemblages of these species. Important communities include the fungi of native pine woods, unimproved grasslands and wood pastures, and the rich lichen and bryophyte floras of our western, oceanic woodlands. Some individual species have remarkable disjunct world ranges: stretching, in the case of some lichens and bryophytes, from the western UK to the Azores, Canary Islands, mountain tops in Africa, southern tip of South America and beyond to Antarctica and islands in the Pacific. Yet for many species, information on current status and population trends is poor or out of date. Selection of priority species is, accordingly, more difficult, and actions for their conservation harder to determine, than for better known groups such as vertebrates and vascular plants. The following paragraphs address some of the issues encountered in the development of these plans.

Taxonomy

- 2.3 A fundamental difficulty with some species is that their taxonomy is uncertain or that they are newly described to science. The identification of many of these species may be critical and requires the skills of professional taxonomists. Some species are included as priorities because they are believed to be endemic to the UK but further research in other parts of the world may result in their discovery elsewhere. For example, *Pictus scoticus* and *Sphagnum skyense* are both putative endemic species and both are known in Britain only from single collections. However, these may be, respectively, simply an unusual form of a more common British species and a species already described from Asia and western North America. Such taxonomic issues need to be resolved if we are to fully understand the status of these and other taxa. Herbarium collections of lower plants are an invaluable resource for such studies and, by retaining voucher specimens, enable the distribution and taxonomy of species to be critically re-evaluated should the need arise.

Survey

- 2.4 Many lower plants which are considered to be threatened in the UK did not qualify for action plan production because reliable data on decline or global status were not readily available. Even for those lower plants which have been identified as priorities, information on distribution and status is often incomplete. There is a corresponding emphasis in the plans on the need for further targeted survey and monitoring and for the collation of existing information. In the absence of the results of such survey or associated research, section 2 of the plans (*Current factors causing loss or decline*) is necessarily lacking in detail or is based on the best expert opinion rather than on hard evidence.
- 2.5 One of the major constraints on lower plant conservation is the limited body of specialists able to identify species accurately and to undertake survey work. If better data are to be gathered, there is a need to train naturalists in the necessary identification skills and to prompt the collation of records - another common theme within the plans. Paradoxically, such targeted survey may result in an apparent increase in the range or number of populations (through the discovery of 'new' populations), even though the underlying trend is one of genuine decline. For example, over the period during which these action plans were being prepared, *Cladonia botrytes*, *Didymodon mamillosus* and *Peltigera lepidophora* (none of which had been seen in the UK since the 1970s) were all re-found in Scotland; a second UK site for *Catapyrenium psoromoides* was also discovered. It is unlikely that such survey effort would have been devoted to these species if they were not Biodiversity Action Plan priorities.

Advisory

- 2.6 Since the identification of lower plants usually requires specialist knowledge, the plans also have an emphasis on providing advice to others. Land managers, for example, cannot be expected to take account of these species if they do not know where they occur or what their management requirements are. Informing land managers and planners of the locations of these species, and enabling them to have access to specialist advice, is, accordingly, a recurrent theme of the plans. Although not explicit in the plans, this advice may be provided through a variety of media as well as by face-to-face contact. The publication of booklets or factsheets on specific species or groups, explaining their habitat requirements and listing possible sources of advice, is one possible approach. However, little information exists on management for priority species. Consequently, there is often a requirement in the plans for further autecological research to inform this need.

Population management

- 2.7 Most plans contain targets to maintain or restore populations of the species concerned. The implicit assumption is that such populations should be *viable*. Defining viability in lower plant populations is not straightforward but is taken here to mean *populations of such a size and reproductive vigour, set within a sufficient quantity and quality of habitat, as to be able to maintain themselves in perpetuity*. Typically, these populations will have a long-term stable or upward trend. Techniques for direct intervention in populations of lower plants which are not considered to be viable, such as by reintroductions or reinforcement, are often not

available or have not been studied in any detail. Ambitious restoration targets are not, therefore, generally feasible and the priority for positive action is focused on habitat management and the protection of extant sites. However, the development of *ex situ* conservation techniques for bryophytes is considered to be a feasible and exciting initiative and is consequently reflected in many bryophyte plans (where a direct benefit can be anticipated). Developing such an approach would provide a safeguard against the extinction in the wild of small isolated colonies and would also provide material for autecological and genetic studies (without threatening wild sources), and for reintroduction attempts. However, where a contraction in range is known to have occurred and the potential for reintroductions (using currently available techniques) is believed to exist, appropriate targets and actions are included in the plans. Such targets may act as a spur to test, empirically, techniques for translocations. Implicit in these proposals is that IUCN guidelines (and terminology) on reintroductions and translocations will be followed and that any genetic implications will also be considered.

Site protection

- 2.8 Many priority lower plants occur in very few localities and many of these are notified as Sites (or Areas) of Special Scientific Interest (SSSI/ASSI) or may even be candidate Special Areas of Conservation. In some cases, the lower plant interest forms part of the reason for the notification of these sites; often it does not, either because the presence of these priority species is newly discovered or because the interest does not match existing selection criteria. The plans, therefore, often refer to the need to take account of these species in the development of management proposals for such protected sites. For a few species which are not well represented on SSSI/ASSIs, the plans may contain reference to reviewing the need for designation against selection criteria. Such reviews need to be set in the context of the priorities for designations amongst the Country Agencies and in light of the reviews of site protection legislation currently underway.

Wider countryside

- 2.9 Lower plants are especially vulnerable to the insidious effects of atmospheric pollution. Such effects may be direct, say through the deposition of atmospheric nitrogen or sulphur, or indirect, through the impact of climate change on the lichens and bryophytes of late snow-beds. Action to counter such threats invariably requires significant and co-ordinated international efforts by Governments to reduce emissions. Wider countryside measures, such as agri-environment schemes, may also be critical in conserving some of these species, especially where habitat enhancement is required or, as importantly, where measures are needed to prevent or reduce nutrient enrichment (from fertiliser application) of grasslands or the boles of trees supporting epiphytic lower plants. Whilst it may not always be possible to target such measures directly to priority species, they have the opportunity to influence the countryside surrounding extant populations or to enhance habitats to which the target species may ultimately spread.
- 2.10 One major group of threatened lower plants comprise the lichen and bryophyte epiphytes of wayside trees. These species have been subject to massive declines, largely because of the loss of their host trees to elm disease or to indiscriminate felling. Typically these species occur as small populations on isolated individual trees or clusters of trees. One mechanism to protect such trees could be through the use of Tree Preservation Orders (TPO). However, nature

conservation interest alone is not, under current legislation, sufficient justification for TPOs unless the tree is also of significant amenity value. Accordingly, we have only referred to this mechanism (with appropriate qualifications) in a minority of cases though, if the legislation were to be changed, TPOs have the potential to contribute significantly to the conservation of this group of organisms.

Botanical collection

- 2.11 Botanical collection is identified as a threat in a few plans, though for many species this activity had its greatest impact in the last century. In those cases where over-collecting or direct destruction is perceived as an ongoing threat, a standard prescription to consider legal protection has been used. This takes account of the need to consider protection against criteria developed for the Quinquennial Review of schedules 5 and 8 of the Wildlife & Countryside Act and to ensure that protection will address the cause of decline in a species. We have been careful not to over-emphasise any risk from collecting. In most cases, such risks are low these days and it must be remembered that collecting is, and will continue to be, necessary for the identification and study of most lower plants, especially in critical taxa.

Data

- 2.12 The need for an efficient flow of data on the changing fortunes of these priority species is explicit within the plans. In practice, this is a way of ensuring that the developing National Biodiversity Network becomes a vital tool to aid the conservation of this, often neglected, group of organisms. In this, as in every other aspect of plan implementation, the continued and dedicated contribution of those societies devoted to the study and conservation of lower plants (namely the British Bryological Society, the British Lichen Society, the British Mycological Society and the British Phycological Society) will be fundamental.

3. Introduction to the stoneworts and vascular plants

- 3.1 This volume contains the action plans for seven stonewort (charophyte) species and four vascular plant species. Some 36 vascular plant plans were published in the *UK Biodiversity Group Tranche 2 Action Plans Volume I* and the ones in this volume complete those to be published for priority species in this taxonomic group. The commentary below applies to the group as a whole, as well as the stoneworts.

General observations

- 3.2 The action plans examine, species by species, the factors which have caused their loss or decline over the past 25 years. In many cases these same factors are now operating as constraints on recovery. Some of the endemic species have suffered comparatively limited declines but extreme range restriction renders them vulnerable to a variety of threats.
- 3.3 Before examining some of the main factors affecting these species, and the actions that have been proposed to deal with them, two broad observations on the plans merit comment:

(1) Naturally restricted vs formerly widespread species. A number of species are naturally restricted ecologically and/or geographically. In such cases emphasis is placed on the need to protect their extant localities and on taking a cautious approach to their recovery through gradual reinforcement of existing populations and/or reintroduction to former sites, but only where the factors which led to their local extinction are understood. The endemic *Limonium* species, *Sorbus leyana* and *Asparagus officinalis* ssp *prostratus* fall into this group. Other species, by contrast, have suffered considerable declines and range contractions. In these cases more emphasis is placed on active recovery employing the full range of mechanisms from encouraging regeneration from the seed-bank, through reintroduction at former sites, to introduction to new sites within the former range (see below). The arable wildflowers and a number of the species of wet habitats typify this group.

(2) Groups of species with shared factors causing loss and decline. Comparison of the action plans indicates that many of the species covered fall into groupings that share the same, or similar, key factors causing loss or decline. The arable wildflowers form the most cohesive group, although this can be further split into two sub-groups: species of sandy, nutrient poor ground (eg *Filago* spp) and species of richer calcareous soils (eg *Scandix pecten-veneris*). Other groups include those of pools (especially ephemeral ones) on wet heaths (eg *Lycopodiella inundata*), species of aquatic habitats (eg the stoneworts) and other species of traditionally managed semi-natural habitats.

Major factors

- 3.4 One factor stands out above all the others in its frequency of occurrence across the plans and that is change in agricultural practice. This is most clearly demonstrated in the case of the arable wildflowers which have suffered from the introduction of herbicides and the increase in use of fertilisers. They have also been adversely affected by changes in the farming calendar, especially the change from spring to autumn-sown cereals. Very clear parallels can be seen here with the causal factors relevant to the decline of many farmland bird species.
- 3.5 Changes in agricultural practice and other land uses have resulted in habitat loss (eg of Beckland heathlands for *Arabis glabra*) or degradation (eg the species of traditionally managed watercourses such as *Leersia oryzoides*, *Sium latifolium* and *Carex vulpina* and those of formerly extensive managed heathland such as *Lycopodiella inundata* and *Mentha pulegium*).
- 3.6 Climate change may affect some of the species (given that a number are towards the edge of their range in the UK) but this factor is poorly understood for most of the species considered here. A number of the highly restricted endemics could be especially vulnerable to predicted climate change (eg *Sorbus leyana*, *Limonium* taxa).
- 3.7 Other types of threat that recur include disturbance (eg of *Potamogeton compressus*, *Chara connivens* and *Nitellopsis obtusa* by boat traffic), pollution (usually of waters, but possibly also of the atmosphere in the case of *Lycopodiella*), and competition (eg from *Crassula helmsii* in the case of *Pilularia*).

Proposed actions

- 3.8 The main processes for safeguarding and recovering these threatened plant taxa in the wild can be thought of as four sequential steps representing an increasing scale of intervention. The particular steps needed for a species will depend on its life strategy and natural distribution, the severity of its decline and current predicament, as well as the degree to which earlier steps, if undertaken, are successful. They are:

1. **Maintenance of extant populations through habitat management and/or site protection.** The minimum objective for any of the priority vascular plants and stoneworts is the maintenance of extant populations. This often means restoring viability to populations which are currently not self-sustaining. Achieving the right habitat management regime, whether it be grazing levels, timing of sowing and harvesting of crops, or sympathetic ditch clearance, can be crucial in this respect. The use of agri-environment schemes and site management agreements is encouraged to secure such management. Local Environment Agency Plans (LEAPs) and Water Level Management Plans (WLMPs) can also help ensure that the wet habitat requirements of some species are met. Protection from potentially damaging activities and developments can be essential, and a range of measures, from wardening to statutory legislation for species or sites, can be called upon when appropriate.
2. **Increasing the total population size and range by encouraging recolonisation and regeneration from the seed-bank.** For species that are naturally widespread, but now restricted to a few sites, the creation of suitable habitats in the vicinity of extant populations is important. This is likely to be particularly successful for the opportunistic species with high dispersal ability, for which a network of suitable areas to support a dynamic 'metapopulation' is more important than single locations under stable management. Agri-environment scheme prescriptions can be ideal for this purpose, and may be the only means of re-establishing some species in the wider countryside. Undertaking experimental management to encourage regeneration of the species from persisting seed-banks is also widely recommended for restoring populations to known historic sites. The two strategies working together can potentially be highly effective.
3. **Reintroductions to former sites, and reinforcement of extant populations.** If steps 1 and 2 (above) fail, or indeed are not an option at all, then the artificial release of a species (as a plant, seed or other propagule) to a former site (reintroduction of a population) or to an existing one (reinforcement of a population) can be attempted. This may be the only way that a naturally rare species can be restored to its former range, or the viability returned to an existing population. However, this whole approach is resource demanding, and not guaranteed to be successful. Its place in the recovery strategy of any species needs to be carefully considered.
4. **Introduction to new sites.** Sometimes former sites for a species have been destroyed, or are no longer suitable for its survival. Replacement sites in the native range can in this instance be sought, and translocations undertaken to establish new, replacement populations.

Supporting processes

- 3.9 The above steps are designed to meet the biological objectives of enhancement of population size and viability, and recovery of range. However, they are nearly always impossible without the supporting, and often pioneering, work of research, survey, monitoring, *ex situ* conservation, and giving advice.
- 3.10 **Research** may be into the taxonomy of the species, to clarify its identity and conservation status, and aid its identification in the field. Such work is proposed for *Alchemilla minima* and is underway for the endemic *Limonium* species. Research is also needed into the autecology of the species, to inform habitat management for it.
- 3.11 **Survey** finds out or confirms the current distribution of extant populations, and the degree to which each is under threat. For some species, selective searches of known former or current sites may be adequate; for others national surveys that include potential sites are advocated. Research and survey together often need to be undertaken early in the implementation of the action plan, as a means of prioritising and directing the actions to follow.
- 3.12 **Monitoring** helps keep the finger on the pulse of a plant species' status. It can be used to investigate how factors operate on the species to cause its decline; it can chart the positive impact of remedial action and refine techniques being used. It is particularly important for experimental management, (re)introductions and reinforcements.
- 3.13 ***Ex situ*** is highlighted as a biological objective for many of the plant species, as it is a means of preserving genetic material and ensuring the continuation of a species as a reserve population should it reach a particularly precarious state in the wild. It has many other purposes, however, including providing material for research and translocations.
- 3.14 **Advisory work** is key to gaining the cooperation of landowners and managers and increasing the effectiveness of agri-environment scheme project officers. The elements of advice that are identified are the locations of populations, management requirements, and potential threats and damaging activities. The importance of these species is also a message that needs to be stressed, to the general public as much as to the owners and occupiers of sites.

Priority Species Action Plans

Fungi



Armillaria ectypa (an agaric)

Action Plan

1. Current status

- 1.1 *Armillaria ectypa* is one of the honey fungus species but, unlike some other species of *Armillaria*, it is not a serious pathogen. Its favoured habitat is *Sphagnum* bogs, where it grows amongst mosses. Its fruiting bodies grow up to 8-10 cm tall and have an ochre or honey coloured cap 3-5 cm in diameter.
- 1.2 The only known British record of this species is from an area of common land in the Pennines, where it was known to be extant in 1995. The history of this species in Britain is poorly understood and it is unclear whether it may have suffered a decline through drainage of its bog habitats. It is rare throughout Europe, but may be under-recorded.
- 1.3 In Great Britain *A. ectypa* is classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981. This species is also included on the provisional European red data list.

2. Current factors causing loss or decline

- 2.1 Current potential threats to the hydrology of its only known site include land drainage, peat cutting and conifer afforestation in the surrounding catchment.
- 2.2 Potential threats to water quality on this site include run-off of agricultural chemicals, and nutrient-rich rainfall.

3. Current action

- 3.1 The only known British *A. ectypa* site is protected as an SSSI.

4. Action plan objectives and targets

- 4.1 Maintain a population of this species at its single known extant site, and increase its extent at this site if appropriate and feasible.

5. Proposed action with lead agencies

Very little is known about this species in Britain. There is no record of the extent of the population at its only known British site, and it is not known whether this is a widely overlooked species or whether it is, in fact, as rare as current information suggests. Similarly, very little is known about its ecology. With these points in mind, action should initially focus on survey work, ecological research and protection of its single known site.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Seek to protect the single known *A. ectypa* site from activities in the surrounding catchment which may affect its hydrology, such as afforestation, peat cutting and agricultural drainage. (ACTION: EN, FC, LA, MAFF)

5.2.2 Assess the risk to the single known *A. ectypa* site posed by run-off of agricultural chemicals or by deposition of atmospheric nitrogen. If a threat is identified, seek to undertake remedial action to address the problem. (ACTION: EA, EN, MAFF)

5.3 Species protection and management

5.3.1 None proposed.

5.4 Advisory

5.4.1 Advise landowners and land managers, and relevant agencies, of the presence and importance of this species, specific management for conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.4.2 When fruiting bodies appear, organise a site meeting between a mycologist and relevant people involved in the management of the site. (ACTION: EN)

5.5 Future research and monitoring

5.5.1 Undertake regular surveys of the single known *Armillaria ectypa* site in order to monitor the status of the species and to assess changes in habitat quality. (ACTION: EN)

5.5.2 Undertake surveys of suitable *Sphagnum* bogs in northern Britain with the aim of discovering new *A. ectypa* sites. (ACTION: CCW, EN, SNH)

5.5.3 Compile a list of sites that would be worth searching for *A. ectypa* and distribute to active mycologists encouraging further surveys of *Sphagnum* bogs. (ACTION: CCW, EN, SNH)

5.5.4 Commission a research project, in order to improve understanding of the ecology of this species, particularly its methods of spread and habitat requirements. (ACTION: EN)

5.6 Communications and publicity

- 5.6.1** Encourage mycologists to pass all records of *A. ectypa*, including ecological information, to a national database by 2002. (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** None proposed.

Royal bolete (*Boletus regius*)

Action Plan

1. Current status

- 1.1 Royal bolete is known mainly from grassy areas under broadleaved trees in ancient, deciduous woods, particularly hornbeam or beech woods but also oak, on calcareous or acidic sandy soils. It is an ectomycorrhizal species which depends on old host trees. Many of its known host trees are old oak pollards. It has attractive, edible fruiting bodies which generally appear between May and September, although it is not known how reliable its fruiting is. The fruiting bodies are reddish in colour with a cap 6-15 cm in diameter.
- 1.2 In Britain, this species is only known from southern England. There is very little information on its historic distribution in Britain. It may always have been rare, but some experts suggest that it may have declined over the last 40 years. In recent years, it has only been seen at three sites: the New Forest, Ashgreen (Surrey) and Windsor Forest. Elsewhere, this species has been recorded in scattered locations across central Europe.
- 1.3 In Great Britain royal bolete is classified as *Endangered*. It is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. This species is also included on the provisional European red data list.

2. Current factors causing loss or decline

- 2.1 Whilst there is no firm evidence of a decline in the British population of royal bolete, it is likely that it has disappeared from some sites following losses of old pollard trees with which it is associated.
- 2.2 Other potential threats may include replacement of broadleaved woods with conifers, and enrichment of soils through air pollution and run-off of agricultural chemicals.

3. Current action

- 3.1 This species was added to Schedule 8 of the Wildlife and Countryside Act 1981 at the last review in 1998.

4. Action plan objectives and targets

- 4.1 Maintain populations at all extant sites, and increase the extent of populations at these sites where feasible.
- 4.2 Ensure a continuity of suitable host trees at all extant sites.

5. Proposed action with lead agencies

This species appears to be very rare in Britain, and may always have been so. It is likely that it remains faithful to its sites over many years and is a poor coloniser of new sites. With this in mind, conservation action should focus on the protection and careful management of existing sites. It is important that the long-term requirements of this species are considered at this stage, particularly the management needed to ensure a continuity of suitable host trees. Further research is needed to refine conservation management for this species.

5.1 Policy and legislation

5.1.1 None proposed

5.2 Site safeguard and management

5.2.1 Consider notifying as SSSIs, sites with viable populations of this species where this is consistent with selection guidelines and is necessary to ensure their long-term protection and appropriate management. (ACTION: EN)

5.2.2 Where appropriate, undertake management of suitable trees in the immediate vicinity of extant royal bolete colonies. The aim is to ensure a continuity of living old trees which will provide potential hosts for this species. Management may include re-pollarding/pollarding of host trees and protection of saplings which could, in the long term, become host trees. (ACTION: EN, FC)

5.2.3 Assess the threat to known royal bolete sites posed by drift and run-off of agricultural chemicals or by deposition of atmospheric nitrogen. Where a threat is identified, seek to undertake remedial action to address the problem. (ACTION: EA, EN, MAFF)

5.3 Species protection and management

5.3.1 None proposed.

5.4 Advisory

5.4.1 Advise landowners and land managers, and relevant agencies, of the presence and importance of royal bolete, its legal protection, specific management for conservation, any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.4.2 When fruiting bodies appear, organise site meetings between a mycologist and relevant people involved in site management. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Ensure that all known sites for this species are visited regularly during the fruiting season so as to keep a close check on the population at each site and to monitor changes in habitat quality. (ACTION: EN)
- 5.5.2** Promote research into the ecology of royal bolete in order to underpin future management for its conservation. The research should include an assessment of the effects of trampling on this species and an investigation of the mycorrhizal relationship with its host trees. (ACTION: EN)

5.6 Communications and publicity

- 5.6.1** Encourage mycologists to pass all records of royal bolete, including ecological information, to a national database by 2002. (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to this species and other boletes, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for lowland wood pastures and parkland.

Oak polypore (*Buglossoporus pulvinus*)

Action Plan

1. Current status

- 1.1 This species causes brown rot in mature oaks or on recently dead oaks, but never on any other species. It mainly occurs in wood pasture habitat where there has been a continuity of mature oak trees. The fruiting bodies which are edible, but have a very bitter taste, generally appear between May and December.
- 1.2 In Britain, this species has been recorded at Sherwood Forest and from approximately five other sites in Derbyshire, Norfolk, Suffolk, Oxfordshire and Herefordshire. There is no evidence for a historic decline in this species. Oak polypore is widespread but rare in lowland Europe but is extinct in most northern European countries and is declining in central Europe. Its range extends as far east as Japan.
- 1.3 In Great Britain oak polypore is classified as *Endangered*. It is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. This species is also included on the provisional European red data list.

2. Current factors causing loss or decline

- 2.1 Lack of suitable younger oak trees to ensure a continuity of oak polypore habitat. This is known to be a threat to the long-term survival of this species in Sherwood Forest.
- 2.2 Felling of host trees.
- 2.3 Collecting for identification, or any other purpose, is a potential threat at sites with small populations of this species.

3. Current action

- 3.1 This species was added to Schedule 8 of the Wildlife and Countryside Act 1981 at the last review in 1998.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all extant sites.
- 4.2 Attempt by 2005 *ex situ* cultivation of this species as a precursor to artificially establishing five new colonies by 2010.

5. Proposed action with lead agencies

If the conservation of this species is to be successful in the long term, it is essential that consideration is given to ensuring a continuity of suitable habitat at each extant site. This may demand planting of oaks, maintenance of existing pollard oaks and establishment of new pollard oaks. Existing host trees should be protected from felling, and colonies of oak polypore should be protected from inappropriate collecting through the recent addition of this species to Schedule 8 of the Wildlife and Countryside Act 1981. Attempts should be made to cultivate the species *ex situ* and then to establish new colonies artificially by inoculating suitable trees. This approach may provide an important contingency measure if host trees are lost.

5.1 Policy and legislation

5.1.1 None proposed

5.2 Site safeguard and management

5.2.1 Devise and implement a management strategy to ensure a continuation of mature oak trees in the vicinity of extant oak polypore colonies; management may include establishment of new oak pollards and protection of oak saplings which could, in the long term, become host trees. (ACTION: EN)

5.2.2 Wherever possible, prevent felling of oak polypore host trees; where public safety is an issue, use tree surgery or other techniques to avoid felling as a solution. (ACTION: EN)

5.3 Species protection and management

5.3.1 Assess the possibility, subject to research in 5.5.2, of translocating this species to suitable oak trees in the event of existing host trees becoming unstable. (ACTION: EN)

5.4 Advisory

5.4.1 Advise landowners and land managers, and relevant agencies, of the presence and importance of oak polypore, its legal protection, specific management for conservation, any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.4.2 When fruiting bodies appear, organise site meetings between a mycologist and relevant people involved in site management. This action is an extension of 5.4.1 and will ensure that site managers are alert to the presence of this species. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Undertake regular surveys of all known oak polypore sites in order to maintain an understanding of the status of this species at each and to assess the threats to all extant colonies. (ACTION: EN)
- 5.5.2** Commission research to investigate aspects of the ecology of this species, including *ex situ* cultivation and translocation techniques, and refining habitat management for its conservation. (ACTION: EN)

5.6 Communications and publicity

- 5.6.1** Encourage mycologists to pass all records of oak polypore, including ecological information, to a national database by 2002. (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to oak polypore, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)
- 5.6.3** Raise awareness amongst the public of the ecological and legal implications of collecting this species. The need for site interpretation boards putting this message across should also be assessed. (ACTION: EN)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for lowland wood pastures/parkland.

***Hericium erinaceum* (a hedgehog fungus)**

Action Plan

1. Current status

- 1.1 *Hericium erinaceum* grows mainly on the wounds of old living trees and on the ends of felled trunks in deciduous woods. It often grows high up on its host trees which are usually beech, but may also be oak. This species has an extremely local distribution in Britain, possibly because it is restricted to areas of woodland where there has been a long continuity of old trees. Fruiting bodies appear in late summer to autumn. Techniques are available for cultivating this edible species, and it is now being sold in supermarkets as a fashionable addition to cuisine.
- 1.2 This species is scattered but locally common in southern England, rare in the Midlands (only one record from Herefordshire) and is absent from other parts of the British Isles. There are 12 records from approximately seven sites since 1960. Recent records include sites in the New Forest, Windsor Great Park and Oxfordshire. Elsewhere, this species is widespread, but not common, throughout continental Europe and is also found in Mexico and North America.
- 1.3 *Hericium erinaceum* is classified as *Endangered* in Great Britain. It is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is included on the provisional European red data list for fungi.

2. Current factors causing loss or decline

- 2.1 This species was lost from one site in the New Forest after the half-rotten host tree was cleared away by forest managers.
- 2.2 Collection for botanical and culinary purposes may be a threat to this species.

3. Current action

- 3.1 This species was added to Schedule 8 of the Wildlife and Countryside Act 1981 at the last review in 1998.
- 3.2 An identification book, which includes this species, has recently been published by RBG Kew.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all extant sites, and increase their extent at these sites if feasible.

5. Proposed action with lead agencies

The successful long-term conservation of this species will depend on there being a continuity of suitable host trees, and measures should be implemented to ensure that this is achieved. In parallel with the protection of known sites, sites with previous records of this species should be surveyed in order to determine the current status of this species at each. Since this species can be cultivated, it may be possible to inoculate old trees with the species.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Devise and implement a management plan for each *H. erinaceum* site to ensure a long-term continuity of suitable host trees for this species, by protection of suitable young trees, the establishment of new pollards and re-pollarding existing host trees where appropriate. (ACTION: EN, FE)

5.2.2 Consider notifying as SSSIs sites with viable populations of *H. erinaceum* where this is consistent with selection guidelines and is necessary to ensure their long-term protection and appropriate management. (ACTION: EN)

5.3 Species protection and management

5.3.1 Assess the possibility of translocating this species to suitable host trees in the vicinity of extant colonies, if there is believed to be a lack of suitable habitat for natural colonisation at the existing site. (ACTION: EN)

5.4 Advisory

5.4.1 Advise landowners and land managers, and relevant agencies, of the presence and importance of *H. erinaceum*, its legal protection, specific management for conservation, any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

5.5.1 Visit all sites with records of *H. erinaceum* annually during the fruiting season (other than those sites where this species is definitely known to have been lost) in order to keep a close check on the population at each site and to monitor changes in habitat quality. (ACTION: EN, FE)

5.5.2 Promote research into the ecology of this species (including *ex situ* cultivation) in order to underpin future management for its conservation, and to inform techniques for possible translocation attempts. (ACTION: EN)

5.6 Communications and publicity

- 5.6.1** Encourage mycologists to pass all records of *H. erinaceum*, including ecological information, to a national database by 2002. (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for lowland wood pastures and parkland.

Threatened ‘tooth’ (or stipitate hydroid) fungi - 14 species

Action Plan

1. Current status

- 1.1 This group of stipitate hydroid fungi are known as ‘stalked tooth fungi’ because the spore-bearing surface beneath the cap is composed of teeth-like projections. These fungi form mycorrhizal associations with either coniferous (C), typically Scots pine in Britain, or broadleaved (B) trees (occasionally both). Threatened tooth fungi in the UK include *Bankera fuligineoalba* (C), *Hydnellum aurantiacum* (C), *Hydnellum caeruleum* (B+C), *Hydnellum concrescens* (B+C), *Hydnellum ferrugineum* (C), *Hydnellum peckii* (C), *Hydnellum scrobiculatum* (C), *Hydnellum spongiospies* (B), *Phellodon confluens* (B), *Phellodon melaleucus* (B+C), *Phellodon tomentosus* (C), *Sarcodon glaucopus* (C), *Sarcodon imbricatus* (C) and *Sarcodon scabrosus* (B+C(?)). Although these are all considered to be threatened in the UK, they are almost certainly under-recorded due to their inconspicuous nature and absence of people with skills to identify species in this group. There is some evidence that these species may be able to colonise new areas of suitable habitat in time. For example, tooth fungi have been recorded from some old pine plantations in Scotland.
- 1.2 Many of the species in this group have a stronghold in the Caledonian pine forests of Scotland including *Phellodon melaleucus*, *Phellodon tomentosus*, *Bankera fuligineoalba*, *Phellodon confluens*, *Sarcodon imbricatus*, *Sarcodon glaucopus*, *Hydnellum ferrugineum*, *Hydnellum caeruleum*, *Hydnellum peckii* and *Hydnellum aurantiacum*. Other important areas for these fungi include the New Forest and Windsor Forest. Some are listed as occurring or having occurred in Wales (*Phellodon melaleucus*, *Phellodon tomentosus*, *Hydnellum ferrugineum*, *Hydnellum scrobiculatum*) and Northern Ireland (*Phellodon melaleucus*). Elsewhere, records of these species are scattered throughout continental Europe and have also been recorded from North America.
- 1.3 In Great Britain *Hydnellum aurantiacum* is classified as *Critically Endangered*; *Bankera fuligineoalba*, *Hydnellum caeruleum*, *Hydnellum ferrugineum* and *Sarcodon scabrosus* are all classified as *Endangered*; *Hydnellum concrescens*, *Hydnellum peckii*, *Hydnellum scrobiculatum*, *Hydnellum spongiospies*, *Phellodon confluens*, *Phellodon tomentosus*, *Phellodon melaleucus* and *Sarcodon imbricatus* are all classified as *Vulnerable*. The recently discovered *Sarcodon glaucopus* probably merits *Endangered* status. All the species receive general protection under the Wildlife and Countryside Act 1981, although none are specially protected under Schedule 8. All of these species are included in the provisional red data list of European fungi.

2. Current factors causing loss or decline

- 2.1 Historic losses of native pine wood and wood pasture, and perhaps also recent losses of these habitats to agriculture and building development is likely to have reduced the UK population of these species.

- 2.2 Changing forest practices such as the introduction of clear-felling and underplanting with conifers may have resulted in the loss of some populations, although there is little evidence to support this. Losses of mature host trees to felling, or a break in the ecological continuity of mature trees on a site, may be a significant threat.
- 2.3 Nutrient enrichment of soils, especially by deposition of atmospheric nitrogen, in which these species occur may be a threat at some sites.
- 2.4 Invasion of *Rhododendron* is believed to be a threat on at least one site.

3. Current action

- 3.1 Many of the recent sites for these species are within SSSIs and NNRs (eg Abernethy, the New Forest).
- 3.2 Work was recently initiated by the Bucks, Berks and Oxon Naturalists Trust, the British Mycological Society and the Crown Estate to clear areas of *Rhododendron* which are threatening a site in Windsor where these species occur.
- 3.3 SNH, in collaboration with the RBGE, has established a database of all fungus records in the Cairngorms area, which includes key sites for this group, to inform future management.
- 3.4 An identification book has recently been published by RBG Kew.
- 3.5 SNH have recently commissioned a survey of these fungi in native pine woods.

4. Action plan objectives and targets

- 4.1 Maintain populations at all extant sites.
- 4.2 By 2010, experimentally establish two new populations of one species in expanding native pine woods.

5. Proposed action with lead agencies

The distribution and status of the hydroid fungi in Britain are still poorly understood. Action must therefore initially concentrate on improving such knowledge in order that a baseline can be established against which future population changes can be assessed, and so that habitat management can take account of the occurrence of these species. The requirements of this group of fungi need to be considered in the management of woodlands and wood pastures in which they occur, and also in plans for the expansion of the native Scottish pine woods. Maintaining a continuity of mature trees to act as hosts for these fungi is likely to be a critical action. Research into the rates and means of spread by this group of species is also required, especially in relation to plans for woodland expansion. Tests of novel means of translocation to new woodlands may aid this understanding and help expand the range of these fungi.

5.1 Policy and legislation

- 5.1.1** Consider the requirements of these species when selecting target areas for the expansion of Scots pine woodland. (ACTION: FC, SNH)

5.2 Site safeguard and management

- 5.2.1** Ensure that semi-natural woods with populations of these species are managed appropriately. (ACTION: CCW, EN, FC, SNH)
- 5.2.2** Consider notifying as SSSIs, sites with viable populations of tooth fungi, where this is consistent with selection guidelines and is necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EN, SNH)
- 5.2.3** Use the information arising from the survey work proposed under 5.5.2, to aid development of future management plans in the native pine woods of Scotland. (ACTION: FC, SNH)
- 5.2.4** Assess the threat to sites for threatened hydroid fungi posed by drift and run-off of agricultural chemicals, or by deposition of atmospheric nitrogen. Where a threat is identified, seek to undertake remedial management to address the problem. (ACTION: CCW, EA, EN, FC, MAFF, SEPA, SNH, SOAEFD, WOAD)
- 5.2.5** Undertake management where appropriate to ensure a continuity of mature trees on all sites with populations of these species (ACTION: CCW, EN, FC, SNH)

5.3 Species protection and management

- 5.3.1** Following the research outlined under 5.5.3, assess the feasibility and desirability of translocating colonies of threatened stipitate hydroid fungi to suitable areas of recently planted native pine woods, in order to facilitate the spread of this group of species. (ACTION: SNH)

5.4 Advisory

- 5.4.1** Advise landowners and land managers, and relevant agencies, of the presence and importance of tooth fungi, specific management for their conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN, FA, SNH)

5.5 Future research and monitoring

- 5.5.1** Compile information and resurvey sites where necessary in order to assess the habitat quality at all post-1970 sites and to improve knowledge of the current status of these species at each site. (ACTION: CCW, EN, SNH)
- 5.5.2** Commission survey work over three seasons in the native pine woods of Scotland, with the aim of mapping the distribution of threatened stipitate hydroid fungi and establishing a baseline of information against which future population changes can be assessed. (ACTION: SNH)

- 5.5.3** Undertake research into aspects of the ecology of these species with a view to assessing their capability to colonise naturally new or existing woodlands, providing techniques for possible translocation attempts, and to refine habitat management for their conservation. (ACTION: EN, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage mycologists to pass all records of tooth fungi, including ecological information, to a national database by 2002 (ACTION: CCW, EN, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to tooth fungi, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with those for native pine woods, and lowland wood parklands and pastures.

Pink meadow cap (*Hygrocybe calyptriformis*)

Action Plan

1. Current status

- 1.1 This is principally, but not exclusively, a species of montane to sub-alpine regions. Its main habitats include lawns, grassy meadows, pastures and woodland margins. It has been recorded from both limestone grassland and acidic grassland. Fruiting bodies, which are seldom abundant, generally appear between August and October. They have attractive pointed caps 5-7 cm tall and a white or pinkish stem up to 10 cm tall. Being a conspicuous species, it is thought that it may be better recorded than other waxcap fungi. This fungus is one of a group of the often brightly-coloured waxcap fungi (*Hygrocybe* spp) which are typically associated with unimproved grassland and which are reported to have declined across Europe.
- 1.2 There are at least 46 post-1960 UK records of this species (including 10 sites in Northern Ireland) and, when data from the current British Mycological Society 'waxcap grassland' survey has been collated, it is likely that this figure will be significantly higher. Some 14 sites were discovered in 1997 as a result of survey work in mid Wales. Other records are from North Yorkshire, Scotland, Wales, Oxfordshire, Kent and Worcestershire. A large population is known on an MoD artillery range in Brecknock. Elsewhere this species is found in continental Europe, North America and Asia.
- 1.3 In Great Britain this species is provisionally classified as *Low Risk*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

Historic changes in the population of this species are poorly understood, but potential threats to extant sites include:

- 2.1 Improvement of its grassland habitat through ploughing or addition of fertilisers.
- 2.2 Reduction in the levels, or cessation, of grazing or mowing, leading to growth of rank vegetation and woody species.

3. Current action

- 3.1 One of the known sites for this species in Wales is owned by the National Trust which is aware of its ecological importance and appropriate management for its conservation. It is also present on three SSSIs in mid Wales.
- 3.2 The British Mycological Society is undertaking a 'waxcap grassland' survey which began in 1996.

4. Action plan objectives and targets

- 4.1** Maintain populations of this species at all extant sites, and increase the extent of populations at these sites where appropriate and feasible.

5. Proposed action with lead agencies

Following compilation of data on the current distribution and status of this species, which is a priority, action should focus both on the protection of its extant sites from damaging activities (such as those associated with agricultural improvement of its grassland habitats), and on establishing beneficial site management, including appropriate cutting, mowing or grazing regimes and control of invading scrub. Further research is needed in order to refine management for the conservation of this species.

5.1 Policy and legislation

- 5.1.1** None proposed.

5.2 Site safeguard and management

- 5.2.1** Where possible, provide mechanisms (such as management agreements on SSSIs and relevant agri-environment schemes) to encourage grazing or continued mowing on all extant grassland sites. (ACTION: CCW, DANI, EHS, EN, MAFF, MoD, SNH, SOAEFD, WOAD)
- 5.2.2** Control scrub invasion on all extant pink meadow cap sites where considered to be threatening population viability. (ACTION: CCW, EHS, EN, SNH)
- 5.2.3** Consider notifying as ASSI/SSSIs sites with viable populations of this species where this is consistent with selection guidelines and where this is necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EHS, EN, SNH)

5.3 Species protection and management

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and land managers of the presence and importance of this species, specific management for conservation and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, DANI, EHS, EN, MAFF, SNH, SOAEFD, WOAD)
- 5.4.2** As far as possible, advise relevant agri-environment scheme project officers of the locations for this species and the need to encourage appropriate grazing regimes at these sites. (ACTION: CCW, DANI, EHS, EN, MAFF, SNH, SOAEFD, WOAD)

5.5 Future research and monitoring

- 5.5.1** Compile records of pink meadow cap and encourage regular visits to known sites where necessary, in order to determine the current status of this species at each site. An assessment of current threats should be made at each site. (ACTION: CCW, EHS, EN, SNH)
- 5.5.2** Commission research into the habitat requirements and methods of spread of this species, with a view to refining management techniques for its conservation. (ACTION: CCW, EHS, EN, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage mycologists to pass all records of pink meadow cap including ecological information, to a national database by 2002. (ACTION: CCW, EHS, EN, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, EHS, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** It is likely that implementation of this action plan will have benefits for *Hygrocybe spadicea* and *Microglossum olivaceum*.
- 5.7.2** This plan should be considered in conjunction with those for and upland calcareous grassland, lowland calcareous grassland, lowland dry acid grassland and lowland hay meadows.

Date-coloured waxcap (*Hygrocybe spadicea*)

Action Plan

1. Current status

- 1.1 Date-coloured waxcap is an upland species which occurs mainly on south-facing limestone pastures in sub-montane regions, but has also been recorded on calcareous dunes, neutral grassland which is dry during the summer, and in mown parkland. This species produces fruiting bodies in most years, but only after heavy rain. The fruiting bodies, which are edible, generally appear in summer and early-autumn and have a brown cap 5-7 cm in diameter with bright yellow gills. This fungus is one of a group of the often brightly-coloured waxcap fungi (*Hygrocybe* spp) which are typically associated with unimproved grassland and which are reported to have declined across Europe. However, it is probably under-recorded.
- 1.2 There are several known sites for this species scattered throughout Britain, including sites in Colonsay, Cumberland and Shropshire and also in North, mid, and South Wales. The most recent records are from Slapton on the south Devon coast, where it was discovered in 1994, and a site in mid Wales where it was discovered in 1997. Elsewhere, it occurs in sub-montane regions throughout Europe, as far south as Spain.
- 1.3 In Great Britain date-coloured waxcap is classified as *Vulnerable*. It receives general protection under the Wildlife and Countryside Act 1981. This species is also included on the European provisional red data list.

2. Current factors causing loss or decline

Population trends in this species are poorly understood, but potential threats to extant sites may include the following:

- 2.1 Improvement of its grassland habitat through ploughing or addition of fertilisers.
- 2.2 Reduction in the levels, or cessation, of grazing or mowing, leading to growth of rank vegetation and woody species.
- 2.3 Stabilisation and associated vegetation succession on its dune sites.
- 2.4 Trampling is a potential threat at one site in Wales which is visited by large numbers of people each year.

3. Current action

- 3.1 The British Mycological Society is undertaking a 'waxcap grassland' survey which began in 1996.

4. Action plan objectives and targets

- 4.1** Maintain populations of this species at all extant sites.

5. Proposed action with lead agencies

This species is known from very few British sites and is also rare in Europe. A priority for action therefore is to complete a review of information on the current distribution and status of this species in Britain by 2002.

If further survey work confirms its rarity, all British sites should be considered for SSSI notification where this is necessary to ensure their long-term protection and beneficial management. Improved understanding of the habitat requirements and methods of spread of this species will be vital if conservation action is to be planned accordingly.

5.1 Policy and legislation

- 5.1.1** Ensure that the requirements of date-coloured waxcap are considered in the event of coastal defence work being proposed near to its dune sites on the south Devon coast. (ACTION: DETR, EA)

5.2 Site safeguard and management

- 5.2.1** Where possible, provide mechanisms (such as management agreements on SSSIs and relevant agri-environment schemes) to encourage grazing or continued mowing on all extant grassland sites. (ACTION: CCW, EN, LAs, MAFF, SNH, SOAEFD, WOAD)
- 5.2.2** Control scrub invasion on all extant sites where considered to be threatening population viability. (ACTION: CCW, EN, SNH)
- 5.2.3** Ensure regular assessment of threats posed by visitors to grassland and sand-dune sites where date-coloured waxcap occurs, and implement measures (such as fencing) where necessary to ensure that these threats are minimised. (ACTION: CCW, EN)
- 5.2.4** Consider notifying as SSSIs sites with viable populations of this species where this is consistent with selection guidelines and where this is necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EN, SNH)

5.3 Species protection and management

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and land managers of the presence and importance of date-coloured waxcap, specific management for its conservation, and any potentially damaging actions.

Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN, SNH)

- 5.4.2** As far as possible, advise relevant agri-environment scheme project officers of the locations for this species and the need to encourage appropriate grazing regimes at these sites. (ACTION: CCW, EN, MAFF, SNH, SOAEFD, WOAD)

5.5 Future research and monitoring

- 5.5.1** Conduct a search for this species, following suitable weather, on selected south-facing, short-turfed calcareous grassland sites, in order to establish a better understanding of its UK distribution. (ACTION: CCW, EHS, EN, SNH)
- 5.5.2** Ensure that all sites from which this species has been recorded are visited regularly during appropriate weather so as to monitor the status of this species at each, and to assess changes in habitat quality. (ACTION: CCW, EN, SNH)
- 5.5.3** Commission a research project to investigate the ecology of this species with a view to refining management for its conservation. (ACTION: CCW, EN, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage mycologists to pass all records of date-coloured waxcap, including ecological information, to a national database by 2002. (ACTION: CCW, EHS, EN, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with those for *Microglossum olivaceum*, *Hygrocybe calyptriformis*, coastal sand dunes, upland calcareous grassland and lowland calcareous grassland.

***Hypocreopsis rhododendri* (a lobed, bracket-like ascomycete fungus)**

Action Plan

1. Current status

- 1.1** *Hypocreopsis rhododendri* was first found on *Rhododendron maximum* in North Carolina in 1888, and was thought to be confined to North America on rhododendrons until it was discovered in Britain in the 1970s. Here, it has mainly been found growing on standing, dead stems of hazel (*Corylus avellana*), but has also been recorded on living hazel branches, cut hazel branches and living and dead branches of blackthorn (*Prunus spinosa*). Its pale tan, bracket-like appearance with extending finger-like lobes is both distinctive and conspicuous. One of its best recorded sites is a woodland which had not been coppiced or thinned for many years and therefore contained a considerable amount of standing dead-wood, much of which was hazel. Its sites include coastal hazel woods which are often rich in lichens but which are also scarce and limited in extent.
- 1.2** *H. rhododendri* in Britain is known from a few sites around the Devon and Cornwall border and from several sites in western Scotland, including Mull where it was recorded in the 1970s. The distribution of its known sites very much suggests that this species may have a western distribution in the British Isles, indeed it is strongly oceanic in other parts of its world range, but this needs to be substantiated. *H. rhododendri* has also been recorded in Ireland.
- 1.3** In Great Britain this species is classified as *Vulnerable*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

The history of *H. rhododendri* in Britain is unclear. However, there are several threats to known *H. rhododendri* sites, which include the following:

- 2.1** Destruction of its scrub habitat.
- 2.2** Inappropriate habitat management which may include removal of standing dead stems of hazel and introduction of coppicing to hazel stands that have not been previously managed in this way.
- 2.3** Collection is a potential threat on sites with small populations.
- 2.4** Overgrazing by sheep or deer could lead to a long-term deterioration in vegetation structure on *H. rhododendri* sites.
- 2.5** Overshading of hazel stands by emergent trees and associated successional change.

3. Current action

- 3.1** None known.

4. Action plan objectives and targets

- 4.1** Maintain populations of this species at all extant sites, and increase the extent of these populations where feasible and appropriate.

5. Proposed action with lead agencies

A priority for action is to complete a review of the distribution and status of *H. rhododendri* in Britain, including a targeted survey to update old records. Coppicing of *H. rhododendri* sites should be avoided as it interrupts the continuity of the age range of stems. Indeed, these woods require little attention providing that they are kept free from over-grazing by sheep and deer and excessive shading from emergent trees. Action should include surveys of suitable hazel woods with the aim of discovering new *H. rhododendri* sites.

5.1 Policy and legislation

- 5.1.1** Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 if it meets relevant criteria, and if legal protection will address the threats to it. (ACTION: DETR, JNCC)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of *H. rhododendri* where this is consistent with selection guidelines and where this is necessary to ensure their long-term protection and appropriate management. (ACTION: EN, SNH)
- 5.2.2** Encourage measures to promote the growth of hazel on extant sites. (ACTION: EN, FC, SNH)
- 5.2.3** Ensure that extant sites are not damaged through misguided coppicing management of hazel stands that have not previously been exploited in this way. Standing dead-wood should not be removed from extant *H. rhododendri* sites. (ACTION: EN, FC, SNH)
- 5.2.4** Assess the need to remove emergent trees which threaten to precipitate successional change in *H. rhododendri* sites. (ACTION: EN, FC, SNH)
- 5.2.5** Prevent overgrazing by sheep and deer; woodland sites should be suitably fenced where necessary. (ACTION: EN, FC, SNH)

5.3 Species protection and management

- 5.3.1** Assess the feasibility and desirability of undertaking translocations of this species to suitable habitat in the vicinity of extant *H. rhododendri* sites. (ACTION: EN, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and land managers of the presence and importance of *H. rhododendri*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. Coppicing of previously unmanaged hazel stands should be discouraged. (ACTION: EN, SNH)
- 5.4.2** Ensure that local planning authorities are aware of the locations of *H. rhododendri* sites, in order that damaging developments at these sites can be prevented. (ACTION: EN, LAs, SNH)

5.5 Future research and monitoring

- 5.5.1** Commission a survey of all sites from where this species has been recorded in the past, and of potentially suitable sites nearby, in order to determine the current status of this species at each and to identify threats to extant colonies. (ACTION: EN, SNH)
- 5.5.2** Undertake a survey of suitable hazel woods in western England, Wales and Scotland with the aim of discovering new sites for *H. rhododendri*. (ACTION: CCW, EN, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage mycologists to look for *H. rhododendri* in suitable habitats and to report any new records. All records, including ecological information, should be passed to a national database by 2002. (ACTION: EN, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with those for *Arthothelium dictyosporum*, *A. macounii* and *Pseudocyphellaria norvegica*.

***Microglossum olivaceum* (an earth-tongue)**

Action Plan

1. Current status

- 1.1 This is one of only two British *Microglossum* species. It is a fungus of grassland habitats, lawns and deciduous woods. Little is known about its ecology, but it is believed to be saprophytic on mosses; more research is needed to confirm this. It seems to favour short turf habitats such as grassland on limestone sea-cliffs. Several of the woodland records have been under yew trees (*Taxus baccata*). Its fruiting bodies appear relatively reliably between September and November.
- 1.2 The most recent UK records of this species are from the New Forest, and single sites in each of Lancashire, Devon, Brecknock and Ceredigion. A site near Bristol was also found during the 'waxcap grassland' survey (see 3.2). It has also been recorded in the past in Scotland and Northern Ireland. It is thought that this species has declined over the last 50 years following the widespread improvement of its grassland habitats. Whilst there is no direct evidence of such a decline in Britain, it is known to have declined by 95% in Sweden, and there is good evidence of a similar decline in Holland.
- 1.3 In Great Britain *Microglossum olivaceum* is classified as *Vulnerable*. It receives general protection under the Wildlife and Countryside Act 1981. It is also included on the provisional European red data list.

2. Current factors causing loss or decline

- 2.1 Agricultural improvement of grasslands is a direct threat to *M. olivaceum*, eg through ploughing or application of fertilisers and herbicides.
- 2.2 Scrub encroachment.

3. Current action

- 3.1 One site for this species in Wales is owned by the National Trust which is aware of the presence of this species and measures needed for its conservation.
- 3.2 The British Mycological Society is undertaking a 'waxcap grassland' survey which began in 1996. This survey also aims to record earth-tongue fungi such as *Microglossum olivaceum*.
- 3.3 A key to the identification of earth-tongues has recently been produced.

4. Action plan objectives and targets

- 4.1 Maintain populations of *M. olivaceum* at all extant sites.

5. Proposed action with lead agencies

Action for this species should focus both on ensuring that all extant sites are protected from damaging activities such as those associated with agricultural improvement of grassland sites, and on ensuring that all sites are subject to careful control of scrub encroachment and grazing levels. A review of the current status and distribution of the species is needed, as is research to refine conservation management in the future.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Consider notifying as SSSIs sites with viable populations of this species where this is consistent with selection guidelines and is necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EN, SNH)

5.2.2 Assess the threat to known *M. olivaceum* sites posed by drift and run-off of agricultural chemicals. Where a threat is identified, seek to undertake remedial action to address the problem. (ACTION: CCW, EN, MAFF, SNH, SOAEFD, WOAD)

5.2.3 Where possible, provide mechanisms (such as management agreements on SSSIs and relevant agri-environment schemes) to establish suitable grazing regimes on and around all extant *M. olivaceum* sites. (ACTION: CCW, EN, MAFF, SNH, SOAEFD, WOAD)

5.3 Species protection and management

5.3.1 None proposed.

5.4 Advisory

5.4.1 Advise landowners and land managers of the presence and importance of this species, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN, SNH)

5.4.2 Advise all relevant agri-environment scheme project officers of the locations for this species and the need to encourage appropriate grazing regimes at these sites. (ACTION: CCW, EN, MAFF, SNH, SOAEFD, WOAD)

5.5 Future research and monitoring

5.5.1 Compile information on the current distribution and status of this species in Britain, and undertake further survey if appropriate. An assessment of current threats to each extant site should also be made. (ACTION: CCW, EHS, EN, SNH)

5.5.2 Undertake regular monitoring of all extant *M. olivaceum* sites in order to assess changes in population size and habitat quality. (ACTION: CCW, EN, SNH)

5.5.3 Commission a research project to investigate aspects of the ecology of this species, with a view to providing information for future management and conservation. (ACTION: CCW, EN, SNH)

5.6 Communications and publicity

5.6.1 Liaise with specialist societies to increase the awareness and identification skills of mycologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EHS, EN, JNCC, SNH)

5.7 Links with other action plans

5.7.1 This action plan should be considered in conjunction with those for *Hygrocybe calyptriformis* and *H. spadicea*, and those for lowland calcareous grassland and maritime cliffs and slopes.

Lichens



***Alectoria ochroleuca* (a lichen)**

Action Plan

1. Current status

- 1.1 *Alectoria ochroleuca* is a yellow-green fruticose lichen growing on the ground on montane plateau, usually amongst prostrate *Calluna vulgaris*.
- 1.2 It has recently been recorded only from the northern spurs of the Cairngorm Mountains in north-east Scotland and only on one does it occur as more than isolated plants. Earlier records, also from north-east Scotland (south Aberdeenshire, east Sutherland), have not been confirmed and may be misidentifications of the closely related *Alectoria sarmentosa* subsp *vexillifera*. It is a widespread and common species in Scandinavia.
- 1.3 *Alectoria ochroleuca* is classified as *Vulnerable* in Great Britain. It has recently received special protection under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Effects of grazing animals (red deer).
- 2.2 Likely disturbance through recreational pressure (principally skiing).
- 2.3 Possible effects of climate change.

3. Current action

- 3.1 Many of the sites were surveyed in 1995/1996 as part of SNH's Lower Plants Project.

4. Action plan objectives and targets

- 4.1 Maintain all known populations.
- 4.2 Establish two new populations at new or former sites, and reinforce the two smaller current populations, by 2010.

5. Proposed action with lead agencies

A key element in the long-term delivery of this plan is to reduce pressures from overgrazing by red deer and from recreational pursuits. These are linked to broader management objectives in the Cairngorms and cannot be achieved for this plan alone. In the first instance, better information on the distribution, ecology and population dynamics of this species is required, including the use of exclosures to determine the effects of grazing. Findings of this research will determine whether there is a need to intervene directly in populations.

5.1 Policy and legislation

- 5.1.1** Seek to reduce numbers of grazing animals (principally red deer) in the northern Cairngorms and other potentially suitable areas (southern and eastern Cairngorms). (ACTION: Cairngorm Partnership, LAs, SNH, SOAEFD)
- 5.1.2** Seek to minimise the effects of recreational pressure, particularly skiing, on *Alectoria ochroleuca* in the northern Cairngorms. (ACTION: LAs, SNH, SO)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of *Alectoria ochroleuca* where this is consistent with selection guidelines and necessary to ensure their long-term protection and appropriate management. (ACTION: SNH)

5.3 Species management and protection

- 5.3.1** Transplant and monitor plants from the main population to establish the species at suitable new sites, and reinforce populations at current sites. (ACTION: RBGE, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, planning authorities and other relevant bodies of the presence and importance of *Alectoria ochroleuca*, specific management for its conservation, its legal protection and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: SNH)

5.5 Future research and monitoring

- 5.5.1** Undertake further survey of other known, and potential, sites to enhance knowledge of current status of the species in the UK. (ACTION: RBGE, SNH)
- 5.5.2** Undertake detailed survey of the known populations to enhance the knowledge of the ecological requirements of the species. (ACTION: RBGE, SNH)
- 5.5.3** Erect exclosures around part of main population, and selected subsidiary populations, for protective purposes and to ascertain the effects of complete removal of grazing pressure from the species. (ACTION: SNH)
- 5.5.4** Encourage research on the ecology and conservation of this species at an international level, especially in its outlying localities. (ACTION: JNCC)
- 5.5.5** Investigate the feasibility of *ex situ* cultivation as an adjunct to translocation attempts. (ACTION: SNH)

5.6 Communication and publicity

- 5.6.1** Encourage lichenologists to pass all records of *Alectoria ochroleuca*, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** Implementation of this action plan will also be of benefit to the lichens *Bellemerea alpina* and *Cladonia stricta*.

***Arthothelium dictyosporum* (a lichen)**

Action Plan

1. Current status

- 1.1 This crustose lichen grows on the smooth bark of hazel, holly, rowan and willow in ancient, semi-natural woodlands, including one native pine wood. It is a member of the hyperoceanic facies of the *Graphidion* alliance, which in Europe is best represented in western Scotland, but it is less confined to hazel woods than are *Arthothelium macounii* and *Graphis alboscripta*.
- 1.2 An accurate assessment of the status of *Arthothelium dictyosporum* is hampered by difficulties with identification. It is indistinguishable in the field from the common *Arthonia ilicina*, which grows in the same habitats. Microscopical examination is required to distinguish these species, posing enormous obstacles to the recording and autecological study of this species in the field. It was described in 1979, and has been found at five sites in western Scotland and one in the central Highlands. It has so far not been reported from elsewhere in the world.
- 1.3 The species is classified as *Near Threatened* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Knowledge of *Arthothelium dictyosporum* is insufficient for an assessment of any loss or decline. However, the species would be seriously affected by habitat disturbance (eg extensive coppicing), or habitat modification (eg invasion of *Rhododendron*).

3. Current action

- 3.1 All known sites have NNR or SSSI status.

4. Action plan objectives and targets

- 4.1 Maintain populations of *Arthothelium dictyosporum* at all known sites.

5. Proposed action with lead agencies

Due to difficulties of confirming, at any given site, the presence and size of populations of *Arthothelium dictyosporum*, the key focus of this plan is to attempt to gain a better idea of distribution and habitat preference of this species. The aim should be to investigate 10 more sites by 2005. More needs to be known about the ecological requirements of the species, and management guidelines for old growth stands of hazel should be produced by 2005. The maintenance of viable populations will be otherwise dependent on a general approach of protecting known and likely habitat for this lichen.

5.1 Policy and legislation

- 5.1.1** Continue to encourage the inclusion of *Rhododendron* control in woodland management proposals affecting *Arthothelium dictyosporum* sites when assessing Woodland Grant Scheme applications. (ACTION: FC, SNH)

5.2 Site safeguard and management

- 5.2.1** Discourage use of coppicing as a management option in areas of old growth hazel, without full consideration of the impact on *Arthothelium dictyosporum* and other priority or threatened species (ACTION: FC, LAs, SNH)
- 5.2.2** Encourage and seek additional funding for the removal of invasive *Rhododendron* (if present) from sites containing *Arthothelium dictyosporum*, and from adjacent sites if a threat is posed. (ACTION: FC, LAs, SNH)
- 5.2.3** Review site designation for any non-designated sites that may be discovered in the future. Consider notifying as SSSIs sites with viable populations of *Arthothelium dictyosporum*, where this is consistent with selection guidelines and necessary to ensure their long-term protection and appropriate management. (ACTION: SNH)

5.3 Species management and protection

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Arthothelium dictyosporum*, specific management for its conservation, any potentially damaging actions, and the biological importance of old growth hazel stands in general. Landowners and managers should have access to specialist advice if needed. (ACTION: FC, SNH)
- 5.4.2** Develop and disseminate conservation management guidelines for old growth stands of hazel and the species, including *Arthothelium dictyosporum*, that they support. (ACTION: FC, SNH)

5.5 Future research and monitoring

- 5.5.1** Undertake survey of 10 potential sites in western Scotland by 2005 so as to enhance knowledge of the distribution of the species and other associated rare lichens. (ACTION: SNH)
- 5.5.2** Encourage research on the ecology and conservation of this species. (ACTION: JNCC, RBGE, SNH)
- 5.5.3** Monitor any management, and its outcome, at known sites, and at sites discovered in the future. (ACTION: SNH)

5.6 Communications and publicity

- 5.6.1** Use *Arthothelium dictyosporum* as an example of the importance for nature conservation of a continuity of trees with smooth bark, especially hazel, holly and rowan, in semi-natural woodland habitats, but without resorting to coppicing. (ACTION: JNCC, SNH)
- 5.6.2** Encourage lichenologists to pass all records of *Arthothelium dictyosporum*, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.3** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** Implementation of this plan will also be of benefit to the lichens *Arthothelium macounii* and *Pseudocyphellaria norvegica*, and the ascomycete fungus *Hypocreopsis rhododendri*.

Arthothelium macounii (a lichen)

Action Plan

1. Current status

- 1.1 *Arthothelium macounii* grows in hazel woods with a long historical continuity, usually on the smooth bark of hazel, but has been once seen on ash. It is a member of the hyperoceanic facies of the *Graphidion* alliance, which in Europe is best represented in western Scotland. At two of its Scottish sites, *A. macounii* is host to the apparently endemic, obligately parasitic, host-specific fungus, *Arthonia cohabitans*.
- 1.2 First discovered in 1976, this species is now known from seven sites in western Scotland. All sites are by or close to the coast and, although not known elsewhere in Europe, it has recently been discovered in the laurisilva on Madeira, and on Los Tilos in the Canary Islands. It was formerly called *Arthothelium reagens*, but has been found to have been earlier described as *A. macounii*, from British Columbia, Canada. It may have been overlooked owing to its similarity in the field with the more common *Arthonia ilicina*, although it certainly belongs to a group of lichens that have never been found in areas of secondary or recently formed hazel scrub.
- 1.3 *Arthothelium macounii* is classified as *Vulnerable* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Knowledge of this species is insufficient for an assessment of any loss or decline. However, the species would be seriously affected by habitat disturbance (eg extensive coppicing), or habitat modification (eg invasion of *Rhododendron*).

3. Current action

- 3.1 All sites except one have NNR or SSSI status; the remaining site is under the management of the Scottish Wildlife Trust.

4. Action plan objectives and targets

- 4.1 Maintain and enhance all populations of *Arthothelium macounii*.

5. Proposed action with lead agencies

Due to difficulties of confirming, at any given site, the presence and size of populations of *Arthothelium macounii*, the key focus of this plan is to attempt to gain a better idea of distribution and habitat preference of this species. The aim should be to investigate 10 more sites by 2005. More needs to be known about the ecological requirements of the species, and management guidelines for old growth stands of hazel should be produced by 2005. The

maintenance of viable populations will be otherwise dependent on a general approach of protecting known and likely habitat for this lichen.

5.1 Policy and legislation

- 5.1.1** Ensure that consideration is given to lichen populations where old growth stands of hazel in western Scotland are likely to be affected by felling proposals or Woodland Grant Scheme applications. Implement a lichen survey where necessary. (ACTION: FC, SNH)
- 5.1.2** Continue to encourage the inclusion of *Rhododendron* control in woodland management proposals affecting *Arthothelium macounii* sites when assessing Woodland Grant Scheme applications. (ACTION: FC, SNH)

5.2 Site safeguard and management

- 5.2.1** Discourage the use of coppicing as a management option in areas of old growth hazel, without full consideration of the impact on *Arthothelium macounii* and other priority or threatened species. (ACTION: FC, LAs, SNH)
- 5.2.2** Encourage and seek additional funding for the removal of invasive *Rhododendron* (if present) from sites containing *Arthothelium macounii*, and from adjacent sites if a threat is posed. (ACTION: FC, LAs, SNH)
- 5.2.3** Consider notifying as SSSIs sites with viable populations of *Arthothelium macounii*, where this is consistent with selection guidelines and necessary to ensure their long-term protection and appropriate management. (ACTION: SNH)

5.3 Species management and protection

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Arthothelium macounii*, specific management for its conservation, any potentially damaging actions, and the biological importance of old growth hazel stands in general. Landowners and managers should have access to specialist advice if needed. (ACTION: FC, SNH)
- 5.4.2** Develop and disseminate conservation management guidelines for old growth stands of hazel and the species, including *Arthothelium macounii*, that they support. (ACTION: FC, SNH)

5.5 Future research and monitoring

- 5.5.1** Undertake a survey of 10 potential hazelwood sites in western Scotland by 2005 so as to enhance knowledge of the distribution of this and other priority species in similar habitat. (ACTION: FC, RBGE, SNH)

- 5.5.2** Encourage research on the ecology and conservation of this species. (ACTION: JNCC, RBGE, SNH)

5.6 Communications and publicity

- 5.6.1** Use *Arthothelium macounii* as an example of the importance for nature conservation of ancient stands of hazel in western Scotland, and for caution to be applied to any proposals for extensive clearance or coppicing of hazel in such areas. (ACTION: JNCC, SNH)
- 5.6.2** Encourage lichenologists to pass all records of *A. macounii*, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.3** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** Implementation of this plan will also be of benefit the lichens *Arthothelium dictyosporum* and *Pseudocyphellaria norvegica*, and the ascomycete fungus *Hypocreopsis rhododendri*.

***Bacidia incompta* (a lichen)**

Action Plan

1. Current status

1.1 This crustose lichen grows on the trunks of mature trees with basic bark. In Britain, it is largely confined to elm, but also occasionally occurs on ash, beech, holly, hornbeam and sycamore. It is typically found in old parkland and on wayside trees in open situations, usually growing as uneven vertical streaks along nutrient-rich rain-seepage tracks or below wounds in the bark. It also sometimes occurs on the exposed roots of elm on cliff faces.

1.2 Once relatively widespread throughout the British Isles, *Bacidia incompta* had a scattered distribution extending northwards to Aberdeenshire, but was most frequent in southern England. In 1960 it was known from 142 sites, but many of these are believed to have been lost. A survey of some of the southern English sites show that it has become extinct in at least 30 sites. However, it has survived in some localities such as the New Forest, where it is estimated to occur in approximately 10 woods, and one site at Ashburnham Park in East Sussex, where it occurs on hornbeam. In Scotland it is still thought to exist where there are pockets of surviving elm trees, whilst in Wales, a single population was recorded in Powys in 1995, on the fragments of bark of a dead elm tree. A recent survey of the Glamorgan sites in 1997 failed to detect this species. The present distribution of *B. incompta* in Britain (like that of *Caloplaca luteoalba*) following the loss of mature elms is not well known; it may be a somewhat under-recorded species.

A similar decline has occurred in the Irish Republic where this species is now rare, being known only from the south and west. Elsewhere, this species occurs in continental Europe, Madeira and North America.

1.3 This species is classified as *Vulnerable* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

2.1 Since 1960 this species has suffered a catastrophic decline as a result of Dutch elm disease. Dutch elm disease remains a threat to the survival of this lichen.

2.2 Clearance and non-replacement of wayside and parkland trees is believed to have contributed to the loss of this species from a large number of sites since 1960. Further clearance and non-replacement of such trees or windblow of host trees is a continuing threat.

2.3 Drift of agricultural chemicals, including fertilisers, slurry and pesticides may be a significant threat where wayside trees adjoin cultivated land.

3. Current action

- 3.1** New pollards are being cut in the New Forest in order to help provide a continuity of veteran trees for threatened species which depend on this habitat, including specialist invertebrates and lichens such as *B. incompta*.

4. Action plan objectives and targets

- 4.1** Maintain populations at all extant sites.
- 4.2** Encourage the spread of this species by maintaining or establishing suitable habitat in the vicinity of all extant sites.

5. Proposed action with lead agencies

This species has undoubtedly suffered a significant decline, owing to the demise of the elm. Because the extent of this decline is not fully known, a review of information and fieldwork is urgently needed in order to establish its current British status and distribution. This should be completed by 2003. Meanwhile, conservation action should focus on the protection of known host trees and establishment of appropriate site management regimes which will ensure a long-term continuity of suitable habitat in the vicinity of extant populations.

5.1 Policy and legislation

- 5.1.1** Consider *Bacidia incompta* for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 if its status is confirmed as *Vulnerable*, if it meets relevant criteria, and if legal protection will address the causes of its decline. (ACTION: DETR, JNCC)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of *Bacidia incompta* where this is consistent with selection guidelines, and where it is necessary to ensure their long term protection and appropriate management. (ACTION: CCW, EN, SNH)
- 5.2.2** Where it is in the interests of amenity, apply Tree Preservation Orders to protect host trees and woodlands. (ACTION: LAs)
- 5.2.3** Wherever possible, establish sympathetic management at sites with populations of this species. Particular emphasis should be given to the protection of host trees and potential host trees, and also to preventing felling of other trees which may influence the micro-habitat of this species. Measures should be adequate to ensure the protection of host trees during road-widening schemes. (ACTION: CCW, EN, FE, Highways Agency, LAs, SNH)
- 5.2.4** Where appropriate, undertake planting of replacement host trees, including disease resistant strains of elm, in the vicinity of extant sites for this species. Assess the need for this work at the Powys site if the population there is confirmed as extant. Suitable mechanisms may include the

Countryside Stewardship Scheme and the Woodland Improvement Grant Scheme. (ACTION: CCW, EN, FE, LAs, MAFF, SNH, SOAEFD, WOAD)

- 5.2.5** Assess the threat to extant populations from the drift of agricultural chemicals. Where such a threat exists, consider providing mechanisms (eg management agreements on SSSIs or relevant agri-environment schemes on land outside these areas) to address these problems. (ACTION: CCW, EN, MAFF, SNH, SOAEFD, WOAD)

5.3 Species management and protection

- 5.3.1** Consider creating artificial wounds on trees so as to provide further suitable habitat for this species and allow for the spread of existing colonies. (ACTION: CCW, EN, FE, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Bacidia incompta*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN, SNH)

5.5 Future research and monitoring

- 5.5.1** Compile information and resurvey sites where necessary in order to determine the current status of this species at all sites from which it has been recorded, and to assess current threats to all extant colonies. (ACTION: CCW, EN, SNH)
- 5.5.2** Undertake regular monitoring at all extant sites to assess population changes and to ensure prompt identification of any new threats. (ACTION: CCW, EN, JNCC, SNH)
- 5.5.3** Compile a list of sites that would be worth searching for this species and distribute to active lichenologists. Particular note should be taken of old records where the tree is not elm. (ACTION: CCW, EN, JNCC, SNH)

5.6 Communication and publicity

- 5.6.1** Raise awareness of the importance of managed parkland as a lichen habitat amongst relevant park authorities and managers. (ACTION: CCW, EN, SNH)
- 5.6.2** Encourage lichenologists to pass all records of *Bacidia incompta*, including ecological information, to a national database. (ACTION: CCW, EN, JNCC, SNH)
- 5.6.3** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with those for lowland wood pastures/parkland and the lichen *Caloplaca luteoalba* which is another priority species that grows on old elm trees.

***Belonia calcicola* (a lichen)**

Action Plan

1. Current status

- 1.1 *Belonia calcicola* is a crustose lichen which is restricted to limestone outcrops (it is not known on dry stone walls). It is closely related to *B. russula*, and may possibly be a form of this species.
- 1.2 This species is thought to be endemic to the British Isles and is presently only known from one site in Cumbria. It has also been recorded from one site in north Somerset but has not been seen there since 1934. The reasons for the probable loss of this species from Somerset are unclear.
- 1.3 This species is classified as *Data Deficient* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Because this species is now known at only one site, it is highly vulnerable to single catastrophic events, eg pollution incidents, inappropriate collecting.

3. Current action

- 3.1 None known.

4. Action plan objectives and targets

- 4.1 Maintain the extant population(s) and increase the extent of the population(s) where appropriate and feasible.
- 4.2 Encourage the spread of this lichen in the vicinity of its extant site(s).
- 4.3 If feasible and desirable, and if *B. calcicola* is confirmed as absent from the Somerset site, re-establish this species at the site by 2005.

5. Proposed action with lead agencies

This species is now known at only one British site and is highly vulnerable to single catastrophic events. It is therefore important that this site is fully protected from damaging activities. This should be through SSSI notification if necessary. A survey of the Somerset site from which *B. calcicola* was once recorded is also necessary, in order to determine whether there is still an extant population of this species at the site. Re-establishment of the species at this site should be considered if it is confirmed to be absent.

5.1 Policy and legislation

- 5.1.1** Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 if it meets relevant criteria, and if legal protection will address the causes of its decline. (ACTION: DETR, JNCC)

5.2 Site safeguard and management

- 5.2.1** Consider notifying the only known extant site for this species as an SSSI if it is consistent with selection guidelines, and where it is necessary to ensure its long-term protection and appropriate management. (ACTION: EN)
- 5.2.2** Control scrub at the only known site where this species occurs, and on any new or re-discovered sites. (ACTION: EN)

5.3 Species management and protection

- 5.3.1** If *B. calcicola* is confirmed as absent from the Somerset site, assess the desirability and feasibility of re-establishing this species at the site by translocation. If appropriate, use material from the Cumbria site for a translocation attempt. (ACTION: EN)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Belonia calcicola*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Re-locate and carry out a survey of the Somerset site to determine whether this species is still extant at this site. (ACTION: EN)
- 5.5.2** Undertake regular monitoring of the Cumbrian population to assess the population size and to monitor any potential threats. (ACTION: EN)
- 5.5.3** Commission a review of the taxonomy of this species, focussing on its relationship with *B. russula*. (ACTION: JNCC)
- 5.5.4** Investigate the feasibility of *ex situ* cultivation as an adjunct to translocation attempts. (ACTION: EN)

5.6 Communication and publicity

- 5.6.1** Encourage lichenologists to pass all records of *B. calcicola*, including ecological information, to a national database. (ACTION: EN, JNCC)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

5.7.1 None proposed.

***Biatoridium monasteriense* (a lichen)**

Action Plan

1. Current status

- 1.1 *Biatoridium monasteriense* is a rare, crustose lichen which occurs on the shaded, base-rich bark of broadleaved trees such as elm, ash and elder in sheltered ancient woodland habitats, often in stream valleys. It usually grows in crevices in the bark.
- 1.2 This species has a scattered but restricted distribution in upland Britain, now occurring at eight sites in Cumbria, Northumberland, Merioneth, Galloway, mid and east Perthshire, Inverness-shire and the Isle of Mull. At each site it has been recorded growing on a single tree. The record from the Welsh site was from an elm tree in a sheltered, relatively inaccessible valley in 1960. It was also recorded from elm trees at three other sites, which are known to have since succumbed to Dutch elm disease. It was formerly also recorded from north-east Yorkshire. Elsewhere it has a scattered distribution in Europe, from Sweden to the Ukraine, with stronghold sites in Germany and Switzerland.
- 1.3 This species is classified as *Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Acidification of bark by atmospheric pollution may have been detrimental to this species in the past. Whilst air pollution is no longer such a significant problem, acid residue from the pollution events of the 1960s and 1970s may remain on tree bark, and may be a factor preventing recovery.
- 2.2 Felling or loss of host trees (it is known to have been lost from at least four sites through Dutch elm disease).
- 2.3 A lack of suitable host trees for future colonisation.

3. Current action

- 3.1 No specific action known.

4. Action plan objectives and targets

- 4.1 Maintain populations at all extant sites and reinforce these populations where feasible and appropriate.

5. Proposed action with lead agencies

A review of the status and distribution of this species is urgently needed in order to assess the true impact of Dutch elm disease on its British population. This should be through compilation of data from relevant lichenologists, and surveys of known sites where necessary. Meanwhile, conservation action for this species should focus on the protection of known populations and ensuring that their sites are managed appropriately.

5.1 Policy and legislation

- 5.1.1** Adhere to commitments, as set by the Critical Loads Advisory Group in 1995, to reduce the 1980 levels of sulphur dioxide emissions by 80% by 2010. (ACTION: DETR)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of *Biatoridium monasteriense* where this is consistent with selection guidelines and where it is necessary to ensure their long-term protection. (ACTION: CCW, EN, SNH)
- 5.2.2** Where it is in the interests of amenity, apply Tree Preservation Orders to protect host trees and woodlands. The level of protection should be adequate to ensure that extant colonies are protected from damaging activities such as exposure to direct sunlight through felling of nearby trees. (ACTION: LAs)
- 5.2.3** Provide mechanisms to encourage the planting of replacement host trees, including disease resistant strains of elm, for future colonisation. Mechanisms may include management agreements on SSSIs, relevant agri-environment schemes and the Woodland Improvement Grant Scheme. (ACTION: CCW, EN, FC, MAFF, SNH, SOAEFD, WOAD)

5.3 Species management and protection

- 5.3.1** Where colonies of *B. monasteriense* are vulnerable because of the continuing loss of elm trees, assess the feasibility of translocating this species to other trees with base-rich bark, such as ash. (ACTION: CCW, EN, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Biatoridium monasteriense*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN, SNH)

5.5 Future research and monitoring

- 5.5.1** Identify all sites with records of *B. monasteriense* and undertake a thorough survey of each, in order to establish the current distribution and status of this species in Britain. (ACTION: CCW, EN, SNH)

5.5.2 Undertake regular monitoring at all extant sites to assess population changes and to ensure the prompt identification of any new threats. (ACTION: CCW, EN, SNH)

5.5.3 Investigate the feasibility of *ex situ* cultivation as an adjunct to translocation attempts. (ACTION: CCW, EN, SNH)

5.6 Communication and publicity

5.6.1 Encourage lichenologists to pass all records of *B. monasteriense*, including ecological information, to a national database. (ACTION: CCW, EN, JNCC, SNH)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC, SNH)

5.7 Links with other action plans

5.7.1 This action plan should be considered in conjunction with those for the lichens *Caloplaca luteoalba*, *Bacidia incompta* and *Gyalecti ulmi*, and blunt-leaved bristle-moss *Orthotrichum obtusifolium* in relation to the demise of elm.

***Bryoria smithii* (a lichen)**

Action Plan

1. Current status

- 1.1 *Bryoria smithii* is a dark brown, beard-like lichen of upland areas, where it grows on the acidic bark of old oak trees and on acidic, mossy boulders in sheltered, but relatively well-lit situations. It appears to require locations which receive an annual precipitation in excess of 1500 mm. In central Europe it has been recorded growing in coniferous and sub-alpine forest.
- 1.2 This species has only been recorded from two sites since 1970. Both of these are on Dartmoor, but it is thought to have been lost at one of these sites following a fire. It was previously recorded from six sites in North Wales, but was last seen here in Merioneth in 1969. It was recorded from two sites in Scotland in the 19th century but has not been refound at either. Given the apparent abundance of suitable habitat and its once wide distribution, the causes of its rarity are not understood. Elsewhere it is known from north-west and central Europe, the Himalayas, southern China and Hawaii.
- 1.3 This lichen is classified as *Critically Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is listed as *Threatened* on the preliminary European Red List for lichens.

2. Current factors causing loss or decline

- 2.1 One of the Dartmoor sites has suffered extensive damage by fire and this species may have been lost as a result. Moorland fires are a continuing threat to the remaining site on Dartmoor, and possibly to any other extant heathland sites. Other causes of decline are not well understood, but could include the following:
- 2.2 Atmospheric pollution.
- 2.3 Trampling through human recreation or from domestic livestock, particularly sheep.
- 2.4 Encroachment of scrub and afforestation.
- 2.5 Botanical collection may still be a potential threat, but there is no firm evidence of this.

3. Current action

- 3.1 The only known extant site for this species is designated as an SSSI.

4. Action plan objectives and targets

- 4.1 Maintain the population at the single known extant site and any rediscovered sites and reinforce the population(s) where appropriate and feasible.

- 4.2 Re-establish this species at two suitable historic sites by 2010.

5. Proposed action with lead agencies

The threats to, and habitat requirements of, *B. smithii* are poorly understood. Research into these aspects should therefore form a central element to this action plan. The findings should be used to revise site management aimed at the conservation of this species.

5.1 Policy and legislation

- 5.1.1 Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981, if it meets relevant criteria and if legal protection will address the causes of its decline. (ACTION: DETR, JNCC)

5.2 Site safeguard and management

- 5.2.1 Ensure that the only known extant *B. smithii* site is not damaged by inappropriate levels of grazing or by scrub invasion. Favourable management will include the relevant options under the Dartmoor ESA scheme. (ACTION: EN, MAFF)
- 5.2.2 If trampling by people is confirmed as a significant threat to the performance of this species, devise and implement measures to control public access in the vicinity of known colonies. (ACTION: EN)
- 5.2.3 Devise and implement measures to improve the protection of the *B. smithii* site from damage by fire eg by creating fire-breaks. (ACTION: EN)

5.3 Species management and protection

- 5.3.1 In the light of the research outlined under 5.5.3, assess the possibility of re-establishing this species at two suitable historic sites through translocation or spread of soredia. Attempt such re-establishments if appropriate. (ACTION: CCW, EN)

5.4 Advisory

- 5.4.1 Advise landowners and managers, and relevant agencies, of the presence and importance of *Bryoria smithii*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1 Compile information and resurvey sites where necessary, in order to determine the current status of this species at all sites from which it has previously been recorded, and to assess current threats to all extant colonies. (ACTION: CCW, EN)

5.5.2 Undertake regular monitoring of its extant site(s) so as to assess changes in population size and habitat quality. (ACTION: CCW, EN)

5.5.3 Undertake research to investigate the reasons for the decline of *B. smithii*, its habitat requirements, and techniques for enlarging its extant population and for re-establishing this species on sites from which it has been lost. (ACTION: CCW, EN)

5.5.4 Investigate the feasibility of *ex situ* cultivation as an adjunct to translocation attempts. (ACTION: CCW, EN)

5.6 Communication and publicity

5.6.1 Encourage lichenologists to pass all records of *B. smithii*, including ecological information, to a national database. (ACTION: CCW, EN, JNCC, SNH)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC, SNH)

5.7 Links with other action plans

5.7.1 This action plan should be considered in conjunction with that for upland oak wood.

***Calicium corynellum* (a lichen)**

Action Plan

1. Current status

- 1.1 *Calicium corynellum* is a black pin-head lichen which, in its natural habitat, grows on siliceous rock underhangs in very humid conditions. However, at its only known British site it occurs both on sandstone and mortar on the sheltered, slightly damp, north-facing wall of a church tower. It may possibly grow or live on *Lepraria* species.
- 1.2 This species is restricted to one site in Northumberland, where it was discovered in 1972. It has been closely monitored since it was found and is thought to have decreased in extent by 90%. It is now restricted to only four stones and apothecia are scarce. It is otherwise known from central and northern Europe and also from Canada.
- 1.3 This species is *Critically Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The dwindling size of the only known population of this species is thought to be due to the replacement of a stone slab, at the base of the tower on which it grows, with gravel. This has meant that rain water cascading down from a pipe above no longer splashes high up the wall, and consequently a drier microclimate has developed, which appears to be unsuitable for this species.
- 2.2 Building work, such as repointing and restoration of the church walls is threat to this species.
- 2.3 Botanical collection is a possible threat because of the small size of the only known population.

3. Current action

- 3.1 Periodic monitoring of the only known site is being carried out.
- 3.2 Relevant officials at the church where this species occurs are aware of the presence of this species.

4. Action plan objectives and targets

- 4.1 Maintain the only known population, and restore to its former extent.

5. Proposed action with lead agencies

Because this species has only been recorded at one site the action recommended in this plan is mainly site specific. There is an urgent need to re-establish the damp conditions, under which colonies of the lichen previously flourished at the site by replacing the stone. Repair work to the church tower should be planned carefully with consideration given to the long-term conservation of *C. corynellum*. An expert adviser should be appointed to give guidance on the management of this site.

5.1 Policy and legislation

- 5.1.1** Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act, 1981 if it meets relevant criteria. (ACTION: DETR, JNCC)

5.2 Site safeguard and management

- 5.2.1** Ensure that any repair work to the tower is carried out in a sensitive manner, using the appropriate materials. (see 5.4.1) (ACTION: EN)
- 5.2.2** Re-establish the moist conditions in which this species originally thrived. This may best be achieved by replacing the stone slab which was previously removed from the base of the tower (see 2.1). (ACTION: EN)

5.3 Species management and protection

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise the officials of the church site of the presence and importance of *Calicium corynellum*, specific management for its conservation (including the need to reinstate moist conditions), and any potentially damaging actions (particularly building works). The church officials should have access to specialist advice, if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Continue with regular monitoring at the only known extant *C. corynellum* site. (ACTION: EN)
- 5.5.2** Undertake an autecological assessment of this species in order to refine management for its conservation. (ACTION: EN)

5.6 Communication and publicity

- 5.6.1** Publicity for this species is not recommended because of the small size of the population and the threat from botanical collecting.

5.7 Links with other action plans

5.7.1 None proposed.

***Caloplaca aractina* (a lichen)**

Action Plan

1. Current status

- 1.1 This crustose lichen is restricted to steeply sloping, sunny, acidic rocks on the coast, above high water mark. In Cornwall it is found on Serpentine rocks. Elsewhere it is found on silicious rock substrates, often near to bird-perches.
- 1.2 *Caloplaca aractina* is now restricted to one site in the Lizard Peninsula in Cornwall, where it was found in quite extensive patches when surveyed in 1986. It was formerly recorded from other sites on the west coast in Cumbria, Argyll and Lochaber, and there is also an old inland record from North Yorkshire, although this material needs reassessing. The reasons for the loss of this species from its former sites are unknown. It is otherwise known from the coast of western Europe and from inland southern Europe.
- 1.3 This species is classified as *Critically Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Current threats to this species are poorly understood. Scrub encroachment may be a potential threat to the population at the single known site.

3. Current action

- 3.1 The only known extant site for this species is within a NNR.

4. Action plan objectives and targets

- 4.1 Maintain all known populations of this species.

5. Proposed action with lead agencies

The research element of the plan, which aims to establish a fuller understanding of the habitat requirements of this species, and the reasons for its decline, should be treated as a priority. The current status of the species needs to be determined at all sites from which it has been recorded in the past. The knowledge gained from this work can then be used to refine and strengthen other elements of the conservation plan.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1** Control scrub encroachment, if appropriate, in order to protect the single known *C. aractina* population from over-shading. (ACTION: EN)

5.3 Species management and protection

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Caloplaca aractina*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Undertake a survey of all sites from which this species has been recorded, to establish its current status at each. (ACTION: EN, SNH)
- 5.5.2** Monitor extant populations regularly in order to assess any changes in population size and habitat quality. (ACTION: EN)
- 5.5.3** Compile a list of sites that would be worth searching for this species and distribute to active lichenologists. (ACTION: EN)
- 5.5.4** Commission a study to investigate the reasons for the decline of this species in Britain with a view to refining measures for the conservation of extant colonies. (ACTION: EN)

5.6 Communication and publicity

- 5.6.1** Encourage lichenologists to pass all records of *C. aractina*, including ecological information, to a national database (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for maritime cliffs and slopes.

Tree catapyrenium (*Catapyrenium psoromoides*)

Action Plan

1. Current status

- 1.1 Until recently, this squamulose lichen was known in the UK on only one tree, an ash, in an NNR in east Perthshire, but it was formerly found at two sites in Sussex (early 19th century) and on calcareous rocks at a site in Merioneth (1923). It has recently (1997) been discovered at Chudleigh Rocks SSSI in Devon growing on mossy calcareous rocks, in well-illuminated but sheltered situations. The species is widely distributed world-wide, but always reported as rare, from western and central Europe, Morocco, East Africa, North America, Japan and New Zealand.
- 1.2 Tree catapyrenium is classified as *Critically Endangered* in Great Britain. It is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is classified as *Endangered* in Europe, and *Vulnerable* in Europe and the World.

2. Current factors causing loss or decline

- 2.1 Loss of habitat, especially suitable large trees in favourable situations.
- 2.2 Atmospheric pollution, especially sulphur dioxide.

3. Current action

- 3.1 Five transplants from the Scottish site were made to nearby trees in 1988 and 1989, but only two of the five remain viable (on one new host tree).
- 3.2 The host tree at the Scottish site has had successful tree surgery.
- 3.3 The Scottish site was surveyed in 1994 as part of SNH's Lower Plant Conservation Project.
- 3.4 The Scottish site is within a NNR, and encouragement of new ash trees is underway.
- 3.5 The recently discovered English site is on an SSSI.

4. Action plan objectives and targets

- 4.1 Maintain known populations and establish at least two additional populations in the vicinity of the Scottish population.

5. Proposed action with lead agencies

Action in this plan is focussed on maintaining the single tree in Scotland on which this species occurs. As a safeguard against its accidental loss, the experimental establishment by

translocation of two further populations nearby is recommended. Effort also needs to be directed to the newly discovered English site to assess the status of the colony, any threats to it, and measures which may be required. Searches for other, as yet unknown, populations are encouraged.

5.1 Policy and legislation

5.1.1 Seek to promote planting of suitable trees in parkland and wayside situations. (ACTION: LAs, SOAEFD, SNH)

5.1.2 Adhere to commitments, as set by the Critical Loads Advisory Group in 1995, to reduce the 1980 levels of sulphur dioxide emissions by 80% by 2010. (ACTION: DETR)

5.2 Site safeguard and management

5.2.1 Ensure continued, appropriate woodland management is taken if the Scottish host tree is severely damaged. (ACTION: SNH)

5.3 Species management and protection

5.3.1 Attempt further local transplants to at least two other trees in the vicinity of the Scottish population, and consider translocation to former site in Wales. (ACTION: CCW, SNH)

5.4 Advisory

5.4.1 Ensure continued awareness by the landowner and site manager of the Scottish site, and liaise with the owners of the English site, regarding the presence of the species and its legal status. (ACTION: EN, SNH)

5.5 Future research and monitoring

5.5.1 Continue monitoring of the population and transplants at the Scottish site. (ACTION: SNH)

5.5.2 Investigate the feasibility of *ex situ* cultivation as an adjunct to translocation attempts. (ACTION: CCW, EN, SNH)

5.5.3 Undertake survey of potential sites, especially in eastern Scotland and south-west England and around the former site in Wales, so as to enhance known distribution of the species. (ACTION: CCW, EN, SNH)

5.6 Communications and publicity

5.6.1 Use tree catapyrenium as an example of the importance for nature conservation of mature deciduous trees in parkland, wayside and woodland-edge situations. (ACTION: CCW, EN, SNH)

- 5.6.2** Encourage research on the ecology and conservation of this species at an international level and use expertise gained towards its conservation in the UK. (ACTION: JNCC, SNH)
- 5.6.3** Encourage lichenologists to pass all records of tree catapyrenium, including ecological information, to a national database. (ACTION: CCW, EN, JNCC, SNH)
- 5.6.4** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** None proposed.

Stump lichen (*Cladonia botrytes*)

Action Plan

1. Current status

- 1.1 Stump lichen mostly occurs on the cut surface of pine stumps in the vicinity of native pine woods, but it has also been found on old heather stems and peaty ground on exposed hillsides. It has not, so far, been recorded in Britain from spruce stumps.
- 1.2 First discovered in Britain in 1955, this small but easily recognised species has been found at nine sites in eastern Scotland. It has recently been re-found in 1997 at one site after not having been recorded anywhere since 1978. It has a circumboreal distribution, extending south to central Europe.
- 1.3 The species is classified as *Critically Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Unknown, although changes in forest management may be involved, including reduction in tree felling in vicinity of known localities, lower cutting height of stumps, and chemical treatment of stumps. The decline in the number of records coincided with use of urea as stump treatment.

3. Current action

- 3.1 Stump lichen is included in SNH's Lower Plant Conservation Project, but several localities await site visits.
- 3.2 The species was re-found in 1997 by the RBGE on one stump in Glen More Forest Park (owned and managed by FE) as part of the project above.
- 3.3 An SNH survey in 1998 found the species on 16 stumps at four localities in the Dell Wood NNR and Abernethy SSSI.

4. Action plan objectives and targets

- 4.1 Maintain populations of stump lichen at all known extant sites.

5. Proposed action with lead agencies

A key element of this plan is to search for and locate any additional surviving populations, and raise awareness of the species amongst pinewood managers. Linked to this, research into the causes of the decline are needed so that experimental, positive management can be undertaken. Contact with specialists and forest managers in Scandinavia, where the species is more

abundant, may be instructive in this respect. Unusually, this species may depend on tree felling in native pine woods.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Ensure appropriate protection of the known sites. (ACTION: FE, SNH)

5.3 Species management and protection

5.3.1 None proposed.

5.4 Advisory

5.4.1 Advise landowners and managers, and relevant agencies, of the (potential) presence and importance of stump lichen, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: FC, SNH)

5.5 Future research and monitoring

5.5.1 Undertake survey of former and potential sites to establish the current status and distribution of the species. (ACTION: RBGE, SNH)

5.5.2 Undertake research to establish habitat requirements and possible causes for decline. (ACTION: FC, SNH)

5.5.3 Undertake research into past management history of the extant, or newly (re)discovered, site(s) in order to understand how the present favourable conditions arose. (ACTION: FC, SNH)

5.5.4 Undertake experimental management, in the vicinity of known or newly discovered populations, to ensure conservation of the species in the future. (ACTION: FE, SNH)

5.6 Communications and publicity

5.6.1 In order to maximise possibilities of finding new localities, promote awareness among foresters and local conservation workers of the species through a ‘wanted’ poster with colour illustrations of the species. (ACTION: FC, JNCC, SNH)

5.6.2 Establish links with lichenologists and foresters in Scandinavia to ascertain its status there and any effects of stump treatment or forest practice. (ACTION: JNCC, RBGE, SNH)

5.6.3 Encourage lichenologists to pass all records of stump lichen, including ecological information, to a national database. (ACTION: JNCC, SNH)

- 5.6.4** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for native pine wood.

***Cladonia mediterranea* (a reindeer lichen)**

Action Plan

1. Current status

- 1.1** *Cladonia mediterranea* is a foliose lichen, which grows on basic soils (pH 7.0-7.3), forming straggling low clumps amongst open vegetation. In Cornwall it grows on a bank in Serpentine heath, with a mosaic of rock, amongst *Festuca rubra* and *Calluna vulgaris*. In Pembroke it grows with *Calluna* amongst coarse boulder scree, and on Lundy it is found in damp areas between stands of *Calluna*. The taxonomic status of this species in Britain has recently been questioned. Material from the Lizard, Cornwall does appear to represent *C. mediterranea*, but at other sites it is possible that records may in fact be chemical variants of *C. portentosa*. Clarification of these issues are needed.
- 1.2** This species is restricted in Britain to three sites on the Lizard Peninsula in Cornwall, Pembrokeshire and Lundy Island. In 1986 it was described as *not abundant* on the Lizard site, in a report written following a field meeting of the British Lichen Society. There is some evidence that, when the Cornish population was surveyed in 1986, the colonies were more fragmented and in poorer condition than when collected 35 years earlier. This species is otherwise known from the Mediterranean, western France, the former Yugoslavia, Turkey, North Africa and the Canary Islands.
- 1.3** This species is classified as *Critically Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. This species belongs to the sub-genus *Cladina* which is listed under Annex Vb of the EC Habitats Directive.

2. Current factors causing loss or decline

- 2.1** *C. mediterranea* is particularly vulnerable because of the small size of the extant populations. Potential threats include trampling by domestic livestock and walkers, and moorland fires.

3. Current action

- 3.1** The Cornish site is within a NNR, and the other sites are SSSIs.

4. Action plan objectives and targets

- 4.1** Maintain, and where feasible and appropriate enhance, extant populations of this species, subject to taxonomic confirmation at each site.

5. Proposed action with lead agencies

A review of information on the current British distribution and status of this species is needed by 2003. All currently known *C. mediterranea* sites are protected within SSSIs and an NNR. However, site managers may not be aware of its presence and management requirements. Discussion with the owners and managers of all *C. mediterranea* sites should therefore be undertaken as a priority, and should include an assessment of threats and management needs at each site. Colonies should be regularly monitored so that future management decisions may be better informed. Taxonomic studies are needed to clarify the distinction between *C. mediterranea* and *C. portentosa* in Britain.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Where possible, ensure that management on all SSSIs where *C. mediterranea* occurs is sympathetic to the conservation of this species. (ACTION: CCW, EN)

5.2.2 Assess the threats to extant populations of this species posed by trampling from livestock and walkers. Where necessary, devise and implement measures to ensure that these threats are minimised. (ACTION: CCW, EN)

5.2.3 Devise and implement measures to minimise the risk to extant sites posed by moorland fires. Appropriate measures may include the creation of fire-breaks. (ACTION: CCW, EN)

5.3 Species management and protection

5.3.1 None proposed.

5.4 Advisory

5.4.1 Advise landowners and managers, and relevant agencies, of the presence and importance of *Cladonia mediterranea*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN)

5.5 Future research and monitoring

5.5.1 Undertake an investigation to clarify the distinction between *C. mediterranea* and *C. portentosa*, and use the findings to help revise earlier records attributed to *C. mediterranea*. (ACTION: JNCC)

5.5.2 Undertake a thorough survey of all sites from which this species has been recorded in order to determine the current status of this species at each, and to assess the threats to extant colonies. If proved to occur at Lundy and in Pembrokeshire widen the search to other suitable areas. (ACTION: CCW, EN)

5.5.3 Monitor all extant sites regularly in order to assess changes in population size and habitat quality. (ACTION: CCW, EN)

5.6 Communication and publicity

5.6.1 Encourage lichenologists to pass all records of *Cladonia mediterranea* including ecological information, to a national database. (ACTION: CCW, EN, JNCC)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC)

5.7 Links with other action plans

5.7.1 This action plan should be considered in conjunction with that for lowland heathland, and maritime cliffs and slopes.

***Cladonia peziziformis* (a lichen)**

Action Plan

1. Current status

- 1.1 *Cladonia peziziformis* is a lichen of peaty soils, mainly in coastal or montane heathland up to 400 m in altitude. It seems to favour undisturbed heathland, but at one site in Pembrokeshire discovered in 1989, it was growing on bare patches of soil, created by burning. Some disturbance may therefore be beneficial for this species. More research is needed to clarify this.
- 1.2 This lichen is very rare with only a few widely scattered records. Over the last 30 years the only British records of this species have been from Pembrokeshire (first recorded 1989), Devon and Mull, although there are also post-1960 records from West Sussex and south-west Scotland. In the 19th century it was also recorded from two other sites in Scotland and from London. In Northern Ireland, it is known from two sites, recorded in County Antrim in 1969 and County Down in 1972. It was described as abundant at that time at the County Antrim site. The species is otherwise known from Europe, North and South America.
- 1.3 This lichen is classified as *Critically Endangered* in Great Britain and is given the provisional status of *Rare* in the draft Irish Red Data Book. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

The threats to this species are poorly understood, but are likely to include the following:

- 2.1 Inappropriate use of burning as a management tool.
- 2.2 Natural succession of heathland vegetation.
- 2.3 Inappropriate levels of grazing.
- 2.4 Trampling, as the result of public access to sites.

3. Current action

- 3.1 The Mull site and the Welsh site are within SSSIs and the latter is owned by the National Trust. The Devon site has no site protection.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all extant sites.

5. Proposed action with lead agencies

A review of information on the current distribution and status of this species in the UK should be completed by 2003. Other initial action for *Cladonia peziziformis* should focus on protecting extant sites, and research into its management requirements and the identification of specific threats at each site. The research is needed in order to inform conservation management for this species in the future.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Consider notifying as ASSIs/SSSIs sites with viable populations of *Cladonia peziziformis* where this is consistent with selection guidelines and necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EHS, EN, SNH)

5.2.2 Ensure that all extant sites are protected from overgrazing and, with the benefit of the findings of the research proposed under 5.5.3, establish grazing levels that are recommended for the conservation of this species. (ACTION: CCW, EHS, EN, SNH)

5.2.3 Implement measures to protect all extant sites from fires until the full effects of fire on this species are understood. Appropriate measures may include the creation of fire-breaks. (ACTION: CCW, EHS, EN, SNH)

5.2.4 To avoid damage by trampling, devise and implement measures to restrict public access in fragile areas where this plant occurs. (ACTION: CCW, EHS, EN, SNH)

5.2.5 Following the research outlined under 5.5.3, assess the possibility of creating bare patches of ground for colonisation through soil disturbance in the vicinity of extant colonies. (ACTION: CCW, EHS, EN, SNH)

5.3 Species management and protection

5.3.1 None proposed.

5.4 Advisory

5.4.1 Advise landowners and managers of the presence and importance of *Cladonia peziziformis*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EHS, EN, SNH)

5.4.2 As far as possible, ensure that relevant agri-environment project officers are advised of the locations of this species, its importance, management requirements and potential threats. (ACTION: CCW, DANI, EHS, EN, MAFF, SNH, SOAEFD, WOAD)

5.5 Future research and monitoring

- 5.5.1** Collate information and resurvey sites where necessary, so as to determine the current UK distribution and status of this species, and to assess the threats to all extant sites. This action should include a thorough survey of suitable habitat in the vicinity of known extant sites in order to look for additional colonies as yet unrecorded. (ACTION: CCW, EHS, EN, SNH)
- 5.5.2** Monitor all extant colonies regularly to assess changes in population size and habitat quality. (ACTION: CCW, EHS, EN, SNH)
- 5.5.3** Undertake a research project to improve understanding of the ecological requirements of this species. The research should include a study of the effects of fire, soil disturbance and different levels of grazing on its performance. On completion of the research, management guidelines should be written and used to inform and refine the action proposed in section 5.2. (ACTION: CCW, EHS, EN, SNH)

5.6 Communication and publicity

- 5.6.1** Encourage lichenologists to pass all records of *Cladonia peziziformis*, including ecological information, to a national database. (ACTION: CCW, EN, EHS, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EHS, EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for lowland heathland and maritime cliffs and slopes.

***Enterographa elaborata* (a lichen)**

Action Plan

1. Current status

- 1.1 *Enterographa elaborata* is a crustose lichen which grows on the shaded bases and trunks of mature trees, usually beech, in ancient woodland. In the New Forest it grows in raintracks on the trunk of a hollow senescent beech tree (which resembles a pollarded tree) in old pasture woodland. In County Fermanagh it was found on a mature ash tree in woodland on a north-facing, limestone scarp.
- 1.2 This lichen was thought to be extinct in England until it was rediscovered at a single site in the New Forest in 1993, after an absence of more than 140 years. It was also formerly known from the Isle of Wight. In Northern Ireland it is only known from one site at Hanging Rock NNR in County Fermanagh, where it was found in 1990. It was also formerly recorded from the Irish Republic, but has not been seen there this century. Elsewhere it occurs in the Pyrenees, Denmark, southern Sweden, the Azores and Madeira.
- 1.3 *E. elaborata* is classified as *Critically Endangered* in Great Britain, and provisionally classified as *Endangered* in the draft Red Data Book for Ireland (incorporating Northern Ireland). It has recently received special protection under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 It is thought that the decline of this species was largely a result of the cessation of traditional pollarding in the 19th century.
- 2.2 The most obvious long-term threat to the remaining populations is the age and condition of the host trees. The species may die out with the host trees if suitable trees are not available for colonisation.
- 2.3 Because of the small size of the population, this lichen is vulnerable to inappropriate botanical collection.

3. Current action

- 3.1 The New Forest site is within an SSSI and the County Fermanagh site is within a National Nature Reserve.
- 3.2 This species is currently proposed for addition to Schedule 8 of the Wildlife (Northern Ireland) Order 1985.

4. Action plan objectives and targets

- 4.1** Maintain populations at both known extant sites and increase the extent of these populations if feasible.

5. Proposed action with lead agencies

Action for this species should begin with a survey of all known sites. The survey work should be extended to include suitable habitat in the area surrounding these sites, with the aim of identifying colonies which are as yet unrecorded. On completion of the survey, action should focus on the protection of all host trees, and on establishing management that will provide a continuity of suitable host trees in the vicinity of extant sites.

5.1 Policy and legislation

- 5.1.1** None proposed.

5.2 Site safeguard and management

- 5.2.1** Undertake management of selected trees in the vicinity of extant sites, with the aim of creating a continuity of suitable veteran trees for colonisation. Pollarding is likely to be the most appropriate management method. (ACTION: EHS, EN, FE)
- 5.2.2** Ensure that all standing dead wood in the vicinity of extant sites is allowed to remain standing. (ACTION: EHS, EN, FE)
- 5.2.3** Where appropriate, undertake management, such as pollarding, to stabilise and prolong the life of existing host trees on which this species occurs. (ACTION: EHS, EN, FE)

5.3 Species management and protection

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Enterographa elaborata*, specific management for its conservation, its legal protection, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EHS, EN)

5.5 Future research and monitoring

- 5.5.1** Undertake a thorough survey of potential host trees in the area surrounding the known extant sites, with the aim of discovering populations of this species that have so far gone unrecorded. (ACTION: EHS, EN)

- 5.5.2** Monitor extant populations regularly to detect any change in population size and to ensure regular assessment of the condition of host trees. (ACTION: EHS, EN)

5.6 Communications and publicity

- 5.6.1** Publicity is not recommended for this species, because of the restricted size of the population and the potential threat of botanical collection.
- 5.6.2** Encourage lichenologists to pass all records of *Enterographa elaborata*, including ecological information, to a national database. (ACTION: EN, EHS, JNCC)
- 5.6.3** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: EHS, EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This species should be considered in conjunction with that for lowland wood pastures and parkland.

***Enterographa sorediata* (a lichen)**

Action Plan

1. Current status

- 1.1 This crustose lichen mainly occurs in ancient pasture, woodland and parkland on the dry side of mature oak trunks which are not directly wetted by rain. It is restricted to relatively open ancient woodlands or to trees which were originally within woodland. In Norfolk it occurs on an old oak tree in a sunken lane.
- 1.2 This lichen is thought to be endemic to Britain and is restricted to the New Forest (where it is scattered in approximately 11 woods, but may be under-recorded), one site in Savernake Forest, Wiltshire where it occurs on a few trees, and one site in each of Dorset and Norfolk, in each case confined to a single oak.
- 1.3 This species is categorised as *Near Threatened* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The main threat to this species is from the destruction of the host trees on which it grows and the destruction of potential host trees close to extant colonies.

3. Current action

- 3.1 The host tree in Dorset is within an SSSI.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all extant sites.

5. Proposed action with lead agencies

Enterographa sorediata may be an under-recorded species, and survey work should therefore form a central element of the action for this species. Surveys of known sites should be extended to include a search of suitable habitat in the surrounding areas with the aim of identifying new colonies. All possible measures should be employed to protect host trees and to ensure a long-term continuity of potential host trees around existing sites.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1** Where it is in the interests of amenity, apply Tree Preservation Orders to protect host trees and woodlands. (ACTION: LAs)
- 5.2.2** Consider notifying as SSSIs sites with viable populations of *Enterographa sorediata*, where this is consistent with selection guidelines and necessary to ensure their long-term protection and appropriate management. (ACTION: EN)
- 5.2.3** Where appropriate, undertake management such as pollarding to stabilise and prolong the life of existing host trees on which this species occurs. (ACTION: EN, FE)
- 5.2.4** Ensure that suitable replacement host trees become established in the vicinity of extant sites. Where appropriate, this may involve pollarding and planting of suitable tree species. (ACTION: EN, FC)

5.3 Species protection and management

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Enterographa sorediata*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Undertake a thorough survey of all known *Enterographa sorediata* sites to determine the current status of this species at each, and to assess any threats to extant sites. Extend the survey to include suitable habitat in the area surrounding known sites with the aim of discovering populations that have so far gone unrecorded. Fieldwork should include a thorough survey of suitable habitat in the New Forest. (ACTION: EN)
- 5.5.2** Undertake regular monitoring at all extant sites with the aim of assessing changes in population size and the condition of host trees. (ACTION: EN)
- 5.5.3** Compile a list of sites that would be worth searching for this species and distribute to active lichenologists. (ACTION: EN)

5.6 Communications and publicity

- 5.6.1** Encourage lichenologists to pass all records of *E. sorediata*, including ecological information, to a national database. (ACTION: EN, JNCC)

- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for lowland wood pastures and parkland.

***Graphina pauciloculata* (a lichen)**

Action Plan

1. Current status

- 1.1 This crustose lichen grows on the smooth bark of trees such as hazel (*Corylus*), ancient holly (*Ilex*) and young oak (*Quercus*), in ancient, damp, oceanic woodlands or willow carr.
- 1.2 *Graphina pauciloculata* is very rare and thought to be endemic to Britain and Ireland. It was recorded from one site on Bodmin Moor, Cornwall in 1972, one site at Penharget to the east of Bodmin Moor in 1980, and two sites on Dartmoor, Devon in 1971 and 1977. It is otherwise known only from County Cork, in the Irish Republic. However, it may be a widely overlooked species.
- 1.3 *Graphina pauciloculata* is classified as *Vulnerable* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Current threats affecting this species are unknown, although it requires a moist environment and may suffer if the tree canopy around it is opened up too much. Drainage of the surrounding area may be a threat where the plant occurs in willow carr habitat.

3. Current action

- 3.1 The two Dartmoor sites are within an SSSI and also the National Park, and the Penharget site is also within an SSSI.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all extant sites.

5. Proposed action with lead agencies

A review of information on the current distribution and status of this species in Britain is needed by 2002. Field surveys will form a central element. It is important that these surveys are not restricted to known sites, but are extended to include a search of suitable habitat in surrounding areas. The surveys will also provide an opportunity to collect ecological information which may help to improve understanding of the habitat requirements of this species.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of *Graphinia pauciloculata*, where this is consistent with selection guidelines and necessary to ensure their long-term protection and appropriate management. (ACTION: EN)
- 5.2.2** Where it is in the interests of amenity, apply Tree Preservation Orders to protect host trees and woodlands. (ACTION: LAs)
- 5.2.3** Ensure that the management of all extant sites is beneficial to the conservation of this species. Potentially damaging operations, such as opening up the tree canopy around extant colonies, should be prevented. (ACTION: EN)
- 5.2.4** Undertake management, where necessary, to ensure a continuity of potential host trees in the vicinity of existing colonies. Management may include fencing off areas of woodland, if/where grazing is preventing regeneration of suitable tree species. (ACTION: EN, FE)
- 5.2.5** Where appropriate, undertake management such as pollarding, to stabilise and prolong the life of existing host trees on which this species occurs. (ACTION: EN)

5.3 Species management and protection

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Graphinia pauciloculata*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Survey all known sites and other suitable habitat around each site, to determine the current distribution and status of this species and to assess the threats and management needs at all extant sites. (ACTION: EN)
- 5.5.2** Monitor all extant sites regularly in order to assess changes in population size and habitat quality, and to identify potential threats. (ACTION: EN)
- 5.5.3** Commission a research project to investigate aspects of the ecology of this species with a view to refining management for its conservation. (ACTION: EN)

5.6 Communication and publicity

- 5.6.1** Encourage lichenologists to pass all records of *Graphinia pauciloculata*, including ecological information, to a national database. (ACTION: EN, JNCC)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

5.7.1 This action plan should be considered in conjunction with that for wet woodlands.

Ciliate strap-lichen (*Heterodermia leucomelos*)

Action Plan

1. Current status

- 1.1 Ciliate strap-lichen is a foliose species which grows on mossy rocks or in moss-lichen turf on sunny, exposed, coastal cliff tops, where it scrambles amongst other vegetation. It also rarely occurs on the branches of wayside, broadleaved trees and was recorded growing on an ash tree at one of its former sites in West Sussex. This is also its principal habitat in western France. Fertile plants have not been found in Britain.
- 1.2 This south-westerly species is local and declining, only known from 13 sites in Cornwall, the Isles of Scilly, Bardsey Island, the Llyn Peninsula and Anglesey, where it reaches its northernmost limit in Europe. Three known sites were searched on Bardsey Island in 1985, but only tiny fragments of the lichen were found at two of them. At the Lizard site, where it occurs on mossy boulder scree, a large population was seen in 1986. It was previously more widespread in its range, being recorded from Devon, Dorset, Wiltshire and West Sussex. It is also known from the extreme south-western tip of Counties Cork and Kerry in the Irish Republic where it is relatively well established, and from the Channel Islands. In Europe it has a western oceanic distribution.
- 1.3 This species is classified as *Endangered* in Great Britain and is protected under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 This species is vulnerable to burning, over- and under-grazing and, where it occurs near to cliff-top paths, trampling by walkers. It is relatively well protected from damage by trampling and fires at the Lizard site, as it is situated in an area of boulder scree.
- 2.2 Sulphur dioxide pollution may have contributed to its decline in the past, but the main pollution threat now is more likely to be from nitrogen-rich rain and drift of agricultural chemicals.
- 2.3 Ciliate strap-lichen is a poor competitor and thus the spread of scrub and coarse vegetation in the immediate vicinity is also a potential threat.

3. Current action

- 3.1 The main populations are protected within NNRs.

4. Action plan objectives and targets

- 4.1 Maintain populations at all extant sites and increase their extent where appropriate and feasible.

5. Proposed action with lead agencies

The most important threats to this species are likely to be different on each of its sites. Field surveys are therefore a priority, not only to help establish an up-to-date picture of the current distribution of this species, but also to allow for a thorough assessment of threats and management needs at each site. These should be completed by 2003. The results of the field surveys should be used to revise site management aimed at the conservation of this species.

5.1 Policy and legislation

- 5.1.1** Adhere to commitments, as set by the Critical Loads Advisory Group in 1995, to reduce the 1980 levels of sulphur dioxide emissions by 80% by 2010. Seek adequate monitoring of NO_x levels in remote western coastal sites. (ACTION: DETR)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of ciliate strap-lichen, where this is consistent with selection guidelines and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EN)
- 5.2.2** Where it is in the interests of amenity, apply Tree Preservation Orders to protect host trees and woodlands. (ACTION: LAs)
- 5.2.3** Control the encroachment of scrub and other coarse vegetation on all extant ciliate strap-lichen sites. (ACTION: CCW, EN)
- 5.2.4** Devise and implement measures to restrict public access in areas where this species is vulnerable to trampling. (ACTION: CCW, EN)
- 5.2.5** Ensure that grazing on all extant sites is carefully maintained at levels that will provide maximum benefits for the conservation of ciliate strap-lichen. (ACTION: CCW, EN)

5.3 Species management and protection

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of ciliate strap-lichen, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers are advised of the locations of this species, its importance, management requirements and potential threats. (ACTION: CCW, EN, MAFF, WOAD)

5.5 Future research and monitoring

- 5.5.1** Undertake a thorough survey of all sites from which ciliate strap-lichen has been recorded in the past, in order to determine the current status of this species at each, and to assess the current threats to all extant populations. (ACTION: CCW, EN)
- 5.5.2** Undertake regular monitoring at all extant sites to assess changes in population size and habitat quality. (ACTION: CCW, EN)
- 5.5.3** Undertake a research project to improve understanding of the ecological requirements of this species, with the aim of producing guidelines on management for its conservation. (ACTION: CCW, EN, JNCC)
- 5.5.4** Review available ecological information from all sites to determine the tolerance of this species to air pollution and drift of agricultural chemicals. (ACTION: CCW, EN)

5.6 Communication and publicity

- 5.6.1** Encourage lichenologists to pass all records of ciliate strap-lichen, including ecological information, to a national database. (ACTION: CCW, EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for maritime cliffs and slopes.

Churchyard lecanactis (*Lecanactis hemisphaerica*)

Action Plan

1. Current status

- 1.1 Churchyard lecanactis is a crustose lichen of shaded and sheltered north- and east-facing church walls in coastal areas, where it usually grows on plaster or more rarely on mortar.
- 1.2 It is a rare species which is now confined to 15 sites in the south-east of England, in Kent, Sussex, Suffolk, Norfolk and Dorset. It is otherwise known only from Italy. At most of its known sites it is relatively abundant, but confined within a small area.
- 1.3 This species is classified as *Near Threatened* in Great Britain and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The spread of this species is limited by the scarcity of external plaster walls in sheltered situations.
- 2.2 Deterioration of walls on which this species grows is a possible threat.
- 2.3 Unsympathetic repair of walls on which this species occurs, eg using materials other than plaster or mortar.

3. Current action

- 3.1 None known.

4. Action plan objectives and targets

- 4.1 Maintain populations at all extant sites.
- 4.2 If feasible and desirable, establish three new colonies of this species at suitable sites by 2005.

5. Proposed action with lead agencies

A review of information on the current distribution and status of this species in Britain should be completed by 2003. The successful conservation of this species at its extant sites will depend upon the development and implementation of long-term plans for the sympathetic maintenance of the walls on which it grows. The possibility of establishing new colonies of this species at historic sites, or suitable sites close to extant sites, should also be explored.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Devise, implement and provide incentives for maintenance plans for all walls on which this species occurs. The plans should set out a proposed timetable for the long-term maintenance of the walls, with necessary repair works being staggered, and using the same materials for repair as the existing substrate on which the lichen occurs. (ACTION: EH, EN)

5.3 Species management and protection

5.3.1 Assess the feasibility and desirability of translocating colonies of churchyard lecanactis to suitable substrates in the vicinity of extant sites, and to suitable historic sites, in order to facilitate the spread of this species. If appropriate, undertake three experimental translocation attempts by 2005. Translocation should also be considered in the event of extant sites becoming unstable. (ACTION: EN)

5.4 Advisory

5.4.1 Advise the relevant church authorities of the presence and importance of churchyard lecanactis, its legal protection, specific management for its conservation, and any potentially damaging actions. The authorities should have access to specialist advice if needed. Site owners should also be consulted during the production of the wall maintenance plans recommended under 5.2.1. (ACTION: EN)

5.5 Future research and monitoring

5.5.1 Undertake a thorough survey of all sites where this species has been recorded in the past, in order to determine its current status at each, to assess the condition of the walls on which it occurs, and to identify any threats to extant colonies. (ACTION: EN)

5.5.2 Undertake regular monitoring at all extant sites, in order to identify any changes in population size and to ensure regular assessment of the condition of walls on which this species grows. (ACTION: EN)

5.5.3 Commission a research project to investigate aspects of the ecology of this species, with a view to refining management for its conservation and translocation techniques. (ACTION: EN)

5.6 Communication and publicity

5.6.1 Write an article for relevant national church newsletters and magazines with the aim of raising awareness amongst the church community of the importance of churchyards for lichen conservation. The article should indicate ways in which churches can help to protect these important lichen sites. (ACTION: EN)

5.6.2 Encourage lichenologists to pass all records of churchyard lecanactis, including ecological information, to a national database. (ACTION: EN, JNCC)

5.7 Links with other action plans

5.7.1 *Calicium corynellum* is another churchyard species but with different microhabit.

Ear-lobed dog-lichen (*Peltigera lepidophora*)

Action Plan

1. Current status

- 1.1 Ear-lobed dog-lichen is an ephemeral foliose lichen which, in Britain, occurs on mossy rocks of calcareous Old Red Sandstone conglomerate in a wooded river gorge.
- 1.2 It is known from only one British locality in east Perthshire from which it was first recorded in 1971. Before its recent re-discovery in 1998 it had last been seen there in 1976. The species has a circumpolar, boreal/montane distribution. In Europe, it is frequent in Scandinavia, local in central and eastern Europe, but very rare in the west (northern Spain and Scotland). It is also known from New Zealand, Hawaii and South America.
- 1.3 Ear-lobed dog-lichen is classified as *Critically Endangered* in Great Britain. It is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Not identified: there have been no obvious changes at the site, but the species is believed to be ephemeral in nature.

3. Current action

- 3.1 The site was surveyed in 1994 as part of SNH's Cryptogamic Conservation project, but the species was not refound. It was re-discovered in 1998 by an SNH commissioned survey.
- 3.2 The site is within an SSSI.

4. Action plan objectives and targets

- 4.1 Maintain known and any newly discovered populations.

5. Proposed action with lead agencies

Action in this plan is focussed on safeguarding and monitoring the status of the single, known population of this species though the ephemeral nature of the species must be recognised. Key activities include liaison with the land managers, surveys to attempt to find further colonies, and action to prevent habitat deterioration especially from water pollution where activities off site could have significant impact on the population.

5.1 Policy and legislation

- 5.1.1** Seek to reduce the risk of water pollution, for example through the provision of advice on farm waste management in the catchment where this species occurs. (ACTION: SEPA, SOAEFD)

5.2 Site safeguard and management

- 5.2.1** Ensure the requirements of this species are taken into account in any management plans for the site. (ACTION: SNH)

5.3 Species management and protection

- 5.3.1** Ensure lack of disturbance to the known site. (ACTION: SEPA, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and land managers of the presence and importance of ear-lobed dog-lichen, its legal protection, specific management for conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: SEPA, SNH)

5.5 Future research and monitoring

- 5.5.1** Undertake surveys of potential sites in the same and other river systems in the region. (ACTION: SNH)
- 5.5.2** Undertake periodic monitoring to investigate the growth rate and population dynamics of the species. (ACTION: SNH)
- 5.5.3** Encourage research on the ecology and status of this species at an international level, especially in Europe outside of Scandinavia. (ACTION: JNCC, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage lichenologists to pass all records of ear-lobed dog-lichen, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** The implementation of this plan should be considered in conjunction with that for *Collema dichotomum* as they occur together on one site.

Scaly breck-lichen (*Squamarina lentigera*)

Action Plan

1. Current status

- 1.1 Scaly breck-lichen is a species of sandy, calcareous soils and dunes. In Britain, it grows on the highly calcareous soils of the Brecklands, where the soil is derived directly from the chalk or boulder clay beneath. Disturbance of the soil is important for this species, in order to keep the sward open. All the current sites have had some ground disturbance in the past 50 years.
- 1.2 The species is now restricted to the Brecklands of East Anglia, predominantly in Suffolk, although extending into Norfolk, and is now thought to be restricted to four sites. Previously recorded from Weeting Heath in Norfolk, it was refound there, in a new locality, in 1997. It was formerly also known from East Sussex and the Isle of Wight and unconfirmed records also exist for Somerset and Cornwall. Elsewhere it is known to occur throughout Europe, from Norway to the Mediterranean, south-eastern Russia, North America, North Africa and Asia.
- 1.3 Scaly breck-lichen is classified as *Endangered* in Great Britain, and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 This species has declined sharply since the mid-1980s. One of the main reasons for this is believed to be loss of bare ground habitat on its Breckland sites due to a fall in the rabbit population following the outbreak of myxomatosis.
- 2.2 The drift of agricultural chemicals is a potential current threat.

3. Current action

- 3.1 Since 1992, scaly breck-lichen has been included in English Nature's Species Recovery Programme, and is monitored regularly. Material from relatively healthy populations has been transplanted to other suitable sites nearby and subsequent progress is being monitored.
- 3.2 All of the known sites for this species are within SSSIs.

4. Action plan objectives and targets

- 4.1 Maintain populations at all extant sites.
- 4.2 Encourage the spread of scaly breck-lichen from current sites where appropriate and feasible.

5. Proposed action with lead agencies

Survey and research are needed to determine the current distribution and status of this species, to understand more clearly the reasons for its decline, and to refine management techniques for its conservation including the importance of soil disturbance in the maintenance of viable populations. The legislative protection of any newly discovered sites should be reviewed.

5.1 Policy and legislation

- 5.1.1** Ensure that the requirements of this species are considered during future reviews of the Breckland ESA scheme. (ACTION: MAFF)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs newly discovered unprotected sites, where this is consistent with selection guidelines and necessary to ensure their long-term protection and appropriate management. (ACTION: EN)
- 5.2.2** Control scrub growth on all extant sites. (ACTION: EN)
- 5.2.3** Assess the threat to extant sites posed by the drift of agricultural chemicals. Implement measures to address this threat where it is identified to be significant. Measures may include management agreements on SSSIs, and agri-environment schemes on surrounding land. (ACTION: EN, MAFF)
- 5.2.4** Undertake soil disturbance on all extant sites to encourage the spread of this species. This management will initially be experimental, and methods should be refined in the light of observations made during initial trials. (ACTION: EN)

5.3 Species management and protection

- 5.3.1** Assess the possibility of undertaking translocations of this species in order to facilitate its spread. (ACTION: EN)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of scaly breck-lichen, its legal status, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers are advised of the locations of this species, its importance, management requirements and potential threats. (ACTION: EN, MAFF)

5.5 Future research and monitoring

- 5.5.1** Compile information and resurvey sites where necessary to determine the current distribution and status of this species in Britain. Current threats to all extant sites should also be assessed. (ACTION: EN)
- 5.5.2** Undertake regular monitoring at all extant sites with the aim of assessing changes in population size and habitat quality. (ACTION: EN)
- 5.5.3** Commission a research project to improve understanding of the management requirements of this species, the reasons for its sharp decline since the mid-1980s, and to assess the possibility of re-establishing this species at suitable former sites. (ACTION: EN)
- 5.5.4** Investigate the feasibility of *ex situ* cultivation as an adjunct to translocation attempts. (ACTION: EN)

5.6 Communication and publicity

- 5.6.1** Encourage lichenologists to pass all records of scaly breck-lichen including ecological information, to a national database. (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** It is likely that implementation of this action plan will benefit starry breck-lichen *Buellia asterella*.
- 5.7.2** This plan should be considered in conjunction with that for lowland calcareous grassland.

***Teloschistes chrysophthalmus* (a lichen)**

Action Plan

1. Current status

- 1.1 This fruticose lichen grows on the basic, well-lit, nutrient-rich twigs of shrubs and small trees, in sheltered, sunny situations. It is typically found in old orchards and in hedgerows, but also occasionally occurs on worked timber, such as fence posts, in coastal areas.
- 1.2 Formerly more widespread along the coast of southern England, from West Sussex, through the Isle of Wight to Torquay, the only recent records of this lichen are from Devon in 1966 (although it may now have been lost from this site), and Cornwall in 1997 and 1998 where it was found on blackthorn (*Prunus spinosa*). It also formerly occurred in Counties Down and Antrim in Northern Ireland, where it was last recorded in the 19th century, and is now presumed to be extinct. It also occurs on Jersey. Elsewhere it grows in dry, sunny temperate regions of both hemispheres.
- 1.3 *Teloschistes chrysophthalmus* is classified as *Critically Endangered* in Great Britain, *Extinct* in Northern Ireland, and is listed as *Threatened* on the preliminary European Red List for macrolichens. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The loss of this species from former sites is thought to be due to air pollution, substrate enrichment from inorganic fertilisers, and the destruction of old orchards and hedgerows.
- 2.2 The loss of this species from its last recorded site in Devon, was due to the removal of its host hawthorn bush to enable path widening.
- 2.3 This species may be vulnerable to botanical collection as it is an attractive species, and may only occur in small quantity.

3. Current action

- 3.1 None known.

4. Action plan objectives and targets

- 4.1 Maintain population levels at any sites that are found to be extant.
- 4.2 If feasible and desirable, re-establish this species at two suitable historic sites by 2005.

5. Proposed action with lead agencies

This shrubby lichen appears to be genuinely rare. However, its status and distribution in the UK remains unclear. The first action should therefore be a survey of sites with records of this

species in order to determine its current status at each. This should be achieved by 2003. If it is confirmed as *Critically Endangered*, legislative protection of sites or host trees should be considered.

5.1 Policy and legislation

- 5.1.1** If a viable colony is discovered, and if it meets relevant criteria, consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 and Schedule 8 of the Wildlife (Northern Ireland) Order 1985. (ACTION: DETR, EHS, JNCC)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as ASSIs/SSSIs sites with viable populations of *Teloschistes chrysophthalmus* where this is consistent with selection guidelines and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: EHS, EN)
- 5.2.2** Where it is in the interests of amenity, apply Tree Preservation Orders to protect host trees and woodlands. (ACTION: LAs)
- 5.2.3** On any extant *T. chrysophthalmus* site, assess the threat to each posed by the drift of agricultural chemicals. Implement measures to address any identified threat. Mechanisms may include management agreements on or adjacent to ASSIs/SSSIs, and relevant agri-environment schemes on other land. (ACTION: DANI, EHS, EN, MAFF)

5.3 Species management and protection

- 5.3.1** Assess the feasibility and desirability of re-establishing this species at suitable historic sites. If appropriate, undertake by 2005 experimental re-establishment attempts at two carefully selected sites. (ACTION: EN)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of *Teloschistes chrysophthalmus*, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Compile information and resurvey sites where necessary, in order to determine the current distribution and status of this species in the UK. Survey work should include a visit to the sites in Devon and Cornwall where this species was most recently recorded. (ACTION: EHS, EN)
- 5.5.2** At any extant sites, ensure that they are monitored regularly, in order to assess changes in population size and to ensure prompt identification of any threats. (ACTION: EHS, EN)

5.5.3 Compile a list of sites that would be worth searching for this species and distribute to active lichenologists. (ACTION: EHS, EN)

5.5.4 Investigate the feasibility of *ex situ* cultivation as an adjunct to translocation attempts. (ACTION: EHS, EN)

5.6 Communication and publicity

5.6.1 Develop links with groups working to promote the conservation of old orchards in order to coordinate action for this species with existing initiatives to conserve its orchard habitat. (ACTION: EHS, EN)

5.6.2 Encourage lichenologists to pass all records of *Teloschistes chrysophthalmus*, including ecological information, to a national database. (ACTION: EN, EHS, JNCC)

5.6.3 Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EHS, EN, JNCC)

5.7 Links with other action plans

5.7.1 None proposed.

Warty wax-lichen (*Thelenella modesta*)

Action Plan

1. Current status

- 1.1 This crustose lichen grows on the basic bark of parkland and wayside trees. It is currently known on only one tree, in Angus, but was formerly known at one site in Gloucestershire and one in Armagh. Although widely reported in Europe, including five pre-1916 records from the Republic of Ireland, it has suffered a marked decline. It is also known from Morocco and the USA.
- 1.2 Warty wax-lichen is classified *Critically Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Decline of suitable wayside and parkland trees.
- 2.2 Atmospheric pollution.
- 2.3 Excessive eutrophication of tree boles from agricultural practices may have contributed to its earlier decline.

3. Current action

- 3.1 The Scottish site was surveyed in 1996 as part of SNH's Action Plans for Lower Plants project, and the landowners informed of the location and importance of the species.

4. Action plan objectives and targets

- 4.1 Maintain the known population.
- 4.2 Establish two additional viable populations by 2010.

5. Proposed action with lead agencies

The focus of this plan is on maintaining this species at its single known locality. This requires the long-term survival of the host tree and action, through liaison with landowners, to prevent its accidental loss. In the longer term, and depending on confirmation of its current status, attempts to establish additional populations in the near vicinity are recommended.

5.1 Policy and legislation

- 5.1.1 Seek to promote planting of suitable trees in parkland and wayside situations. (ACTION: LA, SNH, SOAEFD)

5.2 Site safeguard and management

5.2.1 If in the interests of amenity, apply a Tree Preservation Order to protect the single host tree. (ACTION: LA)

5.2.2 Obtain specialist advice regarding the stability of the tree. Consider tree surgery rather than felling if tree should become damaged. (ACTION: SNH)

5.3 Species management and protection

5.3.1 Carry out transplants to at least two nearby trees by 2010, or earlier if the tree should become irrevocably damaged. (ACTION: SNH)

5.4 Advisory

5.4.1 Continue to liaise with land managers and local planning authority so they are aware of the presence and threats to this species, and of the importance of its conservation. (ACTION: SNH)

5.5 Future research and monitoring

5.5.1 Undertake surveys of potential and former sites to enhance known distribution of the species. (ACTION: EHS, EN, SNH)

5.5.2 Investigate reproductive potential by testing viability of spores. (ACTION: RBGE, SNH)

5.5.3 If spores are viable and mycobiont grows well in culture, use an inoculum of mycobiont to establish new populations. (ACTION: RBGE, SNH)

5.5.4 Encourage research on the ecology and conservation of this species at an international level, and use the expertise gained towards its conservation in the UK. (ACTION: JNCC, SNH)

5.6 Communications and publicity

5.6.1 Use warty wax-lichen as an example of the importance for nature conservation of deciduous trees in parkland, wayside and woodland-edge situations. (ACTION: EHS, EN, SNH)

5.6.2 Encourage lichenologists to pass all records of warty wax-lichen, including ecological information, to a national database. (ACTION: EN, EHS, JNCC, SNH)

5.6.3 Liaise with specialist societies to increase the awareness and identification skills of lichenologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EHS, EN, JNCC, SNH)

5.7 Links with other action plans

5.7.1 This action plan should be considered in conjunction with that for lowland wood pasture and parkland.

***Bellemerea alpina* (a lichen)**

Species Statement

1. Current status

- 1.1** *Bellemerea alpina* is a yellow-white crustose lichen known in the UK only from quartzite pebbles in the vicinity of a stream below an area of prolonged snow-lie on Cairn Gorm in north-east Scotland. It was last seen in 1983 and subsequent searches have failed to re-find it. In the last century it was also recorded from Ben Lawers, Perthshire. In Europe it is known from Scandinavia and the Alps, while it also occurs in North America.
- 1.2** The species is classified as *Critically Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1** Likely disturbance through increased recreation pressure.
- 2.2** Possible effects of climate change.

3. Current action

- 3.1** None known.

4. Objective for the species

- 4.1** If re-found at its single known British site, ensure that the population is maintained.

5. Proposed action

- 5.1** Search only. Other conservation action for this species could be integrated with the action plans for the following lichens: *Alectoria ochroleuca*, *Cladonia stricta* and *Hypogymnia intestiniformis*.

Snow caloplaca (*Caloplaca nivalis*)

Species Statement

1. Current status

- 1.1** This is a crustose lichen with a grey thallus and orange apothecia which overgrows bryophytes in montane situations. It has been reliably recorded in Britain only from Ben Lawers, Perthshire where it was described as 'not rare' by Carroll (1865) although Holl (1892) considered it to be 'very rare'. It was last seen there in 1986, overgrowing mosses on a low, mica-schist boulder on an exposed ridge. There is a 19th century record from Ben Cruachan, Argyll, but that is usually discounted. It occurs in both northern and central Europe as well as North America.
- 1.2** Snow caloplaca is classified as *Critically Endangered* in Britain. It is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1** Possible effects of climatic change.
- 2.2** Likely disturbance due to increased recreational pressure (hill-walking).
- 2.3** Botanical collection (more a problem in the 19th century).

3. Current action

- 3.1** The sites were visited in 1994 and 1995 as part of SNH's Cryptogamic Conservation Project but the species was not refound.
- 3.2.** Ben Lawers, the most recent former site, is an SSSI/ NNR owned by the National Trust for Scotland.

4. Objective for the species

- 4.1** Safeguard any populations that are refound.

5. Proposed action

- 5.1** Search only.

Alpine moss pertusaria (*Pertusaria bryontha*)

Species Statement

1. Current status

- 1.1 This crustose lichen, which overgrows mosses and low alpine vegetation, is known with certainty from only one site in the Ben Alder range of the Scottish Highlands. It was last seen there in 1981. Although not refound in 1994, it now seems that the precise locality may not have been closely examined. Two early records from the Cairngorms are considered doubtful. It is widely distributed in arctic Eurasia and North America, extending into the Alps and Caucasus.
- 1.2 Alpine moss pertusaria is classified as *Critically Endangered* in Britain and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. Little information is available on its status elsewhere.

2. Current factors causing loss or decline

- 2.1 Botanical collection, although collections are small and are not of whole thalli.
- 2.2 Accidental detachment by visiting botanists is a possibility, but is unlikely to be significant.

3. Current action

- 3.1 The Scottish sites with previous records were surveyed in 1994 as part of SNH's Lower Plant Conservation Project.
- 3.2 All sites are within SSSIs.

4. Objective for the species

- 4.1 Safeguard populations if refound.

5. Proposed action

- 5.1 Search only.

Liverworts



Wilson's pouchwort (*Acrobolbus wilsonii*)

Action Plan

1. Current status

- 1.1 Wilson's pouchwort is a leafy liverwort found in wooded ravines where there is both constant high humidity and reasonable light levels. It occurs as stems growing through other bryophytes or in lax cushions on rocks subject to intermittent irrigation. Typical associates include other Atlantic liverworts and *Hymenophyllum wilsonii*. Capsules are produced rarely in the autumn.
- 1.2 In Britain, this species is restricted to the west coast of Scotland, with three core areas in southern Argyll, the Sunart and Moidart area, and in southern Skye. Although it was recorded from only three ten km squares up to 1964, further survey has increased this number to 16 by 1991. However, all records are from the same core areas, and often represent a single site within each ten km square. It has apparently disappeared from two sites in southern Argyll recently. Wilson's pouchwort is a European endemic but does not occur on the European mainland, being limited to the oceanic fringe, with sites in the Faroes, western Ireland, the Azores, Madeira and the Canary Islands.
- 1.3 In Great Britain Wilson's pouchwort is classified as *Near Threatened*. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 There has been no systematic resurveying of extant populations of Wilson's pouchwort, so evidence of loss or decline is scant.
- 2.2 It would seem likely that an increase in shading has been a factor in the loss of two small populations in southern Argyll; shade cast by afforestation at the edge of a ravine and encroachment by *Rhododendron* are implicated in these losses. In at least one other locality, the canopy of beech could become a problem.
- 2.3 At least one site for Wilson's pouchwort has been targeted for the development of a small hydro-electric scheme; any subsequent lowering of humidity levels could be detrimental to the population.
- 2.4 The plant appears to have no specialised means of vegetative spread, which may limit its dispersal.

3. Current action

- 3.1 Several populations of Wilson's pouchwort are included within SSSIs, one is within an NNR, and one within a candidate SAC.
- 3.2 At present there is no management specifically directed at this species.

- 3.3 Most of the sites for Wilson's pouchwort are within, or are associated with, areas of broadleaved woodland which are subject to management policies which may, incidentally, favour existing populations of the plant, and may maintain or create suitable sites for establishment. Schemes to eradicate *Rhododendron* are likely to be particularly important.

4. Action plan objectives and targets

- 4.1 Maintain populations of Wilson's pouchwort at all extant sites, and increase their extent where appropriate and feasible.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

Action should concentrate on ensuring favourable management of woodland sites holding populations of this species, and on preventing potentially damaging changes such as the introduction of hydro-electric schemes and scrub encroachment. Further survey work to provide a comprehensive picture of the distribution and status of the species is required, and high priority should also be given to ecological studies, focussing on investigation of reproductive biology. An *ex situ* conservation programme should be instigated to safeguard against chance extinction, and to enable studies of autecology.

5.1 Policy and legislation

- 5.1.1 Ensure that the habitat requirements of Wilson's pouchwort are taken into account when considering proposals which affect the hydrological conditions of ravine sites. (ACTION: FC, LAs, SEPA, SNH, SOAEFD, Water Authorities)
- 5.1.2 Incorporate suitable policies for the conservation of oceanic broadleaved woodland into Local Development Plans and Indicative Forest Strategies. (ACTION: FC, LAs)

5.2 Site safeguard and management

- 5.2.1 Consider notifying as SSSIs sites with viable populations of Wilson's pouchwort where this is consistent with selection guidelines, and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: SNH)
- 5.2.2 Ensure that the habitat requirements of Wilson's pouchwort are taken into account in appropriate site management plans. (ACTION: FC, SNH)
- 5.2.3 Seek to control *Rhododendron* where this is considered to be a threat to populations of Wilson's pouchwort. (ACTION: FC, SNH, SOAEFD)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: RBG Kew, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of Wilson's pouchwort, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: FC, SNH)

5.5 Future research and monitoring

- 5.5.1** Collate existing information on populations of Wilson's pouchwort. (ACTION: RBGE, SNH)
- 5.5.2** Resurvey all known sites, and potentially suitable sites within the known range, to assess the status of the species in Scotland. At each locality an assessment should be made of the current management regime and potential threats. Targeted survey of suitable sites beyond the known range of the species should also be considered. (ACTION: RBGE, SNH)
- 5.5.3** Undertake regular monitoring of all extant populations. (ACTION: SNH)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: RBG Kew, SNH)
- 5.5.5** Encourage or commission research into the reproductive biology of the species. (ACTION: SNH)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of Wilson's pouchwort, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)
- 5.6.3** Use Wilson's pouchwort as an example of a species with a very restricted world distribution, to promote the conservation of oceanic broadleaved woodland and to raise the profile of the British bryophyte heritage. (ACTION: SNH)

5.7 Links with other action plans

- 5.7.1** It is likely that the implementation of this action plan will benefit Atlantic lejeunea (*Lejeunea mandonii*).

- 5.7.2** The implementation of this action plan should be considered in conjunction with that for upland oak wood.

Lindenberg's featherwort (*Adelanthus lindenbergianus*)

Action Plan

1. Current status

- 1.1 Lindenberg's featherwort is a leafy liverwort which is a rare constituent of the rich hepatic community typical of oceanic dwarf shrub heath developed over upland block scree. Associated species typically include a range of other oceanic bryophytes. Lindenberg's featherwort is dioecious; sporophytes are unknown in Britain. Gemmae have been reported in overseas populations but no specialised means of vegetative reproduction is known in British plants.
- 1.2 In the UK this species is only known from one locality on Islay where it was first found in 1990. In Europe it is restricted to Britain and Ireland, with its main populations in western Ireland, where there are a number of localities in Galway, Mayo and Donegal. Elsewhere, Lindenberg's featherwort is a species of montane areas with high rainfall, and is predominantly a southern hemisphere species recorded from East Africa, Madagascar, Mexico, Costa Rica, Venezuela, Bolivia, Peru, Chile, Patagonia, Tierra del Fuego and the Falkland Islands.
- 1.3 Lindenberg's featherwort is provisionally classified as *Vulnerable* in both Great Britain and Europe. It is protected under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The single British locality has been known for such a short period that no data are available on trends in population size.
- 2.2 Oceanic heath has been much reduced in extent by unsympathetic management, particularly muirburn. Irish populations of Lindenberg's featherwort have apparently suffered considerably in recent years through a combination of burning and over-grazing of the associated heathland habitat.
- 2.3 The lack of specialised reproductive structures in this species may limit its dispersal.

3. Current action

- 3.1 The known site for Lindenberg's featherwort has no statutory designation and there is no specific management for the plant.
- 3.2 The site was surveyed in 1995 as part of the SNH Lower Plants Project, and the estate owners were informed of the whereabouts of, and legal protection given to, the plant.

4. Action plan objectives and targets

- 4.1** Maintain a population of Lindenberg's featherwort at its single UK locality, and increase its extent if appropriate and feasible.
- 4.2** Establish *ex situ* stocks of this species by 2005, using material from the Scottish population.

5. Proposed action with lead agencies

The main emphasis of this plan should be on protecting the population of Lindenberg's featherwort at the only known UK site. Sustainable management of oceanic heath (itself a scarce habitat) will be central to the long-term conservation of this species. Careful control of grazing and burning are likely to be of critical importance. In addition, the survival of Lindenberg's featherwort should be safeguarded by the establishment of *ex situ* cultures. Autecological studies to improve knowledge of the means of dispersal and establishment of Lindenberg's featherwort will inform conservation strategies for the species.

5.1 Policy and legislation

- 5.1.1** Seek to limit the use of muirburn as a management tool in areas of hepatic-rich oceanic heath and, where its use is agreed, ensure that muirburn guidelines are followed to the highest standards. (ACTION: SOAEFD, SNH)

5.2 Site safeguard and management

- 5.2.1** Consider notifying the single Scottish site for Lindenberg's featherwort as an SSSI provided this is consistent with selection guidelines and if it is necessary to ensure the long-term protection and appropriate management of the species. (ACTION: SNH)
- 5.2.2** Prepare a management plan for the species at its existing known site, and prevent damaging land-use changes, such as increased grazing levels or burning. (ACTION: SNH)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.4, establish an *ex situ* collection using material derived from the British population. (ACTION: SNH, RBG Kew).

5.4 Advisory

- 5.4.1** Continue to liaise with the managers of the known site over specific management for conservation, any potentially damaging actions; and enable access to specialist advice if needed. (ACTION: SNH)

5.5 Future research and monitoring

- 5.5.1** Undertake regular monitoring of Lindenberg's featherwort at the known site to assess changes in population size and habitat quality. (ACTION: SNH)
- 5.5.2** Consider surveying suitable heathland habitat on Islay and Jura and elsewhere in the west of Scotland to assess whether the species has a wider distribution in Britain. (ACTION: RBGE, SNH)
- 5.5.3** Encourage or commission research into the reproductive biology of Lindenberg's featherwort, and its genetic distinctiveness, and assess the significance of this for the future management of the species. (ACTION: SNH)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: SNH, RBG Kew).

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of Lindenberg's featherwort, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)
- 5.6.3** Use Lindenberg's featherwort as an example of a rare species associated with a scarce and fragile habitat, to publicise the conservation importance of upland oceanic heath in Britain. (ACTION: SNH)
- 5.6.4** Liaise with the statutory authorities in the Irish Republic to learn from population trends in the larger Irish populations in relation to the management of oceanic heath. (ACTION: JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan has links with that for *Herbertus borealis*. Even though these two species are widely separated in their distribution, they are both important components of the Atlantic hepatic mat communities. There are also close links with the habitat plan for upland heathland.

Greater copperwort (*Cephaloziella nicholsonii*)

Action Plan

1. Current status

- 1.1 Greater copperwort is a minute leafy liverwort which is generally found on copper-enriched substrates, including soil, walls, rocks and spoil, found around copper mines. It is ecologically similar to *C. massalongi* with which it frequently occurs, but seems able to tolerate rather drier conditions. Other associates include *Gymnocolea inflata*, *Pohlia annotina* and *Bryum bicolor*. Notable species recorded in association with greater copperwort at some localities include *C. integerrima*, *Ditrichum cornubicum* and *Pohlia andalusica*. Capsules are unknown in greater copperwort, but the species reproduces vegetatively by gemmae which are commonly formed on the leaves.
- 1.2 This species has not been recorded outside Britain. In Britain it is currently known from approximately 22 sites in Cornwall, and another two sites in Devon. Several of these sites were identified during recent surveys of old mine sites in south-west England, and it is thought that several more greater copperwort sites may remain undiscovered in this area. The best known population is in eastern Cornwall where it occurs along approximately 200 m of stream side. It was also previously recorded from one site in Gwynedd, but despite recent searches has not been seen here for over 60 years.
- 1.3 Greater copperwort is provisionally classified as *Vulnerable* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Encroachment of scrub and other vegetation, including shading by gorse and heather, may be a threat at some sites.
- 2.2 Spoil landscaping and redevelopment is a threat to extant sites.
- 2.3 This species is known to occur on the walls of old mine buildings. Restoration of these buildings could therefore be damaging to populations of greater copperwort.
- 2.4 Exploratory digging to relocate old mine shafts is a threat to populations at several sites. (This digging is generally carried out by local authorities who are anxious to replace unsafe timber cappings on old shafts.)

3. Current action

- 3.1 Two of the known greater copperwort sites in south-west England are within SSSIs.

- 3.2 English Nature commissioned surveys of old mine sites in west Cornwall during the winters of 1995 and 1996. A 1997 winter survey of mine sites in east Cornwall is also planned.
- 3.3 The Cornwall Wildlife Trust is compiling a register of rare bryophytes in west Cornwall.

4. Action plan objectives and targets

- 4.1 Maintain populations of greater copperwort at all extant sites, and increase their extent where appropriate and feasible.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

Surveys of mine sites in south-west England should be completed, and information on the current distribution and status of greater copperwort in Britain should be reviewed. Where necessary, action should be taken to ensure adequate protection for those sites with strong populations of this species. Management of greater copperwort sites should be implemented where necessary, and may include scrub control and ground disturbance. Because of its very localised distribution, an *ex situ* conservation programme should be established for this species. It is important to emphasise that action for greater copperwort will have benefits for other threatened bryophytes of old mine sites.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1 Consider notifying as SSSIs sites with viable populations of greater copperwort where this is consistent with selection guidelines, and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: EN)
- 5.2.2 Undertake clearance of gorse, heather and scrub where it threatens to shade out colonies of greater copperwort. (ACTION: EN)
- 5.2.3 Assess the need to undertake some ground disturbance on greater copperwort sites, to reduce competition from encroaching vegetation. (ACTION: EN)
- 5.2.4 Exploratory digging to relocate mine shafts should only be carried out where there are real safety concerns. Where such work is necessary, expert bryological advice should be sought so that damage to greater copperwort colonies is kept to a minimum. (ACTION: EN)

- 5.2.5** Ensure that any proposals for landscaping mine spoil heaps on which greater copperwort occurs, or for redeveloping mine buildings which have colonies of greater copperwort growing on the walls, are accompanied by a conservation plan for this species, written with the guidance of an expert bryologist. The plan should set out ways to ensure the conservation of viable populations of greater copperwort during and after the work. (ACTION: EN)

5.3 Species protection and management

- 5.3.1** Depending on the results of 5.5.5, establish an *ex situ* collection using material derived from populations in south-west England. (ACTION: EN).

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of greater copperwort, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Commission a survey for greater copperwort in Devon and Cornwall, concentrating on localities which have not been recently investigated. Particular care should be taken to ensure that all records are distinguished from *C. massalongi*, and that threats to all extant sites are assessed. The survey results should be used to refine the conservation action for this species recommended in other parts of this plan. (ACTION: EN)
- 5.5.2** Resurvey the site in Wales from which this species was formerly recorded. (ACTION: CCW)
- 5.5.3** Undertake regular monitoring of all extant populations. (ACTION: EN)
- 5.5.4** Commission research into the habitat requirements and population dynamics of this species in order to inform future conservation management. (ACTION: EN)
- 5.5.5** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew).

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of greater copperwort, including ecological information, to a national database. (ACTION: CCW, EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC)

- 5.6.3** Use greater copperwort as an example of a threatened bryophyte associated with metal-rich mine spoil in order to publicise the important lower plant communities of this habitat. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for Cornish path-moss (*Ditrichum cornubicum*), which grows in association with greater copperwort at one site.

There are also links with the action plan for *D. plumbicola*, which occurs on heavy metal-rich substrates associated with lead mine spoil.

Northern prongwort (*Herbertus borealis*)

Action Plan

1. Current status

- 1.1 This robust leafy liverwort, up to 20 cm tall, grows in extensive yellow-brown patches in exposed stony dwarf shrub heath overlying quartzite. Associated species include *Arctostaphylos uva-ursi*, *Calluna vulgaris*, *Juniperus communis* ssp *alpina* and *Pleurozia purpurea*. *Herbertus borealis* is dioecious and sporophytes are unknown.
- 1.2 The species is known in Britain from only a single site in the north-west Highlands of Scotland, where it is locally abundant between 250 and 650 m (with outliers down to 90 m). It was first described in 1970, although it was first collected from its Scottish locality in 1868. Elsewhere, northern prongwort has only been recorded from Stavanger in western Norway; Britain holds over 75% of the known world population. The plant is very conspicuous but may still be under-recorded.
- 1.3 Northern prongwort is provisionally classified as *Vulnerable* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in the Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 There is no evidence of recent decline in the UK, but as the total known Scottish population is restricted to a single locality, it is particularly vulnerable to catastrophic events (eg burning of dwarf shrub heath) or changes in land management (such as increased grazing pressure).
- 2.2 There is no record of any sexual or vegetative propagation in Scotland, and dispersal and spread are likely to be non-existent or very slow; any reduction in population size is therefore likely to be particularly serious.
- 2.3 The species is likely to be vulnerable to climate change.

3. Current action

- 3.1 The only colony has NNR and SSSI designations and is owned by SNH.
- 3.2 The species has been subject to detailed survey and is already well mapped. Monitoring was set up in September 1993 on behalf of SNH, in the form of six permanent quadrats.

4. Action plan objectives and targets

- 4.1. Maintain a population of this species at its single UK locality, and increase its extent if appropriate and feasible.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard the extant Scottish population.

5. Proposed action with lead agencies

The restricted occurrence of northern prongwort means that greatest attention in this plan is focussed on site safeguard and protection against damaging changes in land use or management. Research into the reproductive biology and habitat requirements of the species is also required in order to inform conservation management. Because of its global rarity, an *ex situ* conservation programme should be established in order to safeguard the extant Scottish population.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Ensure the requirements of the species are incorporated in the NNR Management Plan for its known extant site. (ACTION: SNH)

5.2.2 Prevent land management practices, such as muirburn and heavy grazing, which are likely to damage the habitat in which this species occurs. (ACTION: SNH)

5.3 Species management and protection

5.3.1 Depending on the results of 5.5.5, establish an *ex situ* collection using material derived from the British population of northern prongwort. (ACTION: SNH)

5.4 Advisory

5.4.1 None required.

5.5 Future research and monitoring

5.5.1 Initiate survey to search for any new outlying colonies. (ACTION: SNH)

5.5.2 Continue regular monitoring of permanent quadrats, and initiate more detailed monitoring if appropriate. (ACTION: SNH)

5.5.3 Encourage or commission research to investigate the ecological requirements and reproductive potential of the species. (ACTION: SNH)

5.5.4 Monitor grazing (red deer) pressure within the NNR and assess their possible effects on the liverwort. (ACTION: SNH)

5.5.5 Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: SNH, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of northern prongwort, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)
- 5.6.3** Use northern prongwort as an example of a very rare relict species which occurs in a fragile and vulnerable oceanic-montane habitat. (ACTION: SNH)

5.7 Links with other action plans

- 5.7.1** This action plan has links with that for *Adelanthus lindenbergianus*. Even though the species are widely separated in their distribution, they are both important components of the Atlantic hepatic mat communities.

Veilwort (*Pallavicinia lyellii*)

Action Plan

1. Current status

- 1.1 Veilwort is a thalloid liverwort which grows mainly on bare, acid, peaty soils in lowland bogs and damp woodland. It is often associated with tussocks of *Molinia* and *Juncus* in the marginal areas of raised bogs. Other typical habitats include the bases of trees in carr woodland, peaty or sandy banks of ditches and streams, and moist shaded sandstone rocks. Capsules are rarely produced and at some sites only one sex is present. Frequent associates include *Calypogeia* spp, *Conocephalum conicum*, *Kurzia* spp, *Pellia epiphylla* and *Tetraphis pellucida*. Recent research has indicated that the persistence of veilwort at one site alongside the faster-growing *Pellia epiphylla*, may be due to the colonisation of fresh surfaces by spores. Observations in Kent and Sussex suggest that this species is able to colonise available surfaces relatively rapidly.
- 1.2 This species has been recorded from 17 British sites since 1950 mainly in southern England and west Wales. During the last 200 years it has been recorded from 26 sites in Somerset, Hampshire, Isle of Wight, East and West Sussex, Surrey, Greater London, Berkshire, Essex, Suffolk, Ceredigion, Gwynedd, Greater Manchester, North Yorkshire and Cumbria. It has declined significantly in the northern part of its range and is now thought to be extinct in Cumbria, North Yorkshire, Greater Manchester as well as in West Sussex. This species is known from approximately seven sites in the Irish Republic. It is widespread in Europe and occurs in all of the major continents apart from Antarctica; its scarcity in Britain is difficult to explain.
- 1.3 Veilwort is provisionally classified as *Vulnerable* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is also classified as *Vulnerable* in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 Land drainage may have been responsible for the loss of many populations of this species.
- 2.2 Over-shading due to scrub encroachment may be a threat to some populations, although at other localities veilwort persists under heavily shaded conditions. Excessive exposure is also a potential threat.
- 2.3 Climbing and associated activities at some sandrock localities in southern England may have caused damage to veilwort colonies.

3. Current action

- 3.1 Five of the recent British sites for this species are within SSSIs, two of which are owned by the Forestry Commission and another is within an NNR.

4. Action plan objectives and targets

- 4.1** Maintain populations of veilwort at all extant sites, and increase their extent where appropriate and feasible.
- 4.2** If feasible, re-establish populations of veilwort from a possible soil spore-bank at three suitable historic sites by 2005.
- 4.3** Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

A review of the current status and distribution of this species is needed, including thorough survey work. It is likely that the creation of suitable bare substrates will facilitate population growth, and site managers should consider this possibility. Experimental management work should also be undertaken with the aim of regenerating veilwort from a possible soil spore-bank. In view of its surprisingly restricted distribution in the UK, research into the habitat requirements and reproductive biology of the species is also considered to be a high priority. An *ex situ* conservation programme should be instigated to safeguard against chance extinctions, to enable studies of autecology, and to provide material for possible recovery attempts.

5.1 Policy and legislation

- 5.1.1** None proposed.

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of veilwort where this is consistent with selection guidelines and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EN)
- 5.2.2** Ensure that the habitat quality of extant sites is not adversely affected by land drainage activities. (ACTION: CCW, EA, EN, FE, IDBs)
- 5.2.3** Assess the need to control scrub where it threatens to overshadow extant colonies of veilwort, exercising caution so that the colonies are not over-exposed to the equally damaging effects of direct sunlight. (ACTION: CCW, EN, FE)
- 5.2.4** Following the research outlined under 5.5.3, consider undertaking clearance of vegetation at appropriate localities in order to create bare surfaces for veilwort to colonise. (ACTION: CCW, EN, FE)

5.3 Species protection and management

- 5.3.1** Undertake experimental management with the aim of re-establishing populations of veilwort from a possible soil spore-bank at suitable historic sites. Trial management should be carried out on three sites and extended to more localities if successful. Suitable sites will include those where a long-term management plan is in place. (ACTION: CCW, EN)
- 5.3.2** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: CCW, EN, RBG Kew)
- 5.3.3** Consider the feasibility and desirability of undertaking reintroductions of this species on suitable habitat in the vicinity of extant sites, particularly if 5.3.1 is unsuccessful. (ACTION: CCW, EN)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of veilwort, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN)

5.5 Future research and monitoring

- 5.5.1** Compile information and resurvey sites where necessary in order to update information on the current distribution and status of veilwort in Britain. The opportunity should also be taken to assess current threats to this species at each site. (ACTION: CCW, EN)
- 5.5.2** Undertake regular monitoring at all extant sites in order to assess changes in population size and habitat quality. (ACTION: CCW, EN)
- 5.5.3** Encourage or commission research into the reproductive ecology and habitat requirements of this species. The findings should be used to inform conservation management for this species including the work proposed under 5.2.3 and 5.2.4. (ACTION: EN)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: CCW, EN, RBG Kew).

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of veilwort, including ecological information, to a national database. (ACTION: CCW, EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with those for raised bogs and wet woodlands.

Violet crystalwort (*Riccia huebeneriana*)

Action Plan

1. Current status

- 1.1** Violet crystalwort is a small thalloid liverwort which is essentially a colonist, growing on nutrient-poor mud at the edge of large ponds, lakes, reservoirs and rivers. It appears to favour locations that are exposed following dry summers, but are under water during the winter. Abundant capsules are produced in late summer and autumn, and the spores are presumably capable of lying dormant in the mud for several years until the right conditions for growth return. Its appearance depends largely on environmental conditions. In drought years there can be very large populations, but at other times the species often lies dormant below water; substrate disturbance, such as by cattle trampling, may also be an important factor. Violet crystalwort is similar in its ecology to the closely related *R. cavernosa* but, unlike that species, it is distinctly calcifuge. Associated species include: *Fossombronia wondraczekii*, *Riccia glauca*, *Leptobryum pyriforme*, *Physcomitrella patens* and *Pseudephemerum nitidum*.
- 1.2** In Britain, this species has been recorded from over 20 widely scattered sites in Cornwall, Dorset, East and West Sussex, Surrey, Powys, Ceredigion, Anglesey, Cheshire, North Yorkshire and Argyll & Bute. It has not been recorded at many of these localities since 1970, but this may not reflect its true status because of its erratic population fluctuations. Elsewhere, this species is known from one site in the Irish Republic and is widespread throughout most of Europe from southern Scandinavia southwards, but it is not known from the eastern Mediterranean. There is some uncertainty about its world distribution because of confusion with other species.
- 1.3** Violet crystalwort is provisionally classified as *Vulnerable* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in Europe as a whole.

2. Current factors causing loss or decline

- 2.1** Stabilisation of water levels (for recreational/ amenity purposes) leading to a loss of seasonal fluctuations which are a requirement of this species.
- 2.2** Nitrate and phosphate pollution may be a threat to this species, but this requires confirmation by further research.

3. Current action

- 3.1** Several of the sites for this species are designated as SSSIs.

4. Action plan objectives and targets

- 4.1** Maintain populations of violet crystalwort at all extant sites, and increase their extent where appropriate and feasible.
- 4.2** Re-establish populations of this species, if feasible, from a possible soil spore-bank at three suitable historic sites by 2005.
- 4.3** Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

Following data gathering and further survey work to improve understanding of the current distribution and status of this species, conservation action should focus on maintaining suitable habitat conditions at extant sites. Particular attention should be paid to maintaining natural water levels and water-level fluctuations (except in the case of reservoir localities), and addressing the potential threat from pollution. The possibility of establishing new populations by transplantation and regeneration from a possible soil spore-bank or by transplantation should be assessed. An *ex situ* conservation programme should be instigated to safeguard against chance extinctions, to enable studies of ecology, and to enable any recovery attempts.

5.1 Policy and legislation

- 5.1.1** None proposed.

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of violet crystalwort where this is consistent with selection guidelines and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EN)
- 5.2.2** Where appropriate, ensure that natural seasonal fluctuations in water levels are maintained at extant violet crystalwort sites, and that any attempts to stabilise water levels artificially for fishing (or other purposes) are prevented. (ACTION: CCW, EN)
- 5.2.3** Assess the risk to each extant violet crystalwort site posed by run-off of agricultural chemicals including nitrate and phosphate fertilisers. Where this is identified to be a risk, seek to target, when next reviewed, agri-environment schemes and other protection measures to land surrounding violet crystalwort colonies, in order to reduce the pollution of its habitat by agricultural run-off. (ACTION: CCW, EN, MAFF, WOAD)
- 5.2.4** Ensure that the habitat quality of extant sites is not adversely affected by land drainage activities. (ACTION: CCW, EA, EN, IDBs)
- 5.2.5** Where necessary, seek to maintain grazing regimes that provide appropriate open muddy water-side habitats for violet crystalwort. (ACTION: CCW, EN, MAFF, WOAD)

5.3 Species protection and management

- 5.3.1** Assess the possibility of regenerating populations of violet crystalwort from a possible spore-bank at suitable historic sites. If appropriate, undertake experimental management at three sites and extend to more localities if trials are successful. Suitable sites will be those where a long-term management commitment is possible. (ACTION: CCW, EN)
- 5.3.2** Depending on the results of 5.5.5, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: CCW, EN, RBG Kew)
- 5.3.3** If the action outlined under 5.3.1 proves unsuccessful, consider the feasibility and desirability of undertaking translocations of violet crystalwort to suitable habitat in the vicinity of extant colonies. (ACTION: CCW, EN)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of violet crystalwort, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN)

5.5 Future research and monitoring

- 5.5.1** Compile information, and resurvey sites where necessary, in order to determine the current distribution and status of this species in Britain. Survey work should include visits to all post-1960 sites which have not been recently revisited. (ACTION: CCW, EN, SNH)
- 5.5.2** Undertake regular monitoring at all extant sites in order to identify changes in populations of violet crystalwort and changes in the quality of its habitat. The monitoring programme should allow for surveys to be carried out during very dry periods when this species often flourishes. (ACTION: CCW, EN)
- 5.5.3** Commission a research project to investigate the effects of nitrate and phosphate pollution on the performance of violet crystalwort. (ACTION: CCW, EN)
- 5.5.4** Promote research to investigate the importance of substrate disturbance for violet crystalwort. (ACTION: CCW, EN)
- 5.5.5** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: CCW, EN, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of violet crystalwort, including ecological information, to a national database. (ACTION: CCW, EN, JNCC)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC)

5.7 Links with other action plans

5.7.1 None proposed.

Mosses



Triangular pygmy-moss (*Acaulon triquetrum*)

Action Plan

1. Current status

- 1.1 Triangular pygmy-moss is a minute moss growing up to 1.5 mm tall either as thinly scattered individuals or in denser patches. It is an ephemeral species which is generally found on south-facing slopes on coastal cliffs and banks where it grows on dry (but seasonally wet), usually calcareous ground kept open by soil slippage. It has also been found on open, disturbed trackways and on turf-cutting scars. It is a winter annual, producing capsules in winter and early spring.
- 1.2 Triangular pygmy-moss is at the northern edge of its range in Britain and is confined here to the south coast of England, from Devon to East Sussex. It has always been rare, but has declined further and has only been seen recently at one site in East Sussex and two sites in Dorset. However, suitable habitat still remains in the Isle of Wight where this species was recorded in the past. It is widely distributed throughout continental Europe, particularly in the Mediterranean region. Elsewhere, it has also been recorded from Asia, north Africa, Macaronesia, central and eastern North America and Australia.
- 1.3 In Great Britain this species is provisionally classified as *Endangered* and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is not threatened in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 Factors responsible for the decline of this species may include tourist and other building developments. However, suitable habitat remains at some of the sites where it has not been seen recently.
- 2.2 Current threats to these former sites and the extant Sussex site include loss of short turf and open ground through competition from other vegetation.
- 2.3 Development may still be a threat to the remaining East Sussex site.

3. Current action

- 3.1 Both confirmed post-1970 sites for this species are within SSSIs.

4. Action plan objectives and targets

- 4.1 Maintain the range of this species in Britain and enhance its total population size.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

- 4.3** Re-establish this species at its former sites in Dorset and the Isle of Wight by 2005 (if further surveys fail to find the species at these sites).

5. Proposed action with lead agencies

A review of information on the current status and distribution of triangular pygmy-moss in Britain should be completed by 2002. Sites where this species has been recorded in the past (eg Dorset and the Isle of Wight) still have extensive areas of suitable habitat. It is likely that it still grows in these areas, and a thorough survey of all such sites is therefore a high priority. Extant sites should be visited regularly and management such as ground disturbance, preferably by grazing, or scrub clearance undertaken if necessary. An *ex situ* conservation programme should be instigated to safeguard against chance extinctions in the wild.

5.1 Policy and legislation

- 5.1.1** None proposed.

5.2 Site safeguard management

- 5.2.1** Prevent scrub encroachment and the development of rank grassland on the extant triangular pygmy-moss site and any re-discovered sites. Periodic ground disturbance to maintain open soils by the reinstatement of grazing should also be considered in the light of information gathered from the monitoring outlined under 5.5.1 and 5.5.2. (ACTION: EN)
- 5.2.2** Assess the impact of dog-fouling on the vegetation at the extant triangular pygmy-moss site and any re-discovered sites. If necessary, devise and implement measures to address this problem. (ACTION: EN)
- 5.2.3** Ensure that the requirements of this species are taken into account in the management of the SSSI on which this species occurs. (ACTION: EN)

5.3 Species management and protection

- 5.3.1** If the surveys outlined under 5.5.1 fail to find triangular pygmy-moss at its former sites in Dorset and the Isle of Wight, re-establish this species at these sites using propagated material originating from the Sussex site. (ACTION: EN)
- 5.3.2** Depending on the results of 5.5.3, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of triangular pygmy-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Undertake thorough surveys of sites where this species has been recorded in the past. This should include the extant Sussex site, and sites in Dorset, Sussex and the Isle of Wight where the plant has not been seen recently, but where good habitat remains. An assessment of threats to each extant colony should also be made and used to inform the action proposed under 5.2 (ACTION: EN)
- 5.5.2** Undertake regular monitoring of the extant triangular pygmy-moss site(s). The aim of this monitoring is to record not only changes in population but also changes in habitat with a view to implementing management, if necessary, to maintain bare, unshaded ground. (ACTION: EN)
- 5.5.3** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew)
- 5.5.4** Undertake research to investigate the length of time over which spores of this species remain viable. Use the results to refine conservation management of extant sites and, if appropriate, historic sites. (ACTION: EN)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of triangular pygmy-moss, including ecological information, to a national database. (ACTION: JNCC, EN)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for maritime cliff and slopes.

Icy rock-moss (*Andreaea frigida*)

Action Plan

1. Current status

- 1.1 Icy rock-moss was not recognised as a species in the UK until Murray's revision of the genus *Andreaea* in 1988. It is currently recorded from five hectads, four of them post-1950 and three post-1990. The largest and best known populations are in the Cairngorms where it occurs in at least eight localities, often in considerable abundance on irrigated rocks in areas of late snow-lie. It has only been seen recently in these Cairngorm localities, although there are two isolated, and somewhat anomalous, records from England: an 1854 record from Upper Teesdale and a more modern (1952) record from Scafell in the Lake District. There is no information on population status or ecology for these English records due to a lack of bryological survey. Icy rock-moss is a European endemic with scattered records from mountains in northern Norway to Portugal and as far east as Romania.
- 1.2 Icy rock-moss is provisionally classified as *Vulnerable* in Great Britain; it is listed as *Rare* in the 1995 Red Data Book of European Bryophytes. It receives general protection under the Wildlife and Countryside Act 1981. It is not threatened in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 As icy rock-moss has been recognised as a species only very recently, data on changes in population size, and the factors behind these, are lacking.
- 2.2 It seems likely that the greatest long-term threat to the Scottish populations of icy rock-moss is the effect of global warming on areas of late snow-lie.

3. Current action

- 3.1 All the Scottish localities are within the Cairngorms NNR and existing management objectives for snow-bed vegetation should benefit the populations of icy rock-moss.
- 3.2 There is no current management aimed specifically at populations of icy rock-moss.

4. Action plan objectives and targets

- 4.1 Maintain current population levels at all known and discovered sites.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

The priority for the species is to determine the extent and population status in the Cairngorms NNR, and to establish the status of the English records, if possible refinding the sites, determining population sizes and monitoring changes. The plan will be delivered through survey and monitoring of known populations of this species, appropriate management of its snow-bed habitat and an *ex situ* conservation programme to safeguard against chance extinctions in the wild.

5.1 Policy and legislation

- 5.1.1** Take account of the habitat requirements of icy rock-moss when considering changes in land use or development proposals. (ACTION: LAs, SNH)
- 5.1.2** Encourage policies designed to prevent global warming. (ACTION: DETR, SOAEFD)

5.2 Site safeguard and management

- 5.2.1** Encourage the integrated management of areas of late snow-lie and meltwater burns. (ACTION: SNH)
- 5.2.2** Ensure that the habitat requirements of icy rock-moss are taken into account in appropriate site management plans. (ACTION: SNH)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, SNH, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of icy rock-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN, SNH)

5.5 Future research and monitoring

- 5.5.1** Collate existing information on populations of icy rock-moss. (ACTION: EN, JNCC, SNH)
- 5.5.2** Resurvey all known sites. (ACTION: EN, RBGE, SNH)
- 5.5.3** Establish baseline monitoring at a subset of sites. (ACTION: EN, SNH)

5.5.4 Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew, SNH)

5.5.5 Investigate the status and the ecology of the species at its two English sites. (ACTION: EN)

5.6 Communications and publicity

5.6.1 Encourage bryologists to pass all records of icy rock-moss, including ecological information, to a national database (ACTION: EN, JNCC, SNH)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: EN, SNH)

5.7 Links with other action plans

5.7.1 The implementation of this plan is likely to benefit the lichen *Bellemera alpina*.

Rigid apple-moss (*Bartramia stricta*)

Action Plan

1. Current status

- 1.1 Rigid apple-moss is a distinctive, cushion- or tuft-forming moss which grows on thin, often disturbed soil on ledges and in crevices amongst rocks. It prefers sunny, sheltered situations on south-facing slopes. The remaining known population is on basaltic rocks, but there has also been a record from limestone and another from sandstone in Sussex. Colonies of this species appear to be relatively mobile within sites.
- 1.2 As far as is known, this species is confined to one site in Powys. It was previously known from another site, also in Powys, and possibly one in Perthshire (although this needs confirmation), but has not been seen at these sites since the 1960s. It was recorded at a site in East Sussex in the late 19th century, but has not been seen there since. Elsewhere, this species is widespread in the Mediterranean and south-west Europe and is also known from the Channel Islands, Germany, central Africa, Macaronesia, North America and Australia.
- 1.3 In Great Britain this species is provisionally classified as *Endangered* and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Quarrying was probably responsible for the loss of one of the Welsh sites, but is not a threat at the remaining site.
- 2.2 Rock climbing is a potential threat. Boots may dislodge individual specimens.
- 2.3 Cessation of grazing and subsequent growth of scrub and rank grassland may be a threat, and grazing animals on crags may dislodge individual specimens.
- 2.4 Collecting by botanists may have been a contributory factor to its disappearance at one of the Welsh sites, but is less of a threat today.

3. Current action

- 3.1 Monitoring of the only confirmed extant site is being carried out by CCW.
- 3.2 Both the Welsh sites where this species has been recorded are designated as SSSIs (the single extant population is also on an NNR), and the single known Scottish site where this species was possibly recorded is also an SSSI.
- 3.3 The old Powys site was intensively searched in the 1970s and 1990s, but without success.

3.4 The known Scottish site was searched in 1994 as part of the SNH Lower Plant Conservation Project, but the population was not re-located.

3.5 Grazing has been reinstated on part of the extant site.

4. Action plan objectives and targets

4.1 Maintain the single known extant population and, if appropriate and feasible, increase the extent of this population.

4.2 If appropriate and feasible, re-establish this species at one suitable former site by 2005.

4.3 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

A review of information on the current distribution and status of this species in Britain, and a detailed study its habitat and management requirements, should be undertaken by 2002. Following comprehensive surveys for rigid apple-moss, conservation action should focus on maintaining suitable habitat at the known extant site by controlling scrub and grazing levels. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild, and to enable studies on autecology.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Prevent scrub encroachment at the known extant site. Periodic ground disturbance to maintain open soils may also be considered in the light of information gathered from the monitoring outlined under 5.5.2, but should only be done with caution. (ACTION: CCW)

5.2.2 Ensure that appropriate levels of grazing are maintained at the extant site and assess the possibility of extending grazing to include other parts of the site. (ACTION: CCW)

5.3 Species management and protection

5.3.1 Assess the desirability of re-establishing this species at one of its former sites. If appropriate, and subject to successful *ex situ* techniques and the development and availability of material, undertake a translocation attempt using material derived from the single known extant population. (ACTION: CCW, RBG Kew)

5.3.2 Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: CCW, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of rigid apple-moss, specific management for its conservation, its legal protection, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW)
- 5.4.2** Inform all rock-climbing clubs that are active in the vicinity of the extant rigid apple-moss site, of places where it grows, and the need to avoid climbing in these areas. (ACTION: CCW)

5.5 Future research and monitoring

- 5.5.1** Identify and re-survey the possible site in Scotland and the old site in Powys - if it is safe to do so, as the latter site has been extensively quarried and parts are apparently dangerous. An assessment of current threats at each site should be made and used to inform action proposed under 5.2. (ACTION: CCW, SNH)
- 5.5.2** Undertake regular monitoring of this species at the extant site. The findings should be used to refine the action proposed under 5.2. (ACTION: CCW)
- 5.5.3** Re-check the original specimen (if it can be found) from the single known Scottish site, as its location here is something of an oddity. (ACTION: RBGE)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. Attempts should be made to grow rigid apple-moss material from spores held in herbarium packets from the now lost Powys locality with a view to re-establishing it in the wild. (ACTION: CCW, National Museum of Wales, RBG Kew)
- 5.5.5** Promote research into the ecology and population biology of rigid apple-moss. (ACTION: CCW)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of rigid apple-moss, including ecological information, to a national database. (ACTION: CCW, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, JNCC)

5.7 Links with other action plans

- 5.7.1** None proposed.

Appleyard's feather-moss (*Brachythecium appleyardiae*)

Action Plan

1. Current status

- 1.1 Appleyard's feather-moss is a moss which is known from approximately seven sites. Its typical habitat is calcareous rocks in shaded valleys, but on one site it grows in direct sunlight on a hard, acidic sandstone wall where the mortar may provide calcareous enrichment. Many of the colonies have been found on rock ledges that are too dry and dark for most other species.
- 1.2 This species was first found and described in 1967 in Somerset. It is endemic to England where it is restricted to one site in Somerset, one site in Wiltshire and approximately six sites in Derbyshire. It is locally widespread at the Wiltshire site and at the Somerset sites, and is abundant at at least one of the Derbyshire sites. New sites are still being discovered and historic changes in its population are not known.
- 1.3 In Great Britain Appleyard's feather-moss is provisionally classified as *Near Threatened*. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in Europe.

2. Current factors causing loss or decline

- 2.1 Uncontrolled growth of ivy, which may be a threat on at least one site.
- 2.2 Excessive shading of cliffs by secondary woodland and climbing vegetation.
- 2.3 Unsympathetic maintenance of a wall on which it grows.

3. Current action

- 3.1 Most of the known Appleyard's feather-moss sites are within SSSIs.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all extant sites, and increase the extent of these populations if appropriate and feasible.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

The distribution and status of Appleyard's feather-moss in Britain is poorly understood, and the action for this species should therefore initially concentrate on a review of available information and further survey work. This should be completed by 2002. It is also important

that threats to current sites are assessed and appropriate measures implemented to ensure their protection.

5.1 Policy and legislation

- 5.1.1** Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 if it meets relevant criteria, and if legal protection will address the causes of its decline. (ACTION: DETR, JNCC)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of Appleyard's feather-moss where this is consistent with selection guidelines, and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: EN)
- 5.2.2** Ensure that the needs of Appleyard's feather-moss are considered in management agreements on all SSSIs where this species occurs. (ACTION: EN)
- 5.2.3** Control the growth of ivy where it threatens to smother colonies of Appleyard's feather-moss. (ACTION: EN)

5.3 Species management and protection

- 5.3.1** Assess the desirability and feasibility of undertaking translocations of this species to suitable habitat in the vicinity of extant colonies, in order to increase the extent of small populations. If appropriate, undertake translocation attempts at two suitable sites. (ACTION: EN)
- 5.3.2** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from known populations. (ACTION: EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of Appleyard's feather-moss, specific management for its conservation, and any potentially damaging actions (particularly wall improvement and cleaning). Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future survey and monitoring

- 5.5.1** Compile information and resurvey sites where necessary, in order to update information on the current distribution and status of this species in Britain. Surveys should be extended to include suitable habitat in the vicinity of known extant sites. An assessment of threats to colonies of this species should also be made at each site and used to inform the action outlined under 5.2. (ACTION: EN)

5.5.2 Identify other potential habitats for this species in the carboniferous limestone regions of England. Compile, and distribute to active bryologists, a list of the areas which would be worth searching for Appleyard's feather-moss. (ACTION: EN, JNCC)

5.5.3 Undertake regular monitoring of all extant sites in order to maintain an understanding of the status of Appleyard's feather-moss and to identify new threats to individual sites at an early stage. The findings should be used to refine conservation action for this species. (ACTION: EN)

5.5.4 Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: EN, RBG Kew)

5.6 Communications and publicity

5.6.1 Encourage bryologists to pass all records of Appleyard's feather-moss, including ecological information, to a national database (ACTION: EN, JNCC)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

5.7.1 None proposed.

Scottish beard-moss (*Bryoerythrophyllum caledonicum*)

Action Plan

1. Current status

- 1.1 Scottish beard-moss has a very restricted habitat, growing on damp montane schist or basalt ledges which are regularly irrigated. It is endemic to Scotland.
- 1.2 Scottish beard-moss was not recognised as a distinct species in Scotland until 1982, the year when it was described as a new species. It had been collected only very occasionally from 1891 onwards under other names. In 1982 it was reported from three vice-counties and 10 ten km squares; since then it has been discovered in one new vice-county and two new hectads. The highest density and largest populations are in the Breadalbane mountains of mid Perth and Argyll, with outliers in Lochaber, Skye and Rum. The plant has been seen in all sites since 1978, and for several sites there are detailed recent (1996) population data.
- 1.3 In Great Britain the species is provisionally classified as *Low Risk (Near threatened)*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The apparent lack of specialised means of reproduction and dispersal could influence long-term survival.
- 2.2 The very specialised habitat requirements of the moss may mean that long-term climate change poses a threat.

3. Current action

- 3.1 All the known localities for this species are within existing SSSIs or NNRs, including Ben Lawers owned by the National Trust for Scotland
- 3.2 There is no specific management for the plant or its habitat.

4. Action plan objectives and targets

- 4.1 Maintain the populations at the existing sites at current levels.

5. Proposed actions with lead agencies

Work in this plan will focus on safeguarding, managing, and monitoring known populations, and surveying similar habitat elsewhere to determine the full extent of its distribution. Research into its ecology and dispersal is likely to be vital to future conservation effort.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Incorporate the requirements of this species in any development policies, plans and proposals that might affect its sites. (ACTION: LAs, SNH)

5.2.2 Ensure that targets for the species are included in appropriate site management plans. (ACTION: SNH)

5.2.3 Take account of the habitat requirements of Scottish beard-moss when considering the level of grazing on the sites. (ACTION: SNH)

5.3 Species management and protection

5.3.1 Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: RBG Kew, SNH)

5.4 Advisory

5.4.1 Advise landowners and managers, and relevant agencies, of the presence and importance of Scottish beard-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: SNH)

5.5 Future research and monitoring

5.5.1 Collate existing information on populations of Scottish beard-moss. (ACTION: JNCC, SNH)

5.5.2 Survey areas with a similar habitat in the same geographical area to locate further populations. (ACTION: SNH)

5.5.3 Establish baseline monitoring at a subset of sites. (ACTION: RBGE, SNH)

5.5.4 Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: RBG Kew, SNH)

5.5.5 Research into the means of vegetative dispersal and establishment of Scottish beard-moss. (ACTION: RBGE, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of Scottish beard-moss including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: SNH)

5.7 Links with other action plans

- 5.7.1** None proposed.

Dune threadmoss (*Bryum mamillatum*)

Action Plan

1. Current status

- 1.1 Dune threadmoss is a small moss which grows on moist, calcareous, sandy soils near the coast, particularly in dune slacks.
- 1.2 This species had not been seen in Britain since the 1960s until it was rediscovered in small quantities at one site on Ainsdale Sands in 1995. However, there is some doubt about this recent record, with the possibility that it may have been aberrant *B. warneum*. Indeed, there is a possibility that the distributions of dune threadmoss and *B. warneum* may be somewhat confused due to the difficulty of distinguishing between the two species. Dune threadmoss seems to have been lost from sites on the Norfolk, Humberside and Lincolnshire coasts, although more survey work is needed to confirm this. It is also rare in continental Europe where it is recorded from Italy and is scattered around the Baltic and North Sea coasts.
- 1.3 In Great Britain this species is provisionally classified as *Critically Endangered* and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 Falling water table levels are a persistent threat to dune-slack habitat on the Sefton Coast.
- 2.2 Dune stabilisation due to the lack of active dune accretion processes and the gradual infilling of hollows by sand and vegetation.
- 2.3 Holiday developments and the associated increases in recreational pressure have caused habitat deterioration, particularly at the Lincolnshire coast sites. Enrichment of vegetation by dog-fouling is a particular problem associated with such pressures. Dunes at the Lincolnshire sites have been squeezed into a narrow strip of coarse, nutrient-rich vegetation between the developments and the sea.
- 2.4 Invasion of *Hippophae rhamnoides* and *Salix repens* is a potential threat on the Sefton Coast site.

3. Current action

- 3.1 There have been several recent bryological surveys of the Sefton Coast. One of these led to the rediscovery of what is thought to be dune threadmoss in 1995.
- 3.2 The site of the recent dune threadmoss record on the Sefton Coast is within an SSSI and candidate SAC.

- 3.3 Dune slacks have been the focus of much conservation activity in recent years. Active restoration work including turf-cutting and scrub removal has been undertaken on the Sefton Coast.
- 3.4 A recent (1993) survey of the north Lincolnshire coast confirmed the unsuitability of habitat in most areas. However, suitable habitat could return in areas managed for nature conservation (eg scrapes for natterjack toads)

4. Action plan objectives and targets

- 4.1 Maintain a population of this species at its single known site and encourage colonisation of dune slacks in the vicinity of extant colonies.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

A review of available information and further surveys are needed in order to establish a clearer understanding of the distribution and status of this species in Britain. This should be completed by 2003 and include clarification of the confusion surrounding the distribution of this species and *B. warneum*. Ecological research and monitoring are also needed in order to inform habitat restoration initiatives. Meanwhile, action should focus on maintaining suitable habitat at extant sites and protecting sand-dune sites from damage from water abstraction, coastal protection, urban development and recreational pressure. Grazing management may be a key to the conservation of this species in the long-term. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild.

5.1 Policy and legislation

- 5.1.1 Ensure that the need to protect the geomorphology of dune systems harbouring dune threadmoss is recognised in relevant Shoreline Management Plans, and that the impact on threatened species is considered when assessing and/or proposing sea defence and coastal protection measures. (ACTION: DETR, EA, EN, LAs, MAFF)
- 5.1.2 Ensure that the needs of threatened dune-slack species such as dune threadmoss are considered when assessing applications for water abstraction which may contribute to a lowering of the water table of dune-slack sites. (ACTION: EA, EN)

5.2 Site safeguard and management

- 5.2.1 Ensure regular assessment of threats posed by visitors to important sand-dune sites, and implement measures (such as fencing and exclusion of dogs) where necessary to ensure that these threats are minimised. (ACTION: EN)
- 5.2.2 Following a period of monitoring (as outlined under 5.5.2) assess the feasibility of undertaking habitat creation/restoration for this species, including turf-stripping and scrape excavation. (ACTION: EN)

- 5.2.3** Control scrub on all extant dune threadmoss sites. (ACTION: EN)
- 5.2.4** Ensure that extreme caution is exercised when undertaking re-profiling of dune slacks for the creation of natterjack toad habitat in the vicinity of known dune threadmoss sites. (ACTION: EN)
- 5.2.5** Assess the desirability and feasibility of re-instating grazing at the extant dune threadmoss site and any rediscovered sites. (ACTION: EN)
- 5.3 Species management and protection**
- 5.3.1** Depending on the results of 5.5.5, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)
- 5.4 Advisory**
- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of dune threadmoss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)
- 5.5 Future research and monitoring**
- 5.5.1** Review records of dune threadmoss and *B. warneum* in order to remove possible confusion over the distribution of these species, and undertake thorough surveys of former dune threadmoss sites, concentrating on those sites where dune-slack restoration work has been carried out in recent years. A thorough survey of the Sefton Coast where this species may recently have been re-discovered should also be commissioned. (ACTION: EN)
- 5.5.2** Undertake regular monitoring of the single known dune threadmoss site and any rediscovered sites. Information should be collected on population size, ecological conditions and threats to each colony. On the Sefton Coast, a close watch should be kept on the invasion of *Hippophae rhamnoides* and *Salix repens*. The findings should be used to inform the action outlined under 5.2. (ACTION: EN)
- 5.5.3** Compile, and distribute to active bryologists, a list of dune systems worthy of searching (at the right time of year) for dune threadmoss. (ACTION: CCW, EHS, EN, SNH)
- 5.5.4** Compile information from published literature and commission new research if necessary to investigate the problems of falling water tables on sand dune systems including the Sefton Coast. (ACTION: EA, JNCC)
- 5.5.5** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: EN, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of dune threadmoss, including ecological information, to a national database (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: EN)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for coastal sand dunes and also those for *B. neodomense*, *B. warneum*, *Chara curta* and *Petalophyllum ralfsii*. Management works for the natterjack toad (5.2.4) need to take into account the conservation of this species.

Long-leaved threadmoss (*Bryum neodamense*)

Action Plan

1. Current status

- 1.1 Long-leaved threadmoss is a reddish-green moss forming tufts up to 10 cm tall. It is relatively distinct, non-critical and normally easy to identify compared with other *Bryum* species. It grows on wet calcareous soils in dune slacks, fens, swamps, ditches and margins of lakes. In the UK, most sites are in dune slacks and there is some evidence from populations of this species on the Sefton Coast that it readily colonises newly created slacks.
- 1.2 This species has always been rare in Britain, but is more common in Ireland. Its British records are widely scattered and it was previously known from Gwynedd, Merseyside, North Yorkshire, and Angus. It is now much less frequent in its former Merseyside stronghold where it is known at only four sites on the Sefton Coast. It is thought to be extinct in North Yorkshire, Angus and possibly at one of its two Caithness sites. It has also been recorded from two sites in Northern Ireland. The last record here was in 1937, but the absence of recent records may simply be because of the lack of survey since then.
- 1.3 Long-leaved threadmoss is provisionally classified as *Endangered* and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is listed as *Rare* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Falling water-table levels are a persistent threat to dune-slack habitat on the Sefton Coast and may be a threat at other sites.
- 2.2 Dune stabilisation due to the combination of a lack of active dune accretion and the gradual infilling of existing hollows by sand and their colonisation by vegetation. This is believed to have led to the loss of at least one former colony on the Sefton Coast.
- 2.3 Holiday developments and the associated increases in recreational pressure have caused habitat deterioration.
- 2.4 Invasion of sea buckthorn *Hippophae rhamnoides* (present as a non-native) and creeping willow *Salix repens* is a potential threat to the Sefton Coast sites. Scrub invasion may also have led to the loss of long-leaved threadmoss from its only known Welsh site.
- 2.5 The Caithness site may be at risk from eutrophication if numbers of wintering geese increase markedly.
- 2.6 Undergrazing may be/have been a problem at some sites.
- 2.7 Prolonged flooding may be a problem at the Caithness site.

3. Current action

- 3.1** Dune slacks have been the focus of much conservation activity in recent years. Active restoration work including turf-cutting and scrub removal has been undertaken on the Sefton Coast.
- 3.2** CCW commissioned a recent survey of the only known Welsh site which failed to re-find this species.
- 3.3** The Caithness site was surveyed in 1996, and the plant confirmed as being present, as part of the SNH Action Plans for Lower Plants project.
- 3.4** Three of the four extant long-leaved threadmoss sites on the Sefton Coast are within an NNR, and the other is within an SSSI; all are within the candidate SAC. The Gwynedd and Caithness sites are also within SSSIs, the Caithness site being part of a larger SPA.

4. Action plan objectives and targets

- 4.1** Maintain populations of this species at all extant sites and encourage colonisation of dune slacks in the vicinity of extant colonies.
- 4.2** Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.
- 4.3** Re-establish populations of this species, if appropriate and feasible, at two suitable historic sites by 2005.

5. Proposed action with lead agencies

A review of information should be undertaken by 2003 in order to establish a clearer understanding of the distribution and status of this species in the UK. Conservation action should focus both on tackling general threats to this species (such as pressures associated with recreational and urban developments), and implementing site-specific management measures (such as habitat creation, falling water tables and restoration work) where necessary. The success of this action plan will, in the long term, depend on maintaining/establishing natural dynamic processes over a wide area at long-leaved threadmoss sites. Grazing management may be an important tool in this respect. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild, and to enable studies on autecology.

5.1 Policy and legislation

- 5.1.1** Ensure that the need to protect the geomorphology of dune systems harbouring long-leaved threadmoss is recognised in relevant Shoreline Management Plans, and that the impact on threatened species is considered when assessing and/or proposing sea defence and coastal protection measures. (ACTION: DETR, EA, EN, LAs, MAFF)

- 5.1.2** Ensure that the needs of this species are considered when assessing applications for water abstraction which may contribute to a lowering of the water table in dune-slack habitat. (ACTION: EA, EN)

5.2 Site safeguard and management

- 5.2.1** Ensure that damp patches of bare sand are available for colonisation in close proximity to extant long-leaved threadmoss colonies. This may require management intervention in order to prevent complete closure of the sward. (ACTION: EHS EN, SNH)
- 5.2.2** Ensure regular assessment of threats posed by visitors to important sand-dune sites. Control measures (such as fencing) should be established where necessary. However, care should be taken to ensure that control measures do not lead to further stabilisation of the dune vegetation. (ACTION: EHS, EN, SNH)
- 5.2.3** Following a period of monitoring (as outlined under 5.5.2) assess the possibility of undertaking habitat restoration work for long-leaved threadmoss at historic and extant sites. Work should include turf-stripping, scrub removal and scrape excavation. This action should include the only known long-leaved threadmoss site in Wales. (ACTION: CCW, EHS, EN, SNH)
- 5.2.4** Ensure that extreme caution is exercised when undertaking re-profiling of dune slack for the creation of natterjack toad habitat in the vicinity of known long-leaved threadmoss sites. (ACTION: EN, SNH)
- 5.2.5** Maintain grazing at those sites where it takes place, and assess the desirability and feasibility of extending to other extant sites. (ACTION: EHS, EN, SNH)
- 5.2.6** Ensure that further dehydration of sites (eg through afforestation) does not occur. (ACTION, CCW, EN, FE, SNH)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.5, establish *ex situ* stocks of this species from material derived from UK populations. (ACTION: EN, RBG Kew, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of long-leaved threadmoss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN, SNH)

5.5 Future research and monitoring

- 5.5.1** Compile information and resurvey sites where necessary in order to update information on the current distribution and status of this species in the UK. A detailed assessment of threats to each colony should be made and the findings used to inform the action proposed under 5.2. (ACTION: CCW, EHS, EN, SNH)
- 5.5.2** Compile, and distribute to active bryologists, a list of dune systems and other suitable habitats worthy of searching for long-leaved threadmoss. (ACTION: CCW, EHS, EN, JNCC, SNH)
- 5.5.3** Monitor all extant sites with the aim of maintaining an understanding of the threats to each colony. (ACTION: EHS, EN, SNH)
- 5.5.4** Compile information from published literature, and commission new research if necessary, to investigate the problems of falling water tables on sand-dune systems where this species occurs, including the Sefton Coast. (ACTION: EA, JNCC)
- 5.5.5** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew, SNH)
- 5.5.6** Promote research into the ecology and population biology of this species. (ACTION CCW, EN, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of long-leaved threadmoss, including ecological information, to a national database (ACTION: CCW, EN, EHS, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: CCW, EHS, EN, JNCC, SNH)
- 5.6.3** Establish links with European bryologists in order to encourage survey for long-leaved threadmoss on the continent. Improved understanding of the European populations of this species will allow the importance of the British populations to be reassessed. (ACTION: JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for coastal sand dunes and also those for *B. mamillatum*, *B. warneum*, *Bufo calamita*, *Chara curta*, *Gentianella uliginosa*, *Liparis loeselii*, and *Petalophyllum ralfsii*. Management works for the natterjack toad (5.2.4), in particular, need to take into account the conservation of this species.

Sea bryum (*Bryum warneum*)

Action plan

1. Current status

- 1.1 Sea bryum is a species of dune slacks, wet sandy ground at the edges of saltmarshes and occasionally old gravel pits. In Britain it is essentially a dune-slack species.
- 1.2 This species was once widely distributed around the coast of Britain. It has been recorded from approximately 35 sites on the coasts of Devon, Somerset, Glamorgan, Ceredigion (Cardiganshire), Gwynedd, Anglesey, Cheshire, Merseyside, Lancashire, Cumbria, Kyle and Carrick, Lincolnshire, Humberside, Cleveland, East Lothian, Fife, Angus, Moray and Ross. It has not been seen at over half of these sites since 1950; post-1970 records exist only for Tayside, Lothian, Sefton Coast, Gwynedd and Kent. There is also an inland record from Greater Manchester, but the plant has not been found there for over a century. There is a possibility that the distribution of sea bryum may be somewhat confused with *B. mamillatum* as it is difficult to distinguish between the two species. Sea bryum has a widespread, but mainly coastal, distribution in northern and central Europe, but becomes rare in the south. It was once known in Ireland. It is also recorded from Asia and southern Africa.
- 1.3 In Great Britain this species is provisionally classified as *Vulnerable*. It receives general protection under the Wildlife and Countryside Act 1981. It is also classified as *Vulnerable* in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 Dune stabilisation and associated infilling of dune slacks in which this species grows. In some cases, dune stabilisation has been increased by coastal protection works.
- 2.2 Holiday developments and the associated increase in recreational pressures, for example golf course construction.
- 2.3 Falling water-table levels are a persistent threat to many of the dune-slack sites for this species.
- 2.4 Invasion of scrub, particularly associated with a decline in rabbit populations, is a potential threat at all dune sites.
- 2.5 Development of coarse vegetation following enrichment from dog-fouling is a significant threat at some sites.

3. Current action

- 3.1 The extant sea bryum sites on the Sefton Coast are within SSSIs and the candidate SAC. Most of the Welsh localities are SSSIs and some are NNRs.

3.2 Dune slacks have been the focus of much conservation activity in recent years. Active restoration work including turf-cutting and scrub removal has been undertaken on the Sefton Coast.

3.3 SNH has recently commissioned a survey of the Wester Ross site.

4. Action plan objectives and targets

4.1 Maintain populations of this species at all extant sites and encourage colonisation of dune slacks in the vicinity of extant colonies.

4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

A review of information on the current distribution and status of sea bryum in Britain should be completed by 2003. It should include an assessment of the possible confusion between records of sea bryum and *Bryum mamillatum*. In the short term, action for this species may focus on survey, monitoring and habitat restoration/creation such as turf-stripping, scrub removal and scrape excavation. However, in the long term, the success of conservation action will depend upon implementation of measures to reinstate natural dynamic processes over a wide area of the dune system sites. Grazing management should therefore be maintained/introduced where appropriate, and this action plan should be implemented in parallel with the habitat action plan for coastal sand dunes. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild.

5.1 Policy and legislation

5.1.1 Ensure that the need to protect the geomorphology of dune systems harbouring sea bryum is recognised in relevant Shoreline Management Plans, and that the impact on threatened species is considered when assessing and/or proposing sea defence and coastal protection measures. (ACTION: DETR, EA, EN, LAs, MAFF)

5.1.2 Ensure that the needs of threatened dune slack species such as sea bryum are considered when assessing applications for water abstraction, or other developments, or land uses which may contribute to a lowering of the water table in dune-slack habitat. (ACTION: CCW, EA, EN, LAs, SNH)

5.2 Site management and protection

5.2.1 Ensure regular assessment of threats posed by visitors to important sand-dune sites, and implement measures (such as fencing) where necessary to ensure that these threats are minimised. (ACTION: CCW, EN, SNH)

5.2.2 Following a period of monitoring (as outlined under 5.5.2) assess the need to undertake habitat creation/restoration including turf-stripping, scrub removal and scrape excavation, and implement if necessary. (ACTION: CCW, EN, SNH)

- 5.2.3 Consider notifying as SSSIs sites with viable populations of sea bryum where this is consistent with selection guidelines and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: CCW, EN, SNH)
- 5.2.4 Ensure that extreme caution is exercised when undertaking re-profiling of dune slacks for the creation of natterjack toad habitat in the vicinity of known sea bryum sites. (ACTION: CCW, EN, SNH)
- 5.2.5 Ensure that further dehydration of sites (eg through afforestation) does not occur. (ACTION: CCW, EN, FE, SNH)
- 5.3 **Species management and protection**
- 5.3.1 Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, CCW, RBG Kew, SNH)
- 5.4 **Advisory**
- 5.4.1 Advise landowners and managers, and relevant agencies, of the presence and importance of sea bryum, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN, SNH)
- 5.5 **Future research and monitoring**
- 5.5.1 Compile information and resurvey sites where necessary, in order to establish an understanding of the current distribution and status of sea bryum in the UK. Surveys should also focus on sites in the vicinity of old records where dune slack restoration has taken place, so as to discover whether this species has recolonised. An assessment of threats to each extant colony should also be made. (ACTION: CCW, EHS, EN, SNH)
- 5.5.2 Compile a list of dune systems which would be worth searching for sea bryum and distribute to active bryologists, encouraging surveys of these areas. (ACTION: CCW, EHS, EN, SNH)
- 5.5.3 Undertake regular monitoring of all extant sea bryum sites and any rediscovered sites. The findings should be used to inform the action outlined under 5.2.1. (ACTION: CCW, EN, SNH)
- 5.5.4 Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: CCW, EN, RBG Kew, SNH)
- 5.5.5 Compile information from published literature, and commission new research if necessary, to investigate the problems of falling water tables on sand dune systems including the Sefton Coast. A report should be produced identifying measures which are needed to ensure that water levels are maintained at optimal levels for the conservation of sea bryum and other dune species. The findings of the study should also be used to refine the action outlined under 5.1.2. (ACTION: EA, EN)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of sea bryum, including ecological information, to a national database (ACTION: CCW, EN, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for coastal sand dunes and also those for *B. neodamense*, *B. mamillatum*, *Bufo calamita*, *Chara curta*, *Gentianella uliginosa*, *Liparis loeselii* and *Petalophyllum ralfsii*. Management works for the natterjack toad (5.2.4), in particular, need to take into account the conservation of this species.

Multi-fruited river moss (*Cryphaea lamyana*)

Action Plan

1. Current action

- 1.1 Multi-fruited river moss is a robust moss growing on exposed roots of trees, particularly sycamore and ash in the flood zone of river banks. It is also occasionally found on low-hanging horizontal branches, river-bank rocks and bridge stonework. It is typically found growing on near-vertical surfaces and appears to avoid heavily shaded situations, possibly because of increased competition from species such as *Thamnobryum alopecurum*. Occasional scouring by flood water may help in reducing competition from other species, and help regeneration and dispersal.
- 1.2 Multi-fruited river moss has been recorded in several parts of Europe, including France, Switzerland, Spain, Italy and Portugal. It also occurs in Africa. In Britain it is confined to south-west England and south-west Wales. Its principal stronghold is the Afon Teifi in Wales, where it is dotted along an 80 km stretch of the lower part of the river. It has also been recorded in Devon and Cornwall, where there are several records for the middle and upper reaches of the River Tamar. It last seen on the River Tamar in 1992, and there are more recent records on the rivers Bovey, Taw and Dart. However, searches in Devon and Cornwall in 1996 failed to refind the species. Historical changes in the population of this species are poorly understood
- 1.3 In Great Britain this species is provisionally classified as *Vulnerable* and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 River-bank engineering work including channel straightening/re-profiling, removal of river bank trees and boulders.
- 2.2 Water pollution.
- 2.3 River dredging (where dredgings are dumped on or dragged across colonies of this species).
- 2.4 Excessive shading from overhanging trees.

3. Current action

- 3.1 A thorough survey of the Afon Teifi was carried out by CCW in 1992. Subsequent inspections of sites on the Teifi suggest that populations here are stable.
- 3.2 The Environment Agency and Ceredigion DC are aware of the presence of this species on the lower Afon Teifi and both bodies are willing to manage projects sympathetically.
- 3.3 The Afon Teifi was notified as an SSSI in 1997 and is proposed as a SAC.

4. Action plan objectives and targets

- 4.1** Maintain the range of this species in Britain, and increase the extent of populations where appropriate and feasible.
- 4.2** Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

A review of information on the current distribution and status of this species in Britain should be completed by 2003. It is probable that multi-fruited river moss occurs at other sites in south-west England and south-west Wales which are as yet undiscovered. Thorough surveys of suitable rivers in these areas should therefore be conducted. River-bank engineering and river dredging works should also be carefully controlled in sensitive areas so as not to damage extant colonies, particularly by the removal of host trees. Water quality should be maintained at a high standard. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild, and enable any recovery attempts.

5.1 Policy and legislation

- 5.1.1** Ensure that the requirements of this species are considered when developing Water Catchment Management Plans/Local Environment Agency Plans (LEAPs) for rivers where this species occurs. (ACTION: EA, IDBs, LAs, MAFF)

5.2 Site safeguard and management

- 5.2.1** Where possible, to help maintain habitat and water quality at multi-fruited river moss sites, target agri-environment schemes, including the Countryside Stewardship Scheme, the Water Fringe Option of the Habitats Scheme, and the new Tir Gofal Scheme in Wales to land adjacent to rivers where this species occurs. (ACTION: CCW, EN, MAFF, WOAD)

5.3 Species management and protection

- 5.3.1** Assess the desirability and feasibility of establishing new colonies of multi-fruited river moss by translocation to areas of suitable habitat on rivers where this species occurs. (ACTION: CCW, EN).
- 5.3.2** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: CCW, EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise all relevant Environment Agency staff and agri-environment scheme project officers working in south-west England and Wales of the locations of this species, its importance, and measures needed to ensure its conservation. They should be told of the need to avoid felling host trees and dumping dredgings on colonies of this species. (ACTION: CCW, EA, EN, MAFF, WOAD)

- 5.4.2** Advise landowners and managers of the presence and importance of multi-fruited river moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN)

5.5 Future research and monitoring

- 5.5.1** Undertake thorough surveys of rivers in Devon, Cornwall and south-west Wales with suitable habitat for this species. These should include the rivers Taw, Bovey, Dart, Tamar and Gwaun. The aim should be to improve understanding of the current distribution and status of this species, and to identify threats to extant sites. (ACTION: CCW, EN)
- 5.5.2** Compile a list of rivers that would be worth searching for multi-fruited river moss and distribute it to active bryologists in south-west England and Wales. (ACTION: CCW, EN)
- 5.5.3** Undertake regular monitoring of all extant sites to identify changes in population size and habitat quality with a view to initiating conservation management and site protection if necessary. (ACTION: CCW, EN)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: CCW, EN, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of multi-fruited river moss, including ecological information, to a national database (ACTION: CCW, EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** None proposed.

Flamingo moss (*Desmatodon cernuus*)

Action Plan

1. Current status

- 1.1 Flamingo moss is a small moss of highly calcareous soils, associated particularly with disused Magnesian limestone quarries. It is essentially a ruderal species which seems to prefer open conditions. It is typically found on open soils by paths, on banks or at the foot of spoil heaps, in situations that have some protection from desiccation. Frequent associates include *Funaria hygrometrica* and *Leptobryum pyriforme*.
- 1.2 The main stronghold of this species is on the Magnesian limestone outcrop in Nottinghamshire and South, West and North Yorkshire, where it has been reported from a total of 12 sites. It has also been recorded from outside the Magnesian limestone area: one site in South Yorkshire and another in Cheshire. Elsewhere, this species is widespread in northern and central Europe and has a scattered distribution across northern and central Asia, North America and Greenland. It seems to be rather scattered throughout its world range, and becomes more montane towards its southern outposts.
- 1.3 In Great Britain this species is provisionally classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 Lack of suitable habitat for colonisation, possibly as a result of the the cessation of quarrying in the vicinity of extant sites. This is likely to be the main threat to flamingo moss though factors affecting this species are poorly understood.
- 2.2 Encroachment of rank grassland and scrub.
- 2.3 Waste tipping, which is known to have destroyed part of one site.

3. Current action

- 3.1 None known.

4. Action plan objectives and targets

- 4.1 Maintain the range of this species in Britain and enhance its total population size.
- 4.2 Regenerate colonies of this species from a possible spore-bank at at least three suitable sites by 2010.

- 4.3 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.
- 4.4 If regeneration from spore banks fail, assess by 2010 the feasibility and desirability of undertaking translocations to suitable habitat at three sites.

5. Proposed action with lead agencies

A review of information on the current distribution and status of this species in Britain should be completed by 2003. Threats to flamingo moss are poorly understood, but are likely to be very different from one site to the next. It is therefore a high priority to undertake an assessment of threats to this species at each of its sites, so that appropriate conservation management and site protection measures can be established. Action at each site may include periodic ground disturbance, scrub control and ensuring that redevelopment proposals for sites on which flamingo moss grows do not conflict with conservation interests. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild.

5.1 Policy and legislation

- 5.1.1 Ensure that the needs of flamingo moss are considered when assessing planning applications for old quarry sites where this species occurs. Damaging developments may include re-landscaping of quarry spoil heaps and use of quarries as landfill sites. (ACTION: LAs)

5.2 Site safeguard and management

- 5.2.1 Following the action outlined under 5.5.1, assess the need to undertake scrub clearance and periodic ground disturbance at all known sites for this species and implement where necessary in order to maintain suitable habitat for colonisation. (ACTION: EN)
- 5.2.2 Ensure that any proposals that involve land-use changes of flamingo moss sites are accompanied by a conservation plan for this species written with the guidance of an expert bryologist. The plan should set-out measures which will ensure the conservation of flamingo moss *in situ*, during and after work at the site. (ACTION: EN)
- 5.2.3 Assess the need to control encroachment of rank grassland on sites with extant populations of this species. The desirability and feasibility of establishing a grazing regime at each site should be considered and implemented if appropriate. (ACTION: EN)

5.3 Species management and protection

- 5.3.1 Undertake attempts to regenerate colonies of this species from a possible spore bank in areas surrounding extant colonies. Suitable management will be similar to that outlined under 5.2.1. (ACTION: EN)
- 5.3.2 If the action outlined under 5.3.1 proves unsuccessful, assess desirability of undertaking experimental translocations of this species to suitable habitat in the vicinity of extant sites and, subject to the development of successful *ex situ* techniques and stocks (actions 5.5.4 and 5.3.3), undertake translocations to at least three sites. (ACTION: EN)

- 5.3.3** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of flamingo moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Resurvey all sites with post-1970 records of this species in order to update information on its current status. An assessment of current threats to all extant colonies should also be made and used to inform the action outlined under 5.2.1. (ACTION: EN)
- 5.5.2** Undertake regular monitoring of all extant sites for this species so as to maintain an understanding of the changes in its population, to improve understanding of its ecology and to ensure prompt identification of any need for habitat management. (ACTION: EN)
- 5.5.3** Compile, and distribute to active bryologists, a list of sites that would be worth searching for flamingo moss (in addition to those covered under 5.5.1). (ACTION: EN)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: EN, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of flamingo moss, including ecological information, to a national database (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: EN, JNCC)
- 5.6.3** Raise awareness amongst relevant local authorities, planning departments, quarrying authorities and landscaping companies of the importance of mine spoil bryophytes in order to reconcile reclamation schemes with the conservation of threatened species. (ACTION: EN)

5.7 Links with other action plans

- 5.7.1** None proposed.

Perthshire beard-moss (*Didymodon mamillosus*)

Action Plan

1. Current status

- 1.1 In the UK Perthshire beard-moss is only known from the locality in Perthshire where it was first found in 1967 and eventually described as a new species. No further records of this species were made until 1998 when a single tuft was discovered growing on a small limestone rock at an altitude of *c* 580 metres. It is a European endemic with four known localities outside Scotland, in Iceland, Germany, the Czech Republic, and north-east Spain.
- 1.2 Perthshire beard-moss is provisionally classified as *Data Deficient* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is rated as *Vulnerable* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 With the paucity of records, there are no data available on trends in the population and the factors affecting it.

3. Current action

- 3.1 There is no management specifically for Perthshire beard-moss.

4. Action plan objectives and targets

- 4.1 Maintain populations at the existing known site and any newly discovered sites.
- 4.2 Establish by 2005 *ex situ* stocks of the species to safeguard extant populations.

5. Proposed actions with lead agencies

With the apparent extreme rarity of this species, the primary task in this action plan is to ensure beneficial management at its single known locality, and to safeguard the population through *ex situ* cultivation. The *ex situ* work will also be necessary to enable studies on taxonomy and autecology.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1 Ensure that the single known site is appropriately managed for the requirements of this species. (ACTION: SNH)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from the British population. (ACTION: RBG Kew, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of Perthshire beard-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: SNH)

5.5 Future research and monitoring

- 5.5.1** Undertake regular monitoring of the known population in order to gain an understanding of the threats to this species. (ACTION: RBGE, SNH)
- 5.5.2** Investigate the ecology of Perthshire beard-moss and determine management requirements. (ACTION: SNH)
- 5.5.3** Survey areas with a similar habitat in the same geographical area to locate further populations. (ACTION: RBGE, SNH)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: SNH, RBG Kew)
- 5.5.5** Undertake further taxonomic study to verify the status of Perthshire beard-moss as a true species. (ACTION: RBGE)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of Perthshire beard-moss, including ecological information, to a national database (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)

5.7 Links to other action plans

- 5.7.1** None proposed.

Sausage beard-moss (*Didymodon tomaculosus* = *Barbula tomaculosa*)

Action Plan

1. Current status

- 1.1 This tiny moss grows as scattered stems amongst other bryophytes on bare, slightly acid to neutral, clayey soils. Most records are from arable fields, but it has also been recorded from trampled ground in pasture. Only female plants are known and capsules have never been found. However, tubers are produced abundantly on the rhizoids.
- 1.2 Sausage beard-moss is endemic to Britain and Ireland and has been recorded from six sites, in Derbyshire, North Yorkshire and West Yorkshire and from two sites in Ireland at Counties Offaly and Kildare. This species has only recently been described (1981), and although easily overlooked, does seem to be genuinely rare. Factors which may be a threat to its survival are still poorly understood.
- 1.3 In Great Britain this species is provisionally classified as *Near Threatened*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The recent switch to winter crop varieties and decline in the practice of leaving stubbles over winter may be significant.
- 2.2 Use of pesticides and fertilisers may also affect the survival of this species.

3. Current action

- 3.1 None known.

4. Action plan objectives and targets

- 4.1 Maintain the range of this species in Britain and enhance its total population size.

5. Proposed action with lead agencies

Conservation action for sausage beard-moss should focus on ensuring the sympathetic management of extant sites. However, the distribution and ecology of this species are still poorly understood and, therefore, it is also important that research into its ecological requirements, particularly habitat and methods of spread, is undertaken and further surveys encouraged.

5.1 Policy and legislation

- 5.1.1** Encourage the development of relevant agri-environment schemes, such as the pilot Arable Stewardship Scheme, as a potential means of conserving this species in the countryside. When reviewing such schemes, consider whether changes are needed to increase their potential benefits for this and other threatened arable species. (ACTION: EN, MAFF)

5.2 Site safeguard and management

- 5.2.1** Where possible, target relevant agri-environment schemes to known sites for sausage beard-moss. Suitable management will include the creation of headlands which are cropped and cultivated in spring (leaving stubbles over winter). No herbicides or fertilisers should be applied to the headlands. (ACTION: EN, MAFF)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.3, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of this species, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers (particularly of the Countryside Stewardship Scheme and pilot Arable Stewardship Scheme), and members of regional agri-environment consultation groups, are advised of locations of this species, its importance and measures needed for its conservation. (ACTION: EN, MAFF)

5.5 Future research and monitoring

- 5.5.1** Resurvey all sites with records of this species in order to determine its status at each and to assess current threats to any extant populations. (ACTION: EN)
- 5.5.2** Undertake a research project with the aim of improving the understanding of the ecology of this species with a view to refining management techniques for its conservation. The research should include an investigation of the length of time buried tubers remain viable. (ACTION: EN)
- 5.5.3** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of sausage beard-moss including ecological information, to a national database (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for cereal field margins.

Lead-moss (*Ditrichum plumbicola*)

Action Plan

1. Current status

- 1.1 Lead-moss grows as scattered individuals or in dense, yellowish-green patches up to 15 mm high. The stems are brittle and the main method of dispersal may be by fragmentation. It is a pioneer species and is restricted to sparsely vegetated, acid, peaty, silty or gravelly soils on old lead-mine spoil heaps where it typically occurs on rough knobbly surfaces, probably caused by frost heave. Lead-moss probably does not benefit directly from lead itself but, being a very small plant, it must benefit from reduced competition from species that are less tolerant of high soil concentrations of lead.
- 1.2 Lead-moss is endemic to Europe where it is found only in Germany and Britain. It has been recorded in North Wales and mid Wales, the Isle of Man, western Scotland, northern England and south-west England. The distribution of this species in North Wales was thoroughly investigated in 1982.
- 1.3 This species is provisionally classified as *Near Threatened* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Landscaping and afforestation of lead-mine spoil is the main threat to this species.
- 2.2 Encroachment by rank grassland and scrub.
- 2.3 Uncontrolled reworking of commercially valuable lead-mine spoil.
- 2.4 Fly tipping.
- 2.5 Works prompted by health and safety considerations.

3. Current action

- 3.1 A survey of mid Wales metal-mine sites was completed by CCW in 1994. Two other sites in North Wales have been recently surveyed.

4. Action plan objectives and targets

- 4.1 Maintain the range of this species in Britain and enhance its total population size.
- 4.2 If appropriate and feasible, establish viable populations of this species at two suitable former sites by 2005.

- 4.3 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

Further survey work, and a review of current information, is needed to establish a clearer understanding of the current status and distribution of lead-moss in Britain. This should be completed by 2003. Other action should focus both on ensuring that any development proposals for lead-mine spoil sites are sympathetic to the conservation of this species, and also on implementing appropriate management to ensure that suitable habitat is maintained at all sites. An *ex situ* conservation programme should be instigated to safeguard against chance extinctions, to enable recovery attempts, and to enable studies of autecology.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1 Ensure that the requirements of lead-moss are taken into account should proposals be put forward to change the use of its extant sites. (ACTION: CCW, EN, LAs, SNH)
- 5.2.2 Ensure that afforestation schemes do not threaten extant lead-moss colonies. Assessment of forestry proposals on or around these sites should include consultation with bryologists who should advise on whether proposed schemes need modification in order to remove threats to lead-moss. (ACTION: FC)
- 5.2.3 Ensure that any proposals to re-work lead or re-landscape mine spoil where lead-moss occurs are accompanied by a conservation plan for this species, written with the guidance of an expert bryologist. The plan should set out measures which will ensure the conservation of lead-moss (*in situ*) during and after these operations. (ACTION: LAs, CCW, EN, SNH)
- 5.2.4 Undertake scrub removal, soil disturbance, or other appropriate management at sites if found, from monitoring and research, to be necessary. (ACTION: CCW, EN, SNH)

5.3 Species management and protection

- 5.3.1 Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: CCW, EN, SNH, RBG Kew)
- 5.3.2 Assess the feasibility and desirability of undertaking translocations of lead-moss to suitable habitat at historic localities for this species. (ACTION: CCW, EN, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of lead-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CADW, CCW, EN, SNH)

5.5 Future research and monitoring

- 5.5.1** Compile a list of all sites where lead-moss has been recorded since 1960 and resurvey the sites in order to determine the current distribution and status of this species in Britain. (ACTION: CCW, EN, SNH)
- 5.5.2** Undertake regular monitoring of all extant sites. Information collected should include details of population size and threats to lead-moss colonies. (ACTION: CCW, EN, SNH)
- 5.5.3** Encourage or commission an autecological research project in order to improve understanding of the methods of spread and habitat requirements of lead-moss, and to refine management for its conservation. (ACTION: CCW, EN, SNH)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: CCW, EN, RBG Kew, SNH)

5.6 Communications and publicity

- 5.6.1** Compile a list of lead-mine spoil sites which have never been thoroughly surveyed by bryologists. Distribute a list of these sites (dependent on safety aspects and public access) to active bryologists, to encourage their survey. (ACTION: CCW, EN, SNH)
- 5.6.2** Encourage bryologists to pass all records of lead-moss, including ecological information, to a national database (ACTION: EN, CCW, JNCC, SNH)
- 5.6.3** Encourage surveys for this species in other parts of Europe. (ACTION: JNCC)
- 5.6.4** Use lead-moss as an example of a threatened bryophyte associated with metal-rich mine spoil in order to publicise the importance of lower plant communities of this habitat. (ACTION: CCW, EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** None proposed.

Starry earth-moss (*Ephemerum stellatum*)

Action Plan

1. Current status

- 1.1 Starry earth-moss is a minute, ephemeral species, which grows on sparsely-vegetated, non-calcareous soils in a variety of situations including arable fields and woodland rides. There are also records of it on a cliff-top path and earth-covered parapets of a bridge. The ecology of this species is poorly known, and its rarity is perplexing considering the apparently diverse and unspecific nature of its habitats. Furthermore, it is known from perhaps less than 10 localities in the world.
- 1.2 The British sites for this species are all in southern England (Hampshire, East Sussex, West Sussex and Kent), but it has not been confirmed at two of these sites since the 1940s. It has also been recorded from two sites in south-west County Kerry and is known from Portugal, France and Germany.
- 1.3 In Great Britain this species is provisionally classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Vulnerable* in Europe.

2. Current factors causing loss or decline

Historic population trends of this species are not known, but current threats to this species may include:

- 2.1 The recent switch to winter crop varieties and decline in the practice of leaving stubbles over winter.
- 2.2 Use of pesticides and fertilisers.
- 2.3 The bridge site (if a population is still extant here) will be threatened in the event of repair work being undertaken.
- 2.4 Abandonment of marginal arable land leading to a loss of beneficial ground disturbance.
- 2.5 Neglect of woodland rides where this species occurs.

3. Current action

- 3.1 None known.

4. Action plan objectives and targets

- 4.1** Maintain the range of this species in Britain and enhance its total population size.
- 4.2** Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

It is difficult to recommend practical conservation measures for starry earth-moss because it is an ephemeral species whose ecology and distribution are poorly understood. The current status of the species at all sites with records should be determined by 2002, and research should be undertaken into its methods of spread and habitat requirements. At present, all that can be done is to resurvey sites where it has been recorded in the past, and to implement measures to protect these sites and encourage sympathetic management. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild, and to enable studies of autecology.

5.1 Policy and legislation

- 5.1.1** Encourage the development of relevant agri-environment schemes, such as the pilot Arable Stewardship Scheme, as a potential means of conserving this species in the countryside. When reviewing such schemes, consider whether changes are needed to increase their potential benefits for this and other threatened arable species. (ACTION: EN, MAFF)

5.2 Site safeguard and management

- 5.2.1** Where possible, target relevant agri-environment schemes to known sites for starry earth-moss. Suitable management will include the creation of headlands which are cropped and cultivated in spring (leaving stubbles over winter). No herbicides or fertilisers should be applied to the headlands. (ACTION: EN, MAFF)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of starry earth-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN, MAFF)

- 5.4.2** As far as possible, ensure that relevant agri-environment project officers (particularly of the Countryside Stewardship Scheme) and members of regional agri-environment consultation groups are advised of locations for this species, its importance and management needed for its conservation. (ACTION: EN, MAFF)

5.5 Future research and monitoring

- 5.5.1** Survey all sites with records of this species and extend the survey to cover suitable habitat in the vicinity of these sites. An assessment of threats to extant populations should be made at each site. (ACTION: EN)
- 5.5.2** Undertake regular monitoring of all extant sites in order to maintain an understanding of threats to this species and to support the research work outlined under 5.5.3. (ACTION: EN)
- 5.5.3** Commission an autecological research project with the aim of improving understanding of the methods of spread and habitat requirements of this species and appropriate management for its conservation. (ACTION: EN)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: EN, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of starry earth-moss, including ecological information, to a national database (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for cereal field margins.

Thatch moss (*Leptodontium gemmascens*)

Action Plan

1. Current status

- 1.1 Thatch moss is a small moss forming dull green patches up to 1 cm tall. It normally produces gemmae at the leaf-tips which aids dispersal. In its natural habitat this species grows on the decaying basal sheaths of grass and rush tussocks, and on other decaying vegetation in areas of ungrazed acid grassland and heathland. At one time, it was also widely established on old thatched roofs, but has declined along with traditional thatching techniques. Modern thatch seems unsuitable for this species and it appears to be killed by zinc coated chicken wire which is now used to hold thatch in place.
- 1.2 This species used to be relatively common on old thatched roofs across southern England, as far west as Devon, Hereford and Worcester. However, only six sites have been reported on thatch since the 1960s and only three since 1975, in Wiltshire, Dorset and West Sussex. It has also been found in semi-natural habitats at four sites in Greater London, Hertfordshire, Suffolk and Norfolk (where it was discovered in 1997). It is fairly frequent within an area of about 2500 m² at the Hertfordshire site (Patmore Heath) and is also abundant at the Norfolk site.
- 1.3 In Great Britain this species is provisionally classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981. It is also rare in Europe, but considered to be overlooked in some areas.

2. Current factors causing loss or decline

- 2.1 The demise of traditional thatching practices.
- 2.2 Burning and over-grazing of its semi-natural habitats.
- 2.3 Scrub encroachment on its semi-natural habitats.
- 2.4 The Suffolk site is apparently deteriorating due to drought. Tufts of *Juncus* on which the thatch moss grows are being replaced by the invasive *Campylopus introflexus*.

3. Current action

- 3.1 Three of the semi-natural sites for this species are within SSSIs and two of these are also Wildlife Trust reserves. The other semi-natural site (Barnham Cross) is managed by the Thetford Conservation Society. Another site is on a National Trust property.

4. Action plan objectives and targets

- 4.1** Maintain populations of this species at all known semi-natural sites with extant populations.
- 4.2** Re-establish thatch moss on five suitable thatch roofs by 2010.
- 4.3** Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

This action plan recommends measures for the conservation of thatch moss in both its semi-natural habitat, and on thatched roofs where it was formerly widespread. A review of information on the current distribution and status of this species in Britain should be completed by 2003. All known semi-natural sites should be resurveyed and conservation management implemented where necessary. It is likely that colonies may also be found on other suitable habitat close to extant sites and survey efforts should therefore be extended to cover these areas. Action for the conservation of thatch moss in its thatched roof habitat should include the development of partnership projects with building heritage organisations. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild, to enable studies of autecology, and to enable recovery attempts.

5.1 Policy and legislation

- 5.1.1** None proposed.

5.2 Site safeguard and management

- 5.2.1** Control scrub on all semi-natural sites where thatch moss is known to occur so as to prevent deterioration of its habitat. (ACTION: EN)
- 5.2.2** Implement measures to ensure that extant, semi-natural sites are not damaged by over-grazing or deliberate burning. (ACTION: EN)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.5, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)
- 5.3.2** Following the research outlined under 5.5.5/6 undertake translocation experiments with the aim of establishing this species on five suitable thatched roofs owned by sympathetic organisations. (ACTION: EH, EN)

5.4 Advisory

- 5.4.1** Provide written advice to the owners of thatched buildings on which thatch moss is known to occur, stressing the importance of this species and the need to seek advice from relevant authorities if they intend to undertake re-thatching work. (ACTION: EH, EN)
- 5.4.2** On semi-natural sites, advise landowners and managers, and relevant agencies, of the presence and importance of thatch moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Undertake surveys of all semi-natural sites where this species has been recorded in the past, with the aim of assessing its current status in these areas. This work should be carried out at the same time as the action recommended under 5.4.2. (ACTION: EN)
- 5.5.2** Identify and survey potential semi-natural sites for this species in the region of the Norfolk and Suffolk sites. It is thought probable that new sites will be discovered in these areas. (ACTION: EN)
- 5.5.3** Undertake a survey of thatched roofs in the vicinity of known extant sites, with the aim of identifying colonies of this species that have so far gone unrecorded. (ACTION: EN)
- 5.5.4** Undertake research to investigate the ecological requirements of this species. The work should include an investigation of the effects of zinc-coated chicken wire on the performance of this moss and the types of thatch on which it is able to grow. (ACTION: EN)
- 5.5.5** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew)
- 5.5.6** Undertake a research project in association with building heritage organisations to select recipient sites for translocation attempts. Suitable sites will be those where traditional thatching practices are being maintained. (ACTION: EH, EN)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of thatch moss including ecological information, to a national database. (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** None proposed.

Slender thread-moss (*Orthodontium gracile*)

Action Plan

1. Current status

- 1.1 Slender thread-moss grows as bright green cushions up to about 1cm tall. It is very similar to the much commoner *O. lineare*, and British bryologists have always experienced difficulties in distinguishing between them. In the UK, it grows mainly on damp, vertical, shaded acid rock faces, particularly sandstones and gritstones, and sometimes in rock crevices. However, in western France, it is also found growing on peaty or sandy soils at the bases of trees and more rarely on rotting wood.
- 1.2 This species was once widely distributed from Devon (although there is some doubt about records from this county) and East Sussex to north-east Wales and Stirling and was most frequent in the Midlands and southern Pennines. However, it has suffered a severe decline over the last 150 years and since 1950 has been seen at only seven sites in North Yorkshire, Cumbria, Cheshire, East Sussex and Midlothian. Since 1970, it has only been recorded in the latter two of these counties. It has also been recorded recently at Lough Navar in Northern Ireland. Outside the UK, slender thread-moss is also known from western France, North and South America and tropical Africa.
- 1.3 In Great Britain this species is provisionally classified as *Critically Endangered*. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Endangered* in the Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Casual observations suggest that slender thread-moss may have declined in certain areas due to competition from the introduced *O. lineare*, which is apparently more vigorous.
- 2.2 A recent fire at the Midlothian site may have caused the extinction of the species there. A fire in 1992 also badly damaged the Lough Navar site in Northern Ireland, although this pre-dated the record.
- 2.3 The Midlothian population had been in decline for some time before the fire, and this may be attributable to air pollution.

3. Current action

- 3.1 A Sussex bryologist recently wrote to all British vice-county recorders where this species has been found. The replies indicate that slender thread-moss has only been seen recently in East Sussex.
- 3.2 All known Sussex sites are within SSSIs, as is the Midlothian site. The only known extant site in Northern Ireland is designated as an ASSI.

- 3.3 SNH surveyed the Midlothian site in 1995. The species was not refound, although it had certainly been present until 1991.
- 3.4 This species is currently proposed for addition to Schedule 8 of the Wildlife (Northern Ireland) Order 1985.
- 3.5 Slender thread-moss is currently on English Nature's Species Recovery Programme, and is held in *ex situ* culture. As part of this work, a method by which slender thread-moss and *O. lineare* can be distinguished vegetatively has been reported.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all extant sites.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.
- 4.3 Re-establish populations of slender thread-moss, if appropriate and feasible, at two suitable former sites by 2010.

5. Proposed action with lead agencies

Slender thread-moss has suffered a rapid decline during this century and urgent action is needed to ensure its conservation. A review of information on the current distribution and status of this species in the UK should be completed by 2002. A thorough assessment of the threats to this species and the reasons for its decline is also needed, and this should include an assessment of the relationship between slender thread-moss and *Orthodontium lineare*. Site protection, research and survey are the central elements to this action plan.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1 Following the assessment of threats to extant sites proposed under 5.5.1, implement appropriate measures to ensure protection, where possible, from these threats. (ACTION: EHS, EN, SNH)
- 5.2.2 Ensure that management agreements on all SSSIs and ASSIs where this species occurs provide benefits for its conservation. (ACTION: EHS, EN, SNH)

5.3 Species protection and management

- 5.3.1 Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EHS, EN, RBG Kew, SNH)

- 5.3.2** Assess the reasons for the loss of slender thread-moss from its former sites and, if appropriate, consider undertaking re-establishments. These should use propagated material originating from the nearest extant site. (ACTION: CCW, EHS, EN, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of slender thread-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN, EHS, SNH)

5.5 Future research and monitoring

- 5.5.1** Compile information and resurvey sites where necessary in order to determine the current distribution and status of this species in the UK. All herbarium material needs to be checked following the recent report of vegetative differentiation from *O. lineare* (see 3.5). Survey should cover former and extant sites in northern England, Sussex, Devon, Midlothian, north-east Wales, Lough Navar site and its surroundings. An assessment of threats to extant populations should be made at each site. (ACTION: CCW, EHS, EN, SNH)
- 5.5.2** Undertake a research project to investigate the ecology of slender thread-moss. The project should include an investigation of the extent to which slender thread-moss is threatened by competition with *O. lineare*. The results of the research should be used to refine conservation action for slender thread-moss. (ACTION: CCW, EHS, EN, SNH)
- 5.5.3** Undertake regular monitoring of this species at all extant sites with a view to identifying changes in its abundance and habitat quality. The information collected should be used to refine conservation action at each site. (ACTION: EHS, EN, SNH)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EHS, EN, RBG Kew, SNH)
- 5.5.5** Undertake experimental control of the competitive mosses such as *Orthodontium lineare* at one site in order to assess the benefits to slender thread-moss. Clearance of *O. lineare* should be supervised by an expert, and the colonisation of cleared patches should be monitored. If the technique proves successful, consider implementing at other sites. (ACTION: CCW, EHS, EN)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of slender thread-moss, including ecological information, to a national database. (ACTION: CCW, EN, JNCC)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, EN, JNCC)

5.7 Links with other action plans

5.7.1 None proposed.

Blunt-leaved bristle-moss (*Orthotrichum obtusifolium*)

Action Plan

1. Current status

- 1.1 Blunt-leaved bristle-moss is an epiphyte on the trunks of trees with nutrient-rich bark growing in open situations. Many of the Scottish records are from elm but, at the site where it has been seen recently, it also grows on sycamore, and elsewhere it has been recorded from ash and elder.
- 1.2 This species was once recorded from some 13 vice-counties and 28 ten km squares in Britain. There were a number of scattered localities across the southern English Midlands and a few sites in north-east England, but it seems to have disappeared from these areas before 1920. The only records in the last 60 years are from Scotland and a more recent record for Norfolk, where it is now extinct. The sites from which blunt-leaved bristle-moss has been recorded in Scotland are all in the north east, in Angus, Aberdeenshire and Moray, but it has been seen recently (1996) at only one site, in Aberdeenshire.
- 1.3 In Great Britain blunt-leaved bristle-moss is provisionally classified as *Endangered*. It is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The recent loss of sites in the east of Scotland is almost completely due to Dutch elm disease, the elm being a favoured substrate.
- 2.2 The general loss of wayside trees through road improvement, and parkland trees through senescence, may also have reduced the amount of available habitat.
- 2.3 Historically, the loss of blunt-leaved bristle-moss from its English sites has been attributed to the effects of atmospheric pollution.
- 2.4 The Norfolk population became extinct as a result of the collection of the single cushion for determination.

3. Current action

- 3.1 At present there is no management specifically for blunt-leaved bristle-moss
- 3.2 The single surviving site is owned by the National Trust for Scotland.
- 3.3 Measures designed to improve air quality should have a long-term effect, though measures to combat the spread of Dutch elm disease are now rarely undertaken.
- 3.4 All sites of recent records were surveyed in 1995 and 1996 as part of SNH's Lower Plants Project.

4. Action plan objectives and targets

- 4.1** Maintain the existing population at or near current levels.

5. Proposed actions with lead agencies

The main focus of activity in this plan must be to maintain the population at its single known site, through protection of surviving elms, and to ensure conditions there are suitable for its long-term survival. Additionally, survey of suitable habitat in north-east Scotland is needed to establish whether there are further populations. Mechanisms to maintain and replace wayside and parkland trees are also vital long-term actions.

5.1 Policy and legislation

- 5.1.1** Encourage the maintenance and establishment of wayside or parkland trees using existing or new mechanisms. (ACTION: FC, LAs, SNH, SOAEFD)
- 5.1.2** Incorporate suitable policies for the conservation of parkland and wayside trees into appropriate development plans and proposals. (ACTION: LAs)

5.2 Site safeguard and management

- 5.2.1** Ensure that the requirements of blunt-leaved bristle-moss are considered in any management plan for the known site. (ACTION: SNH)
- 5.2.2** Seek to preserve trees with populations of blunt-leaved bristle-moss, by prophylactic treatments against Dutch elm disease, through the use of Tree Preservation Orders, or by tree surgery, as appropriate. (ACTION: LAs, SNH)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of blunt-leaved feather-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN, SNH)
- 5.4.2** Disseminate information on the importance of wayside and parkland trees for epiphyte communities and rare bryophytes and lichens. (ACTION: FC, MAFF, SOAEFD)

5.5 Future research and monitoring

- 5.5.1** Monitor the known population to establish any trends. (ACTION: SNH)
- 5.5.2** Survey suitable habitat in eastern Scotland to locate other populations. (ACTION: RBGE, SNH)
- 5.5.3** Study the dispersal and establishment of the vegetative propagules of blunt-leaved bristle-moss. (ACTION: EN, SNH)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew, SNH)
- 5.5.5** Monitor the spread of Dutch elm disease in north- east Scotland. (ACTION: LAs)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of blunt-leaved bristle-moss, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** The implementation of this plan should be considered in conjunction with those for other epiphytes on elm: orange-fruited elm-lichen *Caloplaca luteoalba*, the lichen *Bacidia incompta*, and elm gyalecta *Gyalecta ulmi*.

Pale bristle-moss (*Orthotrichum pallens*)

Action Plan

1. Current status

- 1.1 Pale bristle-moss grows on the trunks and branches of trees and shrubs, often by the side of rivers. It seems to prefer host trees with base-rich bark such as ash, elm, and sycamore. Elsewhere in Europe, it has occasionally been reported from dry acid and basic rocks.
- 1.2 Pale bristle-moss was once scattered, but uncommon, from Derbyshire north to Ross. It was most frequently recorded from North and West Yorkshire, where it has now become extinct. It has suffered a marked decline, particularly in England, and within the last 40 years has been seen at only two sites in Lochaber and Moray. All the recent populations are very small and in most cases restricted to a single tree. This species has also been recorded from several sites in Ireland, but has only recently been seen from a single site in County Mayo. It is widely distributed throughout most of Europe and is also present in Asia and North and Central America.
- 1.3 In Great Britain this species is provisionally classified as *Critically Endangered*. It receives general protection under the Wildlife and Countryside Act 1981. It is not threatened in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 Atmospheric sulphur dioxide pollution is believed to have been the main cause of the decline of this species, but may no longer be a limiting factor at its remaining locations.
- 2.2 Drift of agricultural chemicals is a potential threat to some of the remaining colonies.
- 2.3 Felling of host trees.

3. Current action

- 3.1 None known.

4. Action plan objectives and targets

- 4.1 Maintain populations of pale bristle-moss at both known extant sites.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

The current status of pale bristle-moss in Britain is poorly understood and therefore a review of current information is needed. This should be undertaken by 2001. It appears to be highly threatened, and it is important that known sites are given full protection from damaging activities. Further surveys should also be encouraged and the possibility of re-establishing this species at selected sites should be assessed.

5.1 Policy and legislation

- 5.1.1** Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 if it meets relevant criteria, and if legal protection will address the causes of its decline. (ACTION: DETR, JNCC)
- 5.1.2** Adhere to commitments, as agreed by the Critical Loads Advisory Group in 1995, to reduce the 1980 levels of sulphur dioxide emissions by 80% by 2010. (ACTION: DETR)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as SSSIs sites with viable populations of pale bristle-moss where this is consistent with selection guidelines and where it is necessary to ensure their long-term protection and appropriate management. (ACTION: EN, SNH)
- 5.2.2** Assess the need to control use of pesticides on land adjacent to extant sites. If necessary, and where possible, the Countryside Stewardship Scheme and other relevant agri-environment schemes should be targeted to this land in order to prevent the use of sprays in the vicinity of pale bristle-moss sites. (ACTION: EN, MAFF, SNH, SOAEFD)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.3, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew, SNH)
- 5.3.2** Assess the feasibility and desirability of undertaking translocations of this species to suitable habitat in the vicinity of extant or former sites. (ACTION: EN, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of pale bristle-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN, SNH)
- 5.4.2** As far as possible, ensure that all relevant agri-environment project officers are advised of the locations of this species, its importance, management requirements and potential threats. (ACTION: EN, MAFF, SNH, SOAEFD)

5.5 Future research and monitoring

- 5.5.1** Undertake intensive searches of suitable habitat in the vicinity of the two most recent sites where this species has been recorded in order to establish its current status in these areas. An assessment of current threats at each site should also be made. (ACTION: EN, SNH)
- 5.5.2** Undertake regular monitoring of all extant pale bristle-moss sites. Monitoring visits should include a review of threats to each colony. (ACTION: EN, SNH)
- 5.5.3** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew, SNH)
- 5.5.4** Compile a list of sites that would be worth searching for this species and distribute to active bryologists encouraging further surveys. (ACTION: EN, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of pale bristle-moss, including ecological information, to a national database. (ACTION: EN, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** The implementation of this plan should be considered in conjunction with those for other epiphytes on elm: blunt-leaved bristle-moss *Orthotrichum obtusifolium*, orange-fruited elm-lichen *Caloplaca luteoalba*, the lichen *Bacidia incompta* and elm gyalecta *Gyalecta ulmi*.

Scottish pohlia (*Pohlia scotica*)

Action Plan

1. Current status

- 1.1 This acrocarpous moss grows in silt, sand and gravel in sites by lochs and rivers where it is subject to regular inundation. It is an inconspicuous plant that is difficult to differentiate from common related species and it may be under-recorded. There are no data on its sexual or vegetative propagation, and its method of dispersal remains unknown.
- 1.2 There is a concentration of records from the Orchy-Awe catchment in Argyll with outlying records in Dunbartonshire and East Ross-shire. It is a recently described species (1982) with the earliest record dating from 1964. Since that date there have been only seven further records. The species is apparently endemic to Scotland. It is unlikely that any of the sites have statutory protection.
- 1.3 Scottish pohlia is provisionally classified as *Lower Risk (Near Threatened)* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is listed as *Rare* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Scottish pohlia probably functions as a ruderal species and population size is likely to be subject naturally to marked fluctuations. There is no evidence for any factors causing loss or decline.

3. Current action

- 3.1 A survey of four of the known localities took place in 1996 as part of the SNH Lower Plants Project. The plant was refound in only one site (Loch Tulla) but in some quantity.

4. Action plan objectives and targets

- 4.1 Maintain populations at the locality refound in 1996, and any other sites.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

It will be necessary to revisit all known sites and attempt to find further populations with a view to establishing whether the status of the plant, as currently known, is a true reflection of its frequency. Other action in this plan focuses on attempting to assess its likely habitat requirements. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild, and to enable studies on autecology.

5.1 Policy and legislation

- 5.1.1** Assess the status of Scottish pohlia against revised Red Data Book criteria. (ACTION: JNCC, SNH)

5.2 Site safeguard and management

- 5.2.1** Determine and implement appropriate site management for the known locality. (ACTION: SNH).

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.3, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: SNH, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of Scottish pohlia, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: SNH)

5.5 Future research and monitoring

- 5.5.1** Set up appropriate monitoring of the single known population. (ACTION: SNH)
- 5.5.2** Survey known sites not visited in 1996 and survey selected further potential localities in the west of Scotland. (ACTION: SNH)
- 5.5.3** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes (ACTION: RBG Kew, SNH)
- 5.5.4** Investigate ecological requirements and population biology of Scottish pohlia. (ACTION: SNH)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of Scottish pohlia, including ecological information, to a national database. (ACTION: JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** None proposed.

Round-leaved feather-moss (*Rhynchostegium rotundifolium*)

Action Plan

1. Current status

- 1.1 Round-leaved feather-moss is a patch-forming moss with short branches arising from a creeping stem. It grows on tree trunks with alkaline bark (such as ash and field maple), limestone rocks and tree roots in shady places. Sporophytes are common.
- 1.2 This has never been a common species in Britain where it has only been recorded from three sites. It is now known at just two sites in Sussex and Gloucestershire, and has not been seen at its only other locality in Somerset for over 75 years. It is restricted to an area of about half a square metre on one tree at its East Sussex site (where it was first seen in 1956) and is scattered over an area of about 10 m² on a limestone wall, hedgebank and field maple in Gloucestershire. Elsewhere this moss has a scattered distribution across central Europe and has also been recorded from Asia.
- 1.3 In Great Britain this species is provisionally classified as *Critically Endangered* and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is listed as *Rare* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Exposure of colonies to excessive levels of direct sunlight. The East Sussex site has declined recently following removal of vegetation nearby.
- 2.2 Agricultural spray drift.
- 2.3 Repair works to the Gloucestershire wall site.
- 2.4 Major highway improvements alongside the Gloucestershire site.

3. Current action

- 3.1 The East Sussex site is within an SSSI.
- 3.2 Translocation of a few stems of this species was attempted at the East Sussex site, but was unsuccessful.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at both known sites and ensure that suitable habitat is available to encourage their spread.

- 4.2 If it is considered feasible and desirable, establish three new colonies of this species on suitable substrate close to extant sites by 2005.
- 4.3 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

A review of information on the current distribution and status of this species in Britain should be completed by 2003. Round-leaved feather-moss is extremely rare in Britain and always has been. Action for this species should concentrate on the protection of extant sites and ensuring that they are managed appropriately. In the longer term, translocations to suitable trees in the vicinity of extant colonies should be considered. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild, and to enable recovery attempts.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1 Consider notifying the Gloucestershire site as an SSSI, if this is consistent with selection guidelines and necessary to ensure its long-term protection and appropriate management. (ACTION: EN)
- 5.2.2 Visit both extant sites regularly and assess any threats present at each. Conservation management such as scrub control should be implemented if necessary. (ACTION: EN)
- 5.2.3 Ensure that any repair work to the wall in Gloucestershire where round-leaved feather-moss grows, or to the adjacent highway, does not disturb colonies of this species, or lead to a deterioration in its habitat. (ACTION: EN, Highways Agency, LA)
- 5.2.4 Assess the threat to extant colonies of round-leaved feather-moss posed by agricultural spray drift. Address any such threats by discussion with relevant farmers and consider targeting the Countryside Stewardship Scheme where necessary. (ACTION: EN, MAFF)

5.3 Species management and protection

- 5.3.1 Depending on the results of 5.5.3, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)
- 5.3.2 Depending on the success of 5.5.3 and 5.3.1, and if considered appropriate, attempt translocations to three sites close to the known colonies. (ACTION: EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of round-leaved feather-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)
- 5.4.2** As far as possible, ensure that all relevant agri-environment project officers are advised of the locations of this species, its importance, management requirements and potential threats. (ACTION: EN, MAFF)

5.5 Future research and monitoring

- 5.5.1** Undertake a thorough survey for this species in the vicinity of the Sussex site. The Gloucestershire site should also be checked and the survey extended to include suitable habitat surrounding the known colonies. An assessment of current threats should be made at each site and action taken to ensure colonies are protected from these threats. (ACTION: EN)
- 5.5.2** Undertake regular monitoring of each extant site in order to maintain an understanding of the status of this species, and to allow for prompt conservation action in the event of new threats arising at any of its sites. (ACTION: EN)
- 5.5.3** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of round-leaved feather-moss, including ecological information, to a national database. (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** None proposed.

Water rock-bristle (*Seligeria carniolica* = *Trochobryum carniolicum*)

Action Plan

1. Current status

- 1.1 Water rock-bristle is a minute moss growing in solitary to gregarious patches up to 3-4 cm high. It grows mainly on periodically or permanently moist, shaded, calcareous rocks in or near streams in small ravines, growing up to an altitude of about 100 m.
- 1.2 This is the only species of its genus in Europe, and is also endemic to Europe. It has been recorded in Austria, France, Germany, Switzerland, Yugoslavia, Norway, Romania and Sweden. In Britain, it has been recorded from only two sites in Roxburgh and Northumberland; it was seen at the latter locality in 1996. Material was collected from the Scottish site in 1948, but was not correctly identified until later. The site has not been re-located since, and it is therefore not known whether the colonies are still there. Water rock-bristle grows in several areas at the Northumberland site, but there are suggestions that the habitat here is a little degraded.
- 1.3 Water rock-bristle is provisionally classified as *Critically Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is classified as *Endangered* in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 Inappropriate collecting is a possible threat to this species.
- 2.2 Cattle grazing is preventing tree regeneration at the Northumberland site, and this could, in the long term, cause changes in humidity levels and thus have damaging implications for the conservation of water rock-bristle at the site. Trampling and nutrient-enrichment by cattle may also be a threat to water rock-bristle at this site.
- 2.3 Changes in water quality and quantity.

3. Current action

- 3.1 None known.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at its Northumberland site and any other sites where extant colonies are found.
- 4.2 Increase the extent of the single known population if desirable and feasible.

5. Proposed action with lead agencies

A review of information on the current distribution and status of this species in Britain should be undertaken by 2003. The priority for this species is to ensure that the single extant site is fully protected from damaging activities. Further surveys for this species in the vicinity of the area from which the Scottish specimen is thought to have been collected should also be encouraged.

5.1 Policy and legislation

- 5.1.1** Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 if it meets relevant criteria, and if legal protection will address the causes of its decline. (ACTION: DETR, JNCC)

5.2 Site safeguard and management

- 5.2.1** Consider notifying as an SSSI the Northumberland site for water rock-bristle, and any other sites where viable populations of this species is discovered, where this is consistent with selection guidelines and necessary to ensure their long-term protection and appropriate management. (ACTION: EN)
- 5.2.2** Assess the need to control grazing levels at the Northumberland site, through fencing or other measures. An assessment of other threats should also be made at the site and appropriate control measures implemented where necessary. (ACTION: EN)
- 5.2.3** Ensure that water quality and natural seasonal flow rates are maintained at the known site where this species occurs. (ACTION: EA)

5.3 Species management and protection

- 5.3.1** Assess the need to establish an *ex situ* collection using material from the extant English population. (ACTION: EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of water rock-bristle, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN, SNH)

5.5 Future research and monitoring

- 5.5.1** Undertake a thorough survey of the Northumberland site and other suitable sites in the area in order to determine the current status of water rock-bristle in the area and to identify current threats to its conservation. (ACTION: EN)
- 5.5.2** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew, SNH)

- 5.5.3** Compile a list of localities from which the only known Scottish specimen of water rock-bristle may have been collected, and distribute the list to appropriate bryologists to encourage targeted searches. (ACTION: SNH)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of water rock-bristle, including ecological information, to a national database (ACTION: EN, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC, SNH)

5.7 Links with other action plans

- 5.7.1** None proposed.

Prostrate feather-moss (*Sematophyllum demissum*)

Action Plan

1. Current status

- 1.1 Prostrate feather-moss is a moss of shady rocks in humid places, such as wooded streamsides. It frequently occurs on the sloping faces of acid or slightly basic gritty boulders and rock slabs where it receives intermittent seepage. It grows mainly at low altitudes, but extends up to 330 m. Sporophytes are common.
- 1.2 The British populations of this species are confined to the Atlantic oakwoods of west Wales. It is now known in quantity at only one site in this area and in small numbers at four others. It has disappeared from one other site in North Wales. It is thought that the remaining colonies of this species are relatively stable. Elsewhere, it is known at 25 sites in the Irish Republic and is also found in France, Spain, the Alps, south-western Asia, North Africa, and North America. There is an unconfirmed record from western Norway.
- 1.3 In Great Britain this species is provisionally classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981. It is listed as *Rare* in the Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Invasion of *Rhododendron* which may cause excessive shading and poisoning, and a build up of a field layer of bilberry *Vaccinium myrtillus* and wavy hair-grass *Deschampsia flexuosa*, because of insufficient grazing.
- 2.2 The development of hydro-electric power schemes in the vicinity of extant sites.
- 2.3 Woodland clearance or inappropriate woodland management (eg thinning) which may adversely affect shade and humidity in the vicinity of colonies.
- 2.4 Inappropriate grazing by sheep or deer.
- 2.5 Trampling by tourists is a possible threat at one site.
- 2.6 Inappropriate botanical collecting.

3. Current action

- 3.1 Four of the five extant sites for this species are within SSSIs or NNRs.
- 3.2 Atlantic oak woods have been thoroughly surveyed for bryophytes and it is thought that the distribution of prostrate feather-moss is well understood.

4. Action plan objectives and targets

- 4.1** Maintain populations of this species at all extant sites and increase their extent where appropriate and feasible.
- 4.2** Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

The distribution of prostrate feather-moss is thought to be well understood. Action should therefore concentrate on the protection of all known sites, ensuring that they are managed appropriately. Apart from the removal of any invasive scrub and careful intervention to prevent shade becoming too dense, management should generally be kept to a minimum and should avoid causing damaging reductions in humidity. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild, and to enable studies on autecology.

5.1 Policy and legislation

- 5.1.1** Ensure that the requirements of this species are taken into account when assessing development proposals (eg hydro-electric power schemes) which affect extant sites. (ACTION: CCW, DETR, EA, LAs)
- 5.1.2** Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 if it meets relevant criteria, and if legal protection will address the causes of its decline. (ACTION: DETR, JNCC)

5.2 Site safeguard and management

- 5.2.1** Undertake management, where necessary, to remove invading *Rhododendron* which threatens to cause deterioration of prostrate feather-moss habitat, and to restrict or prevent tree felling and timber removal. (ACTION: CCW)
- 5.2.2** Assess the need to control levels of grazing by sheep and deer at all sites with extant populations of prostrate feather-moss. Appropriate action should be taken to ensure that grazing levels are maintained at optimum levels to prevent over-shading and littering by herbaceous species and dwarf shrubs. (ACTION: CCW)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.4, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: CCW, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of prostrate feather-moss, specific management for its conservation, and any potentially damaging

actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW)

5.5 Future research and monitoring

- 5.5.1** Compile information on the current distribution and status of this species in Britain. Sites should be resurveyed if necessary and threats to each colony should be assessed. (ACTION: CCW)
- 5.5.2** Monitor all extant sites regularly so as to identify imminent threats to prostrate feather-moss colonies and to identify any need for habitat management. (ACTION: CCW)
- 5.5.3** Promote research into the ecology of this species with a view to refining habitat management for its conservation, particularly optimum grazing levels and patterns. (ACTION: CCW)
- 5.5.4** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: CCW, RBG Kew)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of prostrate feather-moss, including ecological information, to a national database. (ACTION: CCW, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: CCW, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for upland oak woods.

Baltic bog-moss (*Sphagnum balticum*)

Action Plan

1. Current status

- 1.1 Baltic bog-moss grows in oligotrophic to slightly mesotrophic raised bogs or, more rarely, blanket bogs. It is a species of wet parts of the bog, often partly or completely submerged or growing as a floating mat. Recent research suggests that it is a poor competitor and may be a rather mobile colonist species, replaced as bog pools fill up with other *Sphagnum* species. It is mainly a lowland species, but reaches an altitude of 650 m in Scotland.
- 1.2 This species has been recorded from seven widely scattered sites in England, Scotland and Wales (Cheshire, Northumberland, Yorkshire, Ceredigion (Cardiganshire), Aberdeenshire, Dumfriesshire and Abernethy Forest in Inverness-shire). The Welsh record, from old peat cuttings, may need checking; it has not been seen there since 1967 and a survey in 1998 recorded only *Sphagnum fallax*. Nor has it been seen for over a century at the Cheshire site. It has apparently disappeared from two of its Scottish locations (Loch Muick and Racks Moss, the latter due to afforestation). Elsewhere, it is found across much of lowland northern Europe, extending south to the Alps and Yugoslavia. It is also found in northern Asia, North America and Greenland.
- 1.3 In Great Britain this species is provisionally classified as *Endangered* and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is not threatened in Europe as a whole.

2. Current factors causing loss or decline

- 2.1 Direct afforestation and afforestation in the vicinity of Baltic bog-moss sites with associated effects on the acidity of run-off water and site hydrology.
- 2.2 Peat cutting and associated effects on site hydrology.
- 2.3 Drainage of its peatland sites.
- 2.4 Inappropriate collecting of *Sphagnum* for horticultural purposes is a potential threat to this species.

3. Current action

- 3.1 This species has been recorded at three sites since 1970, two of which are protected as SSSIs or NNRs. The Welsh site is also within an NNR and is a proposed SAC.
- 3.2 An SNH survey in 1995 failed to find the species at its two known Scottish localities, but it was discovered in Abernethy in 1997.

4. Action plan objectives and targets

- 4.1** Maintain populations of this species at all extant sites.
- 4.2** Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

Initial survey work for Baltic bog-moss should be undertaken in order to assess the current distribution and status. Action should focus both on addressing long-term threats to its conservation, such as those posed by forestry activities, as well as more specific threats such as peat cutting and inappropriate site management. Regular monitoring at all sites, including periodic assessment of site hydrology, is needed in order to allow prompt identification of any changes in habitat quality. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild.

5.1 Policy and legislation

- 5.1.1** Ensure that the requirements of Baltic bog-moss are considered when assessing proposals for afforestation in the vicinity of extant sites and in the surrounding catchments. (ACTION: FC)
- 5.1.2** Discourage large-scale peat cutting on all sites where this species occurs, and on nearby land where there is a risk that site hydrology will be affected. (Peat cutting at the northern end of Thorne Moors poses a serious threat to the hydrology of the NNR and should be discouraged.) (ACTION: CCW, EN, LAs)

5.2 Site safeguard and management

- 5.2.1** Consider targeting the Countryside Stewardship Scheme and other relevant agri-environment schemes (eg Tir Gofal in Wales) at land in the vicinity of Baltic bog-moss sites in order to reduce levels of nutrient-rich run-off which may otherwise lead to deterioration of the oligotrophic habitat in which this species grows. (ACTION: CCW, EN, MAFF, SOAEFD, WOAD)
- 5.2.2** Assess the threat to this species at each extant site posed by indiscriminate collecting of *Sphagnum* for horticultural purposes. (ACTION: CCW, EN, LAs, SNH)
- 5.2.3** Ensure that management plans or agreements on all SSSIs at which Baltic bog-moss occurs take into account the requirements of this species. (ACTION: CCW, EN, SNH)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.5, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, CCW, RBG Kew, SNH)

5.4 Advisory

- 5.4.1** Advise landowners and managers of the presence and importance of this species, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: CCW, EN, SNH)

5.5 Future research and monitoring

- 5.5.1** By 2005, collate existing data, undertake a comprehensive survey of extant and former sites (and potential sites in the vicinity of these sites), and assess threats at extant sites. (ACTION: CCW, EN, SNH)
- 5.5.2** Commission research into the habitat requirements of Baltic bog-moss. The findings should be used to inform conservation management of this species. (ACTION: CCW, EN, JNCC, SNH)
- 5.5.3** Undertake regular monitoring at all extant sites in order to record changes in population size and habitat and water quality. A review of threats at each site should be made during each visit. (ACTION: CCW, EA, EN, SNH)
- 5.5.4** Check the herbarium specimen of the Welsh record, to ascertain correct identification. (ACTION: CCW)
- 5.5.5** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, CCW, RBG Kew, SNH)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of Baltic bog-moss, including ecological information, to a national database. (ACTION: CCW, EN, JNCC, SNH)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops (ACTION: CCW, EN, JNCC, SNH)
- 5.6.3** If the action outlined under 5.2.2 identifies a significant threat to this species from moss collecting, address this threat through appropriate measures which may include discussion with local horticulturists, leafleting local people, and on-site signs to explain the problem and the legal implications. (ACTION: CCW, EN, LAs, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with those for raised bogs and blanket bogs.

Yorkshire feather moss (*Thamnobryum cataractarum*)

Action Plan

1. Current status

- 1.1 Yorkshire feather-moss is a dark green feather-moss which grows in patches with shoots up to 5 cm long. It is essentially an aquatic species, mostly forming a pure zone 10-25 cm below summer water level in a swiftly flowing stream in a deep limestone-influenced gritstone ravine. However, it also grows higher up, where it is found in association with other species such as *Thamnobryum alopecurum*. It is thought that this species is able to tolerate very low light intensities.
- 1.2 This species is believed to be endemic to England, but has only recently been described, and has been recorded at only one site where its population appears to be stable. It is possible that it may be present in other similar valleys nearby, but a very narrow distribution range is typical of this group.
- 1.3 This species is provisionally classified as *Endangered* in Great Britain. It receives general protection under the Wildlife and Countryside Act 1981. It is listed as *Vulnerable* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Due to its extremely limited distribution, it is highly vulnerable to threats such as changes in water quality and inappropriate botanical collecting.
- 2.2 Nearby quarrying activities, and water abstraction coupled with low precipitation, may pose a potential threat to the hydrology of the site.

3. Current action

- 3.1 The only known site for this species is designated as an SSSI.

4. Action plan objectives and targets

- 4.1 Maintain a viable population of this species at its single known site.
- 4.2 Establish by 2005 *ex situ* stocks of this species to safeguard the single known population.

5. Proposed action with lead agencies

Action for this species should focus on the protection of its single known site. The Environment Agency has a key role to play in ensuring that water quality of the stream where it grows is maintained at appropriate seasonal levels. Threats posed by activities upstream from the site should be assessed and controls implemented if necessary. It will be important to search other

sites which may possibly support populations. An *ex situ* conservation programme should be instigated to safeguard against chance extinction in the wild.

5.1 Policy and legislation

- 5.1.1** Consider this species for inclusion on Schedule 8 of the Wildlife and Countryside Act 1981 if it meets relevant criteria, and if legal protection will contribute to its conservation. (ACTION: DETR, JNCC)
- 5.1.2** Ensure that the requirements of this species are considered when drawing up and reviewing the Local Environment Agency Plan/Water Catchment Management Plan which covers the only known site where this species occurs. (ACTION: EA, MAFF)

5.2 Site safeguard and management

- 5.2.1** Ensure that the management of the SSSI within which Yorkshire feather-moss occurs is sympathetic to the conservation of this species. (ACTION: EN)
- 5.2.2** Assess the risk posed to this moss by quarrying and forestry activities further upstream. Planning restrictions should be considered where developments are likely to lead to deterioration of the habitat in which Yorkshire feather-moss occurs. (ACTION: EA, EN, FC, LA)
- 5.2.3** Assess the threat posed to the water quality of the Yorkshire feather-moss site by agricultural run-off. If necessary, consider targeting the Countryside Stewardship Scheme to land in this catchment in order to minimise any threat. (ACTION: EA, MAFF)

5.3 Species management and protection

- 5.3.1** Depending on the results of 5.5.3, establish an *ex situ* stock of this species from material derived from its single known population. (ACTION: EN, RBG Kew)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of Yorkshire feather-moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EA, EN)

5.5 Future research and monitoring

- 5.5.1** Undertake regular monitoring of the single site where this species occurs. Visits to the site should include an assessment of water quality. The aim of this monitoring is to detect any changes in population size or habitat quality and to initiate protective measures or management if necessary. (ACTION: EA, EN)

5.5.2 Undertake survey of similar valleys to the known site where this species occurs, to establish whether further populations exist. (ACTION: EN)

5.5.3 Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew)

5.6 Communications and publicity

5.6.1 Encourage bryologists to pass all records of Yorkshire feather-moss, including ecological information, to a national database (ACTION: EN, JNCC)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

5.7.1 None proposed.

Freiberg's screw-moss (*Tortula freibergii*)

Action Plan

1. Current status

- 1.1 Freiberg's screw-moss grows to 2 mm high in yellowish-green patches. It is a species of acid sandstone rock outcrops and walls in sheltered to fairly exposed situations. Frequent associates include *Tortula marginata* and *T. muralis*.
- 1.2 This species is endemic to Europe where it has been recorded from France, Spain, Italy and Portugal; it is apparently rare across its range. In Britain it has recently been discovered on sandstone rock on the North Yorkshire coast. It is also scattered along approximately 12 km of the Bridgewater Canal in Greater Manchester, where it grows on sandstone blocks at the side of the canal. Its only known other British populations are in East Sussex, where it occurs in some abundance at two sites near Hastings.
- 1.3 In Great Britain this species is provisionally classified as *Near Threatened* and it receives general protection under the Wildlife and Countryside Act 1981. It is listed as *Vulnerable* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Maintenance work along the Bridgewater Canal in Greater Manchester, most notably the replacement by concrete of old sandstone blocks which form the banks of the canal.
- 2.2 Freiberg's screw-moss grows beneath several bridges along the Bridgewater Canal. Removal of these bridges has destroyed several colonies in the past and could still be a threat to some colonies.
- 2.3 Encroachment of scrub and other vegetation.
- 2.4 Eutrophication of water from agricultural run-off is a possible factor at sites in farmed landscapes.

3. Current action

- 3.1 One of the two Sussex sites is protected within an SSSI, the other is within a country park. The North Yorkshire site is within a LNR.

4. Action plan objectives and targets

- 4.1 Maintain the range of this species in Britain and enhance its total population size.

5. Proposed action with lead agencies

The distribution and status of Freiberg's screw-moss in Britain may not yet be fully understood. A review of information needs to be undertaken by 2003. Surveys of known sites should also be extended to include potential habitat in other areas. Prompt action is needed to ensure that maintenance work on the Bridgewater Canal is not damaging to the conservation interests of this species.

5.1 Policy and legislation

- 5.1.1** Ensure that the requirements of this species are considered in any development/management plans for the Bridgewater Canal in Greater Manchester (ACTION: EN, LAs)
- 5.1.2** Ensure that proposals for building developments on, or close to, extant Freiberg's screw-moss sites are not damaging to the conservation interests of this species. (ACTION: LAs)

5.2 Site safeguard and management

- 5.2.1** Following the survey work outlined under 5.5.1, assess the need at each site for conservation management such as scrub control. Implement such management as necessary. (ACTION: EN)
- 5.2.2** Consider notifying the section of the Bridgewater Canal where Freiberg's screw-moss occurs as an SSSI, if this is consistent with selection guidelines and if it is necessary to ensure its long-term protection and appropriate management. (ACTION: EN)

5.3 Species protection and management

- 5.3.1** Assess the desirability and feasibility of undertaking translocations of this species in order to increase the extent of populations at its known sites. (ACTION: EN)

5.4 Advisory

- 5.4.1** Advise relevant staff at the Manchester Ship Canal Company, who manage the canal site in Greater Manchester, and other landowners and land managers of the presence and importance of the species, specific management for its conservation, and any potentially damaging actions. They should have access to specialist advice if needed. (ACTION: EN)

5.5 Future survey and monitoring

- 5.5.1** Undertake thorough surveys of all extant sites and suitable surrounding habitat. This should include a survey of Greater Manchester canals above and below the section on which Freiberg's screw-moss is known to occur. Survey work should be carried out in winter or early spring. (ACTION: EN)
- 5.5.2** Identify and survey potential sites where this species might occur, including sites on the Wirral sandstone and other suitable canal sites in north-west England. Survey work should be carried out in winter or early spring. (ACTION: EN)

- 5.5.3** Monitor all extant sites regularly so as to maintain an understanding of changes in the population of this species and to allow for prompt identification of threats to each site as they arise. (ACTION: EN)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of Freiberg's screw-moss, including ecological information, to a national database (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** None proposed.

Knothole moss (*Zygodon forsteri*)

Action Plan

1. Current status

- 1.1 Knothole moss is a small moss, forming dark blackish-green cushions up to 5 mm high. It has exacting and complex habitat requirements. Almost all known colonies are on beech trees where it grows in raintracks on the surface of the bole or root-stocks. These raintracks are fed not by canopy drip-down, but by a reservoir held in a trunk cavity. Such trees are extremely rare and a survey of an area of Epping Forest in 1988 found only three, all of which supported colonies of knothole moss. It also seems to have a preference for well-lit situations. Protonemal mats with gemmae are often conspicuous in the immediate vicinity of cushions of this moss and, together with capsule production, may explain its persistence at its known sites. It is probably limited by its very precise habitat requirements.
- 1.2 Knothole moss was first found in 1790 and has since been discovered in the New Forest, Burnham Beeches and Epping Forest. It has recently suffered a sharp decline at Epping Forest and is now known only on three trees. It is known at two sites in the New Forest and approximately 10 - 20 trees in Burnham Beeches. It is widespread, but rare, in Europe, ranging from eastern Bulgaria to western Portugal and from southern Spain as far north as Denmark.
- 1.3 In Great Britain this species is provisionally classified as *Endangered*. It is protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is listed as *Vulnerable* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Felling of host trees.
- 2.2 Storm damage to host trees and potential host trees. This has already caused the loss of many colonies in Epping Forest.
- 2.3 It is thought that several competitive mosses have increased in vigour in recent years, perhaps because of a combination of falling sulphur dioxide levels and an increase in nutrient-rich rainfall. This may be a threat to knothole moss.
- 2.4 Inappropriate botanical collecting may still be a threat to this species.
- 2.5 A lack of suitable beech trees in the vicinity of extant colonies which can act as replacement host trees and thus provide a continuity of suitable habitat for knothole moss.
- 2.6 Scrub encroachment is a potential threat where it affects light and humidity levels.

3. Current action

- 3.1 All known extant knothole moss populations are within SSSIs or NNRs.
- 3.2 Managers of all extant sites are aware of the locations of this species and the need to ensure its protection.
- 3.3 A management plan has been written for the conservation of knothole moss in Epping Forest and brief management recommendations written for the Burnham Beeches site.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all extant sites and encourage their expansion where possible.
- 4.2 Establish by 2005 *ex situ* stocks of the species to safeguard extant populations.

5. Proposed action with lead agencies

Conservation action for knothole moss should focus on the protection of extant colonies, and the need to provide a continuity of mature beech trees on which this species grows. In order to achieve this aim, pollarding of beech trees should be undertaken where necessary. A review of current information and thorough surveys of all extant sites should also be carried out so as to improve understanding of the status of this species. These should be undertaken by 2003. In addition, action should be taken to develop the potential for undertaking translocations if this is felt necessary in the future.

5.1 Policy and legislation

- 5.1.1 None proposed.

5.2 Site safeguard and management

- 5.2.1 Prevent overshadowing of colonies including removal of encroaching scrub where necessary, particularly at the Burnham Beeches site. (ACTION: EN)
- 5.2.2 Undertake appropriate management of beech trees in the immediate vicinity of extant colonies of knothole moss. The aim of this management is to ensure a continuity of beech trees that provide a precise niche for colonisation; techniques should include pollarding. (ACTION: EN)

5.3 Species management and protection

- 5.3.1 Depending on the results of 5.5.2, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)

- 5.3.2** Assess the feasibility and desirability of translocating this species to suitable new trees in the light of the research outlined under 5.5.3. (ACTION: EN)

5.4 Advisory

- 5.4.1** Advise landowners and managers, and relevant agencies, of the presence and importance of knothole moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future survey and monitoring

- 5.5.1** Undertake surveys at Epping Forest, Burnham Beeches and the New Forest so as to improve understanding of the current status of knothole moss at these sites. Satellite mapping techniques should be used, if possible, to allow easy relocation of colonies in the future. At least two days survey is needed at each site. (ACTION: EN)
- 5.5.2** Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew)
- 5.5.3** Undertake research to investigate the ecological requirements of this species with a view to assessing the possibility of, and appropriate techniques for, translocation of the moss to suitable new trees. The possibility of making artificial holes/wounds that would fill with water should be investigated. (ACTION: EN)

5.6 Communications and publicity

- 5.6.1** Encourage bryologists to pass all records of knothole moss, including ecological information, to a national database (ACTION: EN, JNCC)
- 5.6.2** Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for lowland wood pastures/parkland.

Nowell's limestone moss (*Zygodon gracilis*)

Action Plan

1. Current status

- 1.1 Nowell's limestone moss is a medium-sized moss growing in brownish-green tufts. It is mostly found on old limestone walls, but there are also two records from what must be its natural habitat of dry, exposed rock outcrops and loose stones of Carboniferous limestone. Its autecology is poorly understood, and it has been found with capsules only once in Britain.
- 1.2 This species is endemic to Europe where it is known in Austria, Germany, Switzerland, Italy and Poland. In Britain it has been recorded from five distinct areas of West Yorkshire, but most of these have not been visited for many years.
- 1.3 In Great Britain this species is provisionally classified as *Endangered* and is specially protected under Schedule 8 of the Wildlife and Countryside Act 1981. It is listed as *Vulnerable* in the 1995 Red Data Book of European Bryophytes.

2. Current factors causing loss or decline

- 2.1 Destruction, cleaning and unsympathetic renovation of dry stone wall sites.
- 2.2 Botanical collecting may be a threat at some sites.
- 2.3 Colonies of this species may be threatened where coils of zinc-coated wire are placed on top of walls to make them stockproof. The zinc appears to be toxic to this species and many other mosses.
- 2.4 Nutrient enrichment from agricultural practices.

3. Current action

- 3.1 All sites where this species has been recorded recently are within SSSIs.

4. Action plan objectives and targets

- 4.1 Maintain populations of this species at all known sites and increase their extent where appropriate and feasible.
- 4.2 If desirable and feasible, establish three new colonies in the vicinity of extant populations.
- 4.3 Establish by 2005 *ex situ* stocks of this species to safeguard extant populations.

5. Proposed action with lead agencies

A review of information and further surveys should be completed by 2003 to determine the current distribution and status of this species in Britain. Action should focus on preventing damage to all sites, but particularly those on limestone walls as these are more vulnerable to damage than the colonies on natural rock. Site owners should be encouraged to maintain the walls in a way that is sympathetic to the conservation of this species. An *ex situ* conservation programme should be instigated to safeguard against chance extinctions in the wild, to enable studies on autecology, and to enable recovery attempts.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Ensure that limestone walls with colonies of Nowell's limestone moss are maintained in a way that is appropriate for the conservation of this species. Walls should not be regularly cleaned, and extreme care should be exercised when undertaking repair works. (ACTION: EN)

5.2.2 Ensure that the requirements of the species are taken into account in the management of SSSIs on which this species occurs. (ACTION: EN)

5.3 Species management and protection

5.3.1 Depending on the results of 5.5.3, establish *ex situ* stocks of this species from material derived from British populations. (ACTION: EN, RBG Kew)

5.4 Advisory

5.4.1 Advise landowners and managers, and relevant agencies, of the presence and importance of Nowell's limestone moss, specific management for its conservation, and any potentially damaging actions. Landowners and managers should have access to specialist advice if needed. (ACTION: EN)

5.5 Future research and monitoring

5.5.1 Resurvey all sites where this species has been recorded in order to confirm the current status of Nowell's limestone moss at each. Extend the survey to cover suitable habitat in the vicinity of these sites which may support Nowell's limestone moss. An assessment of current threats to each site should also be made and used to inform site management and protection measures. (ACTION: EN)

5.5.2 Undertake regular monitoring at all extant sites in order to identify changes in the population of Nowell's limestone moss and to maintain a close understanding of threats to its conservation. (ACTION: EN)

5.5.3 Undertake pilot studies to develop and refine *ex situ* conservation techniques for this species and other threatened bryophytes. (ACTION: EN, RBG Kew)

5.6 Communications and publicity

5.6.1 Encourage bryologists to pass all records of Nowell's limestone moss, including ecological information, to a national database. (ACTION: EN, JNCC)

5.6.2 Liaise with specialist societies to increase the awareness and identification skills of bryologists and other naturalists in relation to this species, through publishing articles or holding identification workshops. (ACTION: EN, JNCC)

5.6.3 Coordinate the conservation programme for Nowell's limestone moss with initiatives that encourage the conservation of dry limestone walls in areas where this species occurs. (ACTION: CC, EN)

5.7 Links with other action plans

5.7.1 None proposed.

Stoneworts



Convergent stonewort (*Chara connivens*)

Action Plan

1. Current status

- 1.1 Convergent stonewort usually behaves as a summer annual. It is a species of alkaline permanent water bodies such as lakes, ponds and ditches, where it grows on sandy or marly substrates in depths of up to 3 m. Most of its known sites are close to the sea, which may suggest that it prefers slightly saline conditions. It is a brittle plant and is intolerant of turbulent conditions.
- 1.2 All British records of this species are from England. It has been recorded recently at two sites in Devon (Slapton Ley and Tinhay) although it may no longer occur at the former. There are also recent records from two sites in the Norfolk Broads. It was previously known from three other sites in the Norfolk and Suffolk Broads and at one site in East Sussex. It has a rather local distribution in continental Europe where it is restricted mainly to the Mediterranean area, but extends northwards to Scandinavia.
- 1.3 In Great Britain this species is classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Pollution, particularly from phosphates and nitrates. The most significant sources of this pollution include effluent from sewage treatment works (especially in the Norfolk Broads where phosphates have also become concentrated in the mud), and also run-off of agricultural chemicals (which may be a problem at Slapton Ley). Waste water from boats is also thought to be contributing to the pollution problem in the Norfolk Broads
- 2.2 Wash from boat traffic is a threat to the Norfolk populations. This is both because of physical disturbance from boat wash and a reduction in light quantities due to increased turbidity.
- 2.3 It is thought that the following factors may also be involved at some sites:
 - 2.3.1 One of the Norfolk Broads sites may be at risk from an increase in salinity levels, as influxes by sea water become more common due to sea-level rise. This needs further investigation.
 - 2.3.2 An invasive non-native pondweed, Nuttall's waterweed (*Elodea nuttallii*) has recently arrived at Tinhay and this may result in competition for light. The threat posed to convergent stonewort by Nuttall's waterweed is difficult to estimate and needs investigation.
 - 2.3.3 Algal blooms resulting from agricultural pollution are suspected to be a threat to convergent stonewort at Slapton Ley and may even have led to its loss here.

3. Current action

- 3.1** One of the Norfolk populations is protected within an NNR (Norfolk Broads) and the Slapton Ley population is within an SSSI.
- 3.2** The Norfolk Broads Authority carries out regular surveys for stoneworts including convergent stonewort.

4. Action plan objectives and targets

- 4.1** Maintain viable populations of this species at all extant sites
- 4.2** Regenerate convergent stonewort at Slapton Ley by 2005, if it is confirmed to be absent here.

5. Proposed action with lead agencies

It is necessary to update and collate information on the current distribution and status of this species, and to improve understanding of its habitat requirements and reproductive ecology with a view to refining conservation management. Meanwhile, management for the species must focus on measures to improve water quality at extant sites.

5.1 Policy and legislation

- 5.1.1** Ensure that the LEAP process and Water Level Management Plans take full account of the requirements of this species. The findings of 5.5.3 should be used to set water quality objectives and nutrient standards within these plans. (ACTION: Broads Authority, EA, IDBs, LAs, MAFF)

5.2 Site safeguard and management

- 5.2.1** Notify the Tinhay site as an SSSI if this is necessary to ensure its long-term protection from damaging activities. (ACTION: EN)
- 5.2.2** Consider targeting relevant agri-environment schemes to land adjacent to remaining convergent stonewort sites, seeking to reduce the threat of adverse practices (including herbicide and fertiliser use). (ACTION: EN, MAFF)
- 5.2.3** Depending on the results of 5.5.3, consider implementing measures to control the spread of Nuttall's waterweed at the Tinhay site. (ACTION: EN)
- 5.2.4** Devise and implement measures to minimise the threats of boat traffic wash and, depending on the results of 5.5.3, phosphate pollution. (ACTION: Broads Authority, EA, EN)

5.3 Species protection and management

- 5.3.1** If convergent stonewort is confirmed as absent from Slapton Ley, undertake trial management with the aim of regenerating convergent stonewort from the spore-bank. The problem of algal blooms may need to be resolved. (ACTION: EN)

5.4 Advisory

- 5.4.1** Advise relevant landowners and managers of the presence and importance of convergent stonewort, and of the appropriate management for its conservation. (ACTION: EN)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers and waterways managers are advised of locations of this species, its importance, and of the management needed for its conservation on and adjacent to existing sites. (ACTION: EN, MAFF)

5.5 Future research and monitoring

- 5.5.1** Collate information and resurvey extant and historic sites to gain a more complete understanding of the current distribution and status of convergent stonewort. (ACTION: EN, JNCC)
- 5.5.2** Devise and implement a monitoring programme for all extant populations. This would need to cover an assessment of population size, current management and potential threats. (ACTION: EN)
- 5.5.3** Undertake a research project in order to improve understanding of the ecological requirements of convergent stonewort. Particular emphasis should be given to assessing the impact of vegetation competition, water quality and boat traffic on the performance of this species. (ACTION: EN, JNCC)
- 5.5.4** Commission research into the possibility of salinity levels rising in the Norfolk Broads as influxes of sea water become more frequent as a result of sea-level rise. The research should consider the need for measures to ensure that salinity levels do not increase further. (ACTION: Broads Authority, EA, EN)

5.6 Communications and publicity

- 5.6.1** None proposed.

5.7 Links with other action plans

- 5.7.1** It is likely that implementation of this action plan will benefit starry stonewort and lesser bearded stonewort which have also both been recorded on the Norfolk Broads.
- 5.7.2** This plan should be considered in conjunction with that for mesotrophic lakes.

Lesser bearded stonewort (*Chara curta*)

Action Plan

1. Current status

- 1.1 Lesser bearded stonewort is a species of calcareous water on peaty or sandy substrates and may behave as an annual or perennial. On the west coast it is found in flooded dune slacks and dune pools and the exposed shores of machair lochs. Elsewhere it is found in limestone lochs, and more rarely in clay pits, old peat cuttings and ditches. It frequently grows on sand in fairly shallow water and may be exposed when water levels drop in summer. In this habitat it is probably a summer annual, but spreading mainly by bulbils. In limestone lochs it occurs in depths of up to 4.5 m and frequently forms dense beds which are probably perennial.
- 1.2 Lesser bearded stonewort was once widespread in East Anglia. It is now thought to be extinct in the Fens, and has not been seen in the Norfolk Broads for at least 13 years. Elsewhere it has recently been discovered at several new sites, and is now known at between 30 and 35 British sites, with several additional records from Northern Ireland (a marked increase on the number of sites (24) indicated in the Red Data Book of British Stoneworts). Outside of East Anglia, the sites are widely scattered, with records from Cornwall, South Wales, Anglesey, Scotland (as far north as Shetland) and Northern Ireland. Most of the extant sites are near the coast. It appears to be relatively widespread in Ireland, and a few records exist from elsewhere in Northern Europe and North Africa.
- 1.3 In Great Britain this species is classified as *Near Threatened*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 The most significant threat is nutrient enrichment from agricultural run-off, particularly in Orkney and Northern Ireland. This would appear to lie behind the extinction of the lesser bearded stonewort in the East Anglian Fens.
- 2.2 Invasion of scrub and other vegetation is a threat to several extant lesser bearded stonewort sites including its dune slack sites.
- 2.3 It is thought that the following factors may also be involved at some sites, and these may require further investigation:
 - 2.3.1 Falling water-table levels are a persistent threat to lesser bearded stonewort's dune-slack sites, a problem which is often a consequence of water abstraction.
 - 2.3.2 Algal blooms have been reported from at least one site in Cornwall, which may cause problems by smothering the colonies of lesser bearded stonewort. The algal blooms may be a result of increased nutrients.

3. Current action

- 3.1** There are four lesser bearded stonewort populations on the Sefton Coast, all of which are protected within a NNR. Three sites in Wales are SSSIs, and two of these are NNRs. The species also occurs on at least five ASSIs in Northern Ireland, two of which are candidate SACs.
- 3.2** Pools are periodically dug in selected dune slacks on the Sefton Coast in order to provide habitat for threatened species including lesser bearded stonewort.
- 3.3** A survey of stoneworts in Wales was commissioned by CCW in 1996 and 1998.

4. Action plan objectives and targets

- 4.1** Maintain viable populations at all extant sites.
- 4.2** Restore populations to three historic sites by 2005, focussing on the East Anglian Fens in order to restore its former range.

5. Proposed action with lead agencies

Recent survey work has led to several new records for lesser bearded stonewort, and it is thought likely that continuation of this work will lead to the discovery of more. Further survey will therefore play an important part in determining priorities for action. In parallel with this, measures should be implemented to promote the beneficial management of lesser bearded stonewort sites in both its dune-slack habitat and other habitat types. These measures should not only address local problems such as scrub encroachment, but also broader issues such as water pollution and falling water-table levels. Efforts should be made to restore the former range through the re-establishment of populations in the Fens.

5.1 Policy and legislation

- 5.1.1** Ensure that relevant Local Environment Agency Plans take full account of the requirements of this species. In particular, the needs of threatened dune-slack species such as lesser bearded stonewort should be considered when assessing applications for water abstraction as they may contribute to a lowering of the water table in dune-slack habitat. Water quality objectives and nutrient standards (from the findings of 5.5.3) should be set within these plans. (ACTION: EA, EHS, EN, SNH)
- 5.1.2** Incorporate the requirements of lesser bearded stonewort in Water Level Management Plans relevant to Fenland re-establishment sites (see 5.3.1). (ACTION: IDBs, LAs, MAFF)

5.1.3 Cooperate with relevant authorities in the Republic of Ireland to ensure that cross-border water quality management strategy addresses the requirements of lesser bearded stonewort. (ACTION: EHS)

5.1.4 Review the management of over-stabilised dune systems and the conservation of their threatened early successional communities and species. (ACTION: CCW, EHS, EN, SNH)

5.2 Site safeguard and management

5.2.1 Control scrub encroachment on all extant lesser bearded stonewort sites. (ACTION: CCW, EHS, EN, SNH)

5.2.2 Assess, and modify if necessary, cattle grazing regimes at the Cors Goch site in Anglesey in order to help reduce competition from other vegetation. The need to introduce grazing at other extant British sites should also be assessed, and grazing introduced where appropriate and compatible with other conservation priorities. (ACTION: CCW, EN, SNH)

5.2.3 Assess the benefits of undertaking limited excavation of pools at each dune-slack site, and where appropriate carry out such excavations. This will be a stop-gap means of providing suitable habitat for this species pending the review of the management of over-stabilised dune systems (5.1.4). (ACTION: CCW, EN, SNH)

5.2.4 Consider targeting relevant agri-environment schemes to land adjacent to lesser bearded stonewort sites, seeking to reduce the threat of adverse practices (including herbicide and fertiliser use). (ACTION: CCW, DANL, EHS, EN, MAFF, SNH, SOAEFD, WOAD)

5.2.5 Ensure that no further lesser bearded stonewort sites are lost through increases in levels of water abstraction. (ACTION: EA)

5.3 Species protection and management

5.3.1 Undertake experimental management on at least three suitable historic sites with the aim of regenerating lesser bearded stonewort from a possible spore-bank, and extend to other sites if the work proves successful. Work should only be carried out on sites where a long-term management commitment is possible. (ACTION: EN)

5.3.2 Assess the feasibility and desirability of reintroducing lesser bearded stonewort to selected historic sites should regeneration from the spore-bank prove unsuccessful. (ACTION: EN)

5.3.3 Assess the desirability and feasibility of introducing this species to suitable habitat in the vicinity of extant sites. (ACTION: EN)

5.4 Advisory

- 5.4.1** Advise relevant landowners and managers of the presence and importance of lesser bearded stonewort, and of the appropriate management for its conservation. (ACTION: CCW, DANI, EHS, EN, MAFF, SNH, SOAEFD)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers, waterways managers and drainage engineers are advised of locations of this species, its importance and of the management needed for its conservation on and adjacent to existing sites. (ACTION: CCW, DANI, EHS, EN, MAFF, SNH, SOAEFD, WOAD)

5.5 Future research and monitoring

- 5.5.1** Collate information and resurvey extant and historic sites to gain a more complete understanding of the current distribution and status of lesser bearded stonewort. Priority areas for survey include the Shetland Isles, from which there are no recent records. (ACTION: CCW, EHS, EN, JNCC, SNH)
- 5.5.2** Devise and implement a monitoring programme for all extant populations. This would need to cover an assessment of population size, current management and potential threats. (ACTION: CCW, EHS, EN, JNCC, SNH)
- 5.5.3** Undertake a research project in order to improve understanding of the water quality and other ecological requirements of lesser bearded stonewort. (ACTION: EN, JNCC)
- 5.5.4** Investigate the problems of falling water tables on sand dune systems including the Sefton Coast. A report should be produced identifying measures which are needed to ensure that water levels are maintained at optimal levels for the conservation of sand-dune biodiversity. The findings of the study should also be used to refine the action outlined under 5.1.2. (ACTION: EA, JNCC)

5.6 Communications and publicity

- 5.6.1** None proposed.

5.7 Links with other action plans

- 5.7.1** It is likely that implementation of this action plan will benefit starry stonewort and convergent stonewort, which have also both been recorded on the Norfolk Broads, dwarf stonewort, *Bryum neodamense* and *B. warneum*. The possibilities of combining 5.2.3 with initiatives to recreate natterjack toad habitat should be explored.
- 5.7.2** This plan should be considered in conjunction with those for fens, coastal sand dunes, mesotrophic lakes and eutrophic lakes.

Slender stonewort (*Nitella gracilis*)

Action Plan

1. Current status

- 1.1 Slender stonewort behaves either as an annual or as a perennial. It appears to grow in a diversity of habitats, but is most often found in shallow water bodies such as ditches, flushes and pools. It has also been recorded in larger water bodies such as upland lakes and clay pits. It occurs most frequently in acid waters, but there are also records from alkaline and even brackish situations. Spores seem able to germinate at almost any time of year.
- 1.2 This species has a very wide distribution in Britain, with records from sites in Cornwall, West Sussex, Greater London, Essex, Shropshire, North Wales, Cumbria, Perthshire and Sutherland. However, it has rarely been reported from any site more than once and its present distribution is not known. Its status is further confused as some records appear to be errors for *N. mucronata* var *gracillima*. Current information suggests that extant populations occur at two sites in Cornwall, one site in Sutherland, two sites in Ayrshire and at least three sites in North Wales (Snowdonia and Ceredigion). Other records are either very old or are probably errors. It is widely distributed both within Europe and throughout the rest of the world.
- 1.3 In Great Britain this species is classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

Although not well known, it is thought that the following are factors:

- 2.1 Pollution from agricultural run-off is believed to be the main threat at some sites.
- 2.2 Afforestation activities in the catchment of the Ayrshire sites may be leading to acidification of its habitat.
- 2.3 Encroachment of scrub and other vegetation may be a threat to some sites.

3. Current action

- 3.1 At least two extant populations are protected within an SSSI.
- 3.2 A survey of stoneworts in Wales was commissioned by CCW in 1996 and 1998.

4. Action plan objectives and targets

- 4.1 Maintain viable populations at all extant sites.
- 4.2 Restore a population of slender stonewort at one suitable historic site by 2005.

5. Proposed action with lead agencies

Knowledge of the status and distribution of slender stonewort in Britain has been somewhat confused since many of the old records appear to be erroneous. A rigorous review of all records, combined with a thorough resurvey of known sites, is therefore needed as a priority. An improved understanding of the habitat requirements and reproductive ecology of slender stonewort is also essential in order to refine conservation management for this species. Known extant sites should be protected from forestry activities, and appropriate management implemented which may include scrub control and periodic clearance of other vegetation. One of the most serious threats to this species is believed to be water pollution. Steps should therefore be taken to reduce the impact of agricultural run-off on the water quality of slender stonewort habitats.

5.1 Policy and legislation

- 5.1.1** Ensure that the requirements of slender stonewort are considered when assessing proposals for afforestation in the vicinity of extant sites and in the surrounding catchments. (ACTION: FC)

5.2 Site safeguard and management

- 5.2.1** Ensure that sites for this species are protected from damaging activities and inappropriate management, through SSSI notification if necessary. (ACTION: CCW, EN, SNH)
- 5.2.2** Consider targeting relevant agri-environment schemes to land adjacent to remaining slender stonewort sites, seeking to reduce the threat of adverse practices (including herbicide and fertiliser use). (ACTION: CCW, EN, MAFF, SNH, SOAEFD, WOAD)
- 5.2.3** Undertake control of scrub and periodic clearance of ditches at all extant sites where the performance of slender stonewort is threatened. This action should be refined with the benefit of the management guidelines proposed under 5.5.4. (ACTION: CCW, EN, SNH)
- 5.2.4** Promote schemes which facilitate the development of buffer strips along water-courses feeding into sites and around the edges of sites, where this will help to reduce pollution from agricultural run-off. (ACTION: CCW, EA, EN, MAFF, SNH, SOAEFD, WOAD)

5.3 Species protection and management

- 5.3.1** Undertake suitable management to regenerate a colony of slender stonewort from the seed-bank of at least one suitable historic site. (ACTION: CCW, EN, SNH)
- 5.3.2** If the action suggested under 5.3.1 is considered inappropriate or the trial is unsuccessful, assess the feasibility and desirability of (re)introducing this species to suitable habitat. Establish a trials at a suitable site if appropriate. (ACTION: CCW, EN, SNH)

5.4 Advisory

- 5.4.1** Advise relevant landowners and managers of the presence and importance of slender stonewort, and of the appropriate management for its conservation. (ACTION: CCW, EN, MAFF, SNH, SOAEFD, WOAD)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers are advised of locations of this species, its importance and of the management needed for its conservation on and adjacent to existing sites. (ACTION: CCW, EN, MAFF, SNH, SOAEFD, WOAD)

5.5 Future research and monitoring

- 5.5.1** Commission a review of all British records of slender stonewort. The review is needed because it is now thought that many of the early records of this species were erroneous. (ACTION: CCW, EN, JNCC, SNH)
- 5.5.2** Following the review of slender stonewort records outlined under 5.5.1, collate information and resurvey extant and historic sites to gain a more complete understanding of the current distribution and status of the species. (ACTION: CCW, EN, JNCC, SNH)
- 5.5.3** Devise and implement a monitoring programme for all extant populations. This would need to cover an assessment of population size, current management and potential threats. (ACTION: CCW, EN, SNH)
- 5.5.4** Commission a research project in order to improve understanding of the ecological requirements of this species. Following the research, management guidelines should be produced and used to refine conservation action for this species. (ACTION: CCW, EN, JNCC, SNH)

5.6 Communications and publicity

- 5.6.1** None proposed.

5.7 Links with other action plans

- 5.7.1** None proposed.

Dwarf stonewort (*Nitella tenuissima*)

Action Plan

1. Current status

- 1.1 Dwarf stonewort is one of the smallest stonewort species, growing to a maximum of 20 cm, but usually less than 10 cm tall. It is a species of calcareous fenland, where it occurs in shallow peaty pools and ditches in depths of up to 1 m. It seems to favour a fairly firm peaty substrate without much competition from filamentous algae or vascular plants. It is an annual species which survives as spores during periods of drought which may limit the growth of other aquatic plants. At one of its sites its only recent appearances have been in the summer or autumn following peat-cutting activities, presumably as a result of the exposure of buried spores (which can apparently remain viable for decades), but has soon died out because of competing vegetation. In Anglesey some poaching by livestock may help to maintain openings in the vegetation.
- 1.2 Dwarf stonewort has been seen at only three British sites in recent years. The largest population occurs at a site in Anglesey where it grows in patches within an area of approximately 18 x 5 m. It is also extant at another site in Anglesey and appears periodically at a site in Cambridgeshire. Although it was once known from nine other sites, it has not been seen at any of these in recent years. Elsewhere, this species is known throughout much of central Europe, but becomes rare in Scandinavia and the Mediterranean region. It is also recorded from southern Africa, Madagascar, India and North America.
- 1.3 In Great Britain this species is classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Colonies of dwarf stonewort are threatened by the reversion of its habitat to dense swamp due to lack of disturbance. This may have been responsible for the loss of populations at several historic sites.
- 2.2 Water pollution from agricultural run-off may be another factor limiting its population growth at Cors Goch (Anglesey).

3. Current action

- 3.1 Both of the Anglesey populations are protected within NNRs and the Cambridgeshire population is within an SSSI.
- 3.2 A survey of stoneworts was commissioned by CCW in 1996 and 1998.

4. Action plan objectives and targets

- 4.1** Maintain viable populations at all extant sites.
- 4.2** Restore viable populations of dwarf stonewort at three former sites by 2005.

5. Roposed action with lead agencies

Action for this species should concentrate on addressing the lack of appropriate management at extant sites. Appropriate management might include grazing or periodic vegetation clearance. Management should also be undertaken at suitable historic sites with the aim of regenerating this species from the spore-bank.

5.1 Policy and legislation

- 5.1.1** None proposed.

5.2 Site safeguard and management

- 5.2.1** Ensure that grazing is continued or reinstated at all extant dwarf stonewort sites, and on historic sites where suitable habitat remains and when consistent with other conservation priorities. It is, however, important that a careful check is kept on grazing levels so as to avoid excessive nutrient enrichment. (ACTION: CCW, EN)
- 5.2.2** Consider targeting relevant agri-environment schemes to land adjacent to remaining dwarf stonewort sites, seeking to reduce the threat of adverse practices (including herbicide and fertiliser use). (ACTION: CCW, EN, MAFF, WOAD)
- 5.2.3** Where appropriate, undertake periodic local clearance of vegetation at extant sites. Assess the need for other habitat management at each site with the guidance of a relevant expert. (ACTION: CCW, EN)

5.3 Species protection and management

- 5.3.1** Assess the feasibility of regenerating colonies of dwarf stonewort from the spore-bank at carefully selected historic sites. Suitable management may include clearance of fen vegetation. If appropriate, undertake trials at three sites. (ACTION: CCW, EN)
- 5.3.2** Consider undertaking transplantation of turves of dwarf stonewort to suitable pools within the three selected historic sites if regeneration from the spore-bank proves unsuccessful. (ACTION: CCW, EN)

5.4 Advisory

- 5.4.1** Advise relevant landowners and managers of the presence (or former presence) and importance of dwarf stonewort, and of the appropriate management for its conservation. (ACTION: CCW, EN)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers are advised of locations of this species, its importance and of the management needed for its conservation on and adjacent to existing sites. (ACTION: CCW, EN, MAFF, WOAD)

5.5 Future research and monitoring

- 5.5.1** Collate information and resurvey extant and historic sites to gain a more complete understanding of the current distribution and status of dwarf stonewort. The survey should include a search of pools close to extant colonies, that have not been adequately surveyed in recent years. (ACTION: CCW, EN, JNCC)
- 5.5.2** Devise and implement a monitoring programme for all extant populations. This would need to cover an assessment of population size, current management and potential threats. (ACTION: CCW, EN)
- 5.5.3** Undertake a research project to investigate further the habitat requirements and reproductive ecology of dwarf stonewort. (ACTION: CCW, EN)

5.6 Communications and publicity

- 5.6.1** None proposed.

5.7 Links with other action plans

- 5.7.1** It is likely that implementation of this action plan will benefit lesser bearded stonewort.
- 5.7.2** This plan should be considered in conjunction with that for fens.

Starry stonewort (*Nitellopsis obtusa*)

Action Plan

1. Current status

- 1.1 Starry stonewort is a species of deep lakes and slow-running water at low altitudes. It generally grows at depths of between 1 and 6 m and is very rarely found in shallow water. Most of its sites occur in calcareous water and are usually near to the coast which suggests that it may prefer slightly saline conditions. It seems to be capable of surviving in low light intensities, but is less tolerant of turbulent conditions. Observations suggest that it is generally a summer annual, but in favourable conditions and mild winters it may not die back completely.
- 1.2 The main centre for this species has always been the Norfolk Broads, where it has been recorded from about six sites (historic records are difficult to localise). However, recent surveys have confirmed its presence in only two of these. There is also a recent record from a gravel pit in Gloucestershire. Other areas where it has been recorded in the past include Devon, Hampshire and Surrey, but it is doubtful whether it still occurs at any sites in these areas. Records from Perthshire and Dorset are likely to be erroneous. Starry stonewort is scarce throughout Europe.
- 1.3 In Great Britain this species is classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Water pollution, particularly from phosphates and nitrates. The most significant sources of this pollution include effluent from sewage treatment works (especially in the Norfolk Broads where phosphates have also become concentrated in the mud) and also, run-off of agricultural chemicals.
- 2.2 It is thought that the following factors may also be involved at some sites:
 - 2.2.1 Disturbance from boat traffic may be a threat at the Norfolk Broads sites. Waste water from boats may also be contributing to the pollution problem here.
 - 2.2.2 Algal blooms may be a threat to some populations. These blooms are generally a consequence of the pollution problems mentioned under 2.1.
 - 2.2.3 The Norfolk Broads sites may be at risk from an increase in salinity levels, as influxes by sea water become more common due to sea-level rise. Although starry stonewort appears to tolerate slightly saline conditions, its performance may decline if salinity levels increase.
 - 2.2.4 The large numbers of waterfowl at the Gloucestershire site may threaten the habitat with eutrophication.

3. Current action

- 3.1** Both of the extant Norfolk Broads populations, and the Gloucestershire population, are protected within an SSSI.

4. Action plan objectives and targets

- 4.1** Maintain viable populations at all extant sites.

5. Proposed action with lead agencies

It will be important early on to establish the current distribution of starry stonewort. Action for this species should address both the large-scale threats to its conservation (such as water pollution) and site based threats such as vegetation competition. More research is needed in order to improve understanding of the ecological requirements of this species and appropriate measures for its conservation.

5.1 Policy and legislation

- 5.1.1** Review/establish water quality objectives and associated nutrient standards at all of the extant starry stonewort sites taking into account the requirements of this and other threatened aquatic species. (ACTION: Broads Authority, EA, LAs)

5.2 Site safeguard and management

- 5.2.1** Ensure that the needs of this species are addressed in the management plan for the Gloucestershire site. (ACTION: EN)
- 5.2.2** Assess the benefits of clearing competing vegetation around extant colonies of starry stonewort, and undertake management trials if appropriate. If the technique is found to be successful after careful monitoring of the trials, consider implementing as an on-going management action. (ACTION: EN)
- 5.2.3** Depending on the results of 5.5.3, devise and implement measures to minimise the threats of boat traffic wash and phosphate pollution. (ACTION: Broads Authority, EA, EN)
- 5.2.4** Consider targeting relevant agri-environment schemes to land adjacent to remaining starry stonewort sites, seeking to reduce the threat of adverse practices (including herbicide and fertiliser use). (ACTION: EN, MAFF)

5.3 Species protection and management

- 5.3.1** None proposed.

5.4 Advisory

- 5.4.1** Advise relevant landowners and managers of the presence and importance of starry stonewort, and of the appropriate management for its conservation. (ACTION: EN)

5.5 Future research and monitoring

- 5.5.1** Collate information and resurvey extant and historic sites to gain a more complete understanding of the current distribution and status of starry stonewort. Survey work should include a survey of gravel pits surrounding the known Gloucestershire site, and a check of the reported site for this species in Perthshire. (ACTION: EN, JNCC, SNH)
- 5.5.2** Devise and implement a monitoring programme for all extant populations. This would need to cover an assessment of population size, habitat quality, current management and potential threats. (ACTION: EN)
- 5.5.3** Undertake a research project to investigate further the habitat requirements and reproductive ecology of starry stonewort. The research should include an assessment of the effects of boat traffic on the performance of this species, the significance of competition from other aquatic vegetation and the effects of phosphate pollution. (ACTION: EN, JNCC)

5.6 Communications and publicity

- 5.6.1** None proposed.

5.7 Links with other action plans

- 5.7.1** It is likely that implementation of this action plan will benefit convergent stonewort and lesser bearded stonewort which have also both been recorded on the Norfolk Broads.
- 5.7.2** This plan should be considered in conjunction with that for mesotrophic lakes.

Tassel stonewort (*Tolypella intricata*)

Action Plan

1. Current status

- 1.1 Tassel stonewort is a species of alkaline water in pools, canals, ditches, poached edges of ponds and wheel-ruts that are dry during the summer months. The plant is often a winter or spring annual, able to withstand ice-cover and producing ripe spores as early as April or May. Plants then often disappear by early July. It is not very competitive and benefits from disturbance which keeps down other vegetation. Thus in ditches, it often reappears after clearance work, and cattle disturbance around pools is often beneficial.
- 1.2 This species has been found at six British sites since 1970: ponds in Inglestone Common, Gloucestershire (seven colonies), one site in Cambridgeshire (four colonies), and one site in each of Suffolk, Norfolk, Somerset and Worcestershire. The species reappeared at the Somerset site following ditch clearance in 1989, but has not been seen since. It was once more widespread, being recorded from 42 localities pre-1970, most of which were in southern and eastern England, but it also extended as far north as Durham. It is scattered throughout Europe extending to southern Scandinavia, the Black Sea and North Africa, but is rare in the Mediterranean area.
- 1.3 In Great Britain this species is classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Lack of disturbance (often due to the decline of traditional management practices such as ditch clearance) leading to displacement of this species by more competitive vegetation.
- 2.2 Falling water-table levels may have been responsible for the loss of populations at several sites and may still be a threat at some extant sites. The extent of this problem needs further investigation.

3. Current action

- 3.1 New sites have been recently rediscovered in Gloucestershire following a survey of approximately 200 ponds. There are around 150 ponds which remain unchecked.

4. Action plan objectives and targets

- 4.1 Maintain viable populations of this species at all extant sites.
- 4.2 Restore or establish populations at five suitable sites by 2005.

5. Proposed action with lead agencies

An early action for this species should be the completion of the survey of ponds in the area around the extant Gloucestershire sites. All sites outside Gloucestershire with recent records should also be rigorously checked. In parallel with this work, beneficial management regimes at extant sites should be reinstated. This may include scrub control, grazing and periodic clearance of ditches. The restoration or establishment of colonies at five sites should be pursued to reverse the trend of decline, and the problems of falling water-table levels should also be addressed at extant sites.

5.1 Policy and legislation

- 5.1.1** Take account of the requirements of tassel stonewort when developing new, or reviewing existing, environmental land management schemes that promote the traditional management of lowland commons and village greens. (ACTION: DETR, EN, MAFF)

5.2 Site safeguard and management

- 5.2.1** Control scrub invasion at all extant sites in order to prevent overshadowing of tassel stonewort colonies. (ACTION: EN)
- 5.2.2** Promote the reinstatement/continuation of cattle grazing on extant tassel stonewort sites. Suitable mechanisms may include the Countryside Stewardship Scheme and other relevant agri-environment schemes. (ACTION: EN, MAFF)
- 5.2.3** Notify stronghold sites as SSSIs where this is necessary to ensure their long-term protection. (ACTION: EN)
- 5.2.4** Undertake periodic clearance of ditch sites for this species in order to reduce competition from other vegetation. (ACTION: EN)
- 5.2.5** Ensure that Local Environment Agency Plans and Water Level Management Plans take full account of the requirements of this species. In particular, ensure that no further tassel stonewort sites are lost through increases in levels of water abstraction. This action should take account of the research outlined under 5.5.5. (ACTION: EA, EN, MAFF)

5.3 Species protection and management

- 5.3.1** Undertake experimental management at five suitable historic sites with the aim of regenerating populations from the spore-bank. Management may include scrub clearance and soil disturbance. Suitable historic sites will include those where a long-term management commitment is possible. (ACTION: EN)
- 5.3.2** Consider undertaking (re)introductions of this species to suitable ponds in historic sites or the vicinity of extant sites, if regeneration from the spore-bank proves unsuccessful. (ACTION: EN)

5.4 Advisory

- 5.4.1** Advise relevant landowners and managers of the presence and importance of tassel stonewort, and of the appropriate management for its conservation. (ACTION: EN)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers, particularly in the Gloucestershire area, are advised of locations of this species, its importance and of the management needed for its conservation on and adjacent to existing sites. (ACTION: EN, MAFF)

5.5 Future research and monitoring

- 5.5.1** Complete the survey of ponds within the vicinity of the known Gloucestershire sites. The opportunity should also be taken to assess current threats to sites in this area. (ACTION: EN)
- 5.5.2** Collate information and resurvey extant and historic sites in Somerset and Cambridgeshire to gain a more complete understanding of the current distribution and status of tassel stonewort. (ACTION: EN, JNCC)
- 5.5.3** Undertake a research project to elucidate whether nutrient enrichment and/or competition with filamentous algae is significantly affecting populations of tassel stonewort. (ACTION: EN, JNCC)
- 5.5.4** Devise and implement a monitoring programme for all extant populations. This would need to cover an assessment of population size, habitat quality, current management and potential threats. (ACTION: EN)
- 5.5.5** Collate information and undertake research if necessary to identify measures needed to address the problem of falling water-table levels on extant tassel stonewort sites. (ACTION: EN, JNCC)

5.6 Communications and publicity

- 5.6.1** None proposed.

5.7 Links with other action plans

- 5.7.1** It is likely that implementation of this action plan will benefit pennyroyal and pillwort.

Great tassel stonewort (*Tolypella prolifera*)

Action Plan

1. Current status

- 1.1 Great tassel stonewort is a spring annual which grows in slow-moving alkaline water in ditches, rivers and canals. Although generally found in shallow water, it tends to prefer deeper water than other members of the genus. It seems to benefit from periodic disturbance and often occurs in quantity after ditch clearances.
- 1.2 This species formerly occurred at locations scattered throughout England as far north as Lancashire and Yorkshire. However, it has only been confirmed at six sites since 1970. Two ditch sites are in Cambridgeshire, at one of which it reappeared in 1990 following ditch clearance. The other sites are in Gloucestershire, where it was last seen in 1977 (the site is overgrown but suitable habitat exists nearby); Somerset, where there are two sites, one of which was discovered in 1998; and Sussex, where it has been recorded sporadically in several locations. This latter site is the best remaining. Great tassel stonewort is scattered throughout central western Europe, reaching its northern limit in England and extending to Poland and northern Italy. It is also recorded from North and South America.
- 1.3 In Great Britain this species is classified as *Endangered*. It receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1 Lack of periodic disturbance, eg ditch clearance, leading to overcrowding by other vegetation.
- 2.2 Water enrichment is occurring at one of the Cambridgeshire sites.

3. Current action

- 3.1 Two of the four extant populations for this species are protected within SSSIs, and one of the others is in a local Wildlife Trust reserve.

4. Action plan objectives and targets

- 4.1 Maintain viable populations at all extant sites.
- 4.2 Restore populations to at least three suitable historic sites by 2005.

5. Proposed action with lead agencies

Following further survey to update information on the current distribution and status of great tassel stonewort, action should focus on establishing beneficial management regimes at all extant sites. This will take account of research into the habitat requirements and reproductive ecology of the species. Experimental management with the aim of regenerating this species from a possible spore-bank should also be undertaken at suitable historic sites.

5.1 Policy and legislation

5.1.1 None proposed.

5.2 Site safeguard and management

5.2.1 Clear great tassel stonewort sites periodically (but do not deep-dredge) in order to reduce competition from other vegetation. (ACTION: EN)

5.2.2 Control scrub on all extant sites where it threatens to limit the growth of great tassel stonewort populations. (ACTION: EN)

5.3 Species protection and management

5.3.1 Undertake experimental management on at least three suitable historic sites with the aim of regenerating great tassel stonewort from the spore-bank. Techniques should be developed from research outlined under 5.5.3. (ACTION: EN)

5.4 Advisory

5.4.1 Advise relevant landowners and managers of the presence and importance of great tassel stonewort, and of the appropriate management for its conservation. (ACTION: EN)

5.4.2 As far as possible, ensure that relevant agri-environment project officers, waterways managers and drainage engineers are advised of locations of this species, its importance and of the management needed for its conservation on and adjacent to existing sites. (ACTION: EN, MAFF)

5.5 Future research and monitoring

5.5.1 Collate information and resurvey sites where necessary in order to determine the current distribution and status of this species in Britain, and to assess the threats to populations at extant sites. (ACTION: EN, JNCC)

5.5.2 Devise and implement a monitoring programme for all extant populations. This would need to cover an assessment of population size, current management and potential threats. (ACTION: EN)

- 5.5.3** Undertake a research project to investigate further the habitat requirements and reproductive ecology of great tassel stonewort. Restoration management should form an element of the study, and the findings should be used to refine management action for its conservation. (ACTION: EN, JNCC)

5.6 Communications and publicity

- 5.6.1** None proposed.

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with that for *Leersia oryzoides*.

Vascular Plants



Juniper (*Juniperus communis*)

Action Plan

1. Current status

- 1.1** Juniper is divided into at least two subspecies with frequent intermediates. Subspecies *communis* ranges from a spreading shrub to erect tree, while subspecies *nana* is a procumbent, matted shrub. There is possibly a third subspecies (*hemisphaerica*) from maritime cliffs in Cornwall and Pembrokeshire, but this requires confirmation. Overall, juniper has an extensive, but rather discontinuous distribution; it can tolerate a range of climatic and edaphic conditions, and it forms a component of a number of British plant communities. Subspecies *communis* can be regarded as a successional shrub, opportunistic in its pattern of establishment and quickly shaded out as scrub thickens or an over-topping woodland canopy develops. This subspecies has two main population centres, in the Scottish Highlands and the chalk downs of southern England, but it has important populations elsewhere. Subspecies *communis* forms unusual thickets on sand dunes on the north-east coast of Scotland. Subspecies *nana* is largely restricted to north-west Scotland as a component of montane heath vegetation.
- 1.2** Data at the Biological Record Centre (BRC) suggests that there has been a 60% decline in the number of occupied 10 km squares up to 1960, but the data are known to be incomplete. The most detailed recent study, in Northumbria, only covered the period from 1973 to 1995. Nevertheless there was an overall population decline here of 30%, while 54% of colonies showed a decline in numbers and 16% of colonies became extinct. The long life of the adult bushes means that moribund populations with no regeneration may be recorded for a very long time, although they can be regarded as functionally extinct. No quantitative data are available on the decline of subspecies *nana*, but the total extent of larger stands of *Calluna vulgaris* - *Juniperus communis* ssp *nana* heath (NVC class H15) is estimated at just 805 ha. It is known that burning can reduce this vegetation to a fragmentary cover from which recovery may be very slow.
- 1.3** Juniper receives general protection under the Wildlife and Countryside Act 1981.

2. Current factors causing loss or decline

- 2.1** Excessive grazing which prevents establishment of young bushes.
- 2.2** Insufficient grazing which reduces the area suitable for juniper regeneration. This may also cause the loss of adult bushes as tree recruitment leads to increased shade.
- 2.3** Direct clearance of stands.
- 2.4** Excessive burning which may destroy young regeneration and adult bushes.
- 2.5** Low economic and cultural value attached to the species.

3. Current action

- 3.1** ITE is surveying the current status and distribution of the species in England, continuing demographic monitoring and pathological investigations at Porton Down and researching ways to manage and reinstate subspecies *nana* and its associated vegetation community on Harris.
- 3.2** An English Nature study in Northumbria has led to a Wildlife Enhancement Scheme Initiative which aims to maintain and extend the area and improve the quality of juniper habitats in the area.
- 3.3** FC is studying regeneration and methods of establishment at Glenlivet in Speyside and Glen Garry in Lochaber.
- 3.4** Many juniper populations are included in designated sites. For instance in the Scottish Borders 37 out of 71 juniper sites are in SSSIs, whilst 31% of bushes recorded in an extensive survey of populations in southern England were in protected areas. Some SSSIs have been notified primarily to protect juniper. Subspecies *nana* is found in the Cairngorms NNR, and on at least five SSSIs in north-west Scotland.
- 3.5** Juniper occurs in a number of habitat types listed under the EC Habitats Directive, and juniper scrub has been recognised as a nationally scarce woodland type.
- 3.6** An action group involving SNH, the Forestry Commission, Highland Birchwoods, the Scottish Agricultural College, National Trust for Scotland and Plantlife has been set up to increase interest in, and develop management prescriptions for, montane scrub woodland of which juniper would be a natural component in many areas.

4. Action plan objectives and targets

- 4.1** Maintain the present range and overall population size of juniper.
- 4.2** Restore appropriate management to permit regeneration at all sites under direct conservation management, where the present condition of the population gives cause for concern.
- 4.3** Maintain, or re-establish, populations at sites not under direct conservation management.
- 4.4** Restore representative tree-line juniper populations.

5. Proposed action with lead agencies

Regional priorities for this species will vary considerably, so the first need is to assess the viability of existing juniper populations and develop regional strategies to protect the resource. Within many regions, regeneration urgently needs to be stimulated to enable the restoration of a wider range of age structure across the area as a whole while taking into account the long life of juniper. Since a substantial proportion of populations are in areas with no statutory protection, action is needed to increase awareness and appreciation of juniper amongst land

managers and the general public. Investigating the potential for sustainable exploitation could give the species an enhanced value to land managers. Research is necessary to identify ways to enable successful regeneration by the species.

5.1 Policy and legislation

- 5.1.1** Use the FC Woodland Grant Scheme as a means to maintain populations within the woodland context. This includes measures to encourage the restoration of sub-alpine scrub with juniper where appropriate as the upper limit to native woodland schemes. (ACTION: FC, SNH)
- 5.1.2** When next reviewed, consider how the Scottish Countryside Premium Scheme, the Countryside Stewardship Scheme, Tir Gofal and other agri-environment measures could benefit the species. (ACTION: MAFF, SOAEFD, WOAD)
- 5.1.3** Take into account the ecological requirements of juniper when seeking to influence the reform of CAP with respect to the management of semi-natural rough grazing land. (ACTION: MAFF, SOAEFD, WOAD)

5.2 Site safeguard and management

- 5.2.1** Consider the best examples of juniper habitat which meet local or national criteria for notification as SSSIs. (ACTION: CCW, EN, SNH)
- 5.2.2** Assess site management in reserves and designated sites where juniper exists and ensure that site management permits the natural regeneration of juniper in part at least. (ACTION: CCW, EN, FC, SNH)
- 5.2.3** Maintain existing populations outside SSSIs wherever possible by encouraging landowners to manage their land in ways that encourage juniper, and by offering advice and practical assistance for such management. (ACTION: CCW, EN, FC, MAFF, SNH, SOAEFD, WOAD)

5.3 Species management and protection

- 5.3.1** Assess the desirability of reintroducing juniper at former sites in regions of the UK in which the species has declined significantly. Undertake trial reintroductions where appropriate. (ACTION: CCW, EN, SNH)

5.4 Advisory

- 5.4.1** Advise relevant landowners and managers of the presence and importance of juniper, and of the appropriate management for its conservation. (ACTION: CCW, EN, FC, SNH)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers are advised of locations of this species, its importance and of the management needed for its conservation. (ACTION: CCW, EN, FC, MAFF, SNH, SOAEFD, WOAD)

5.4.3 Develop and issue best practice guidance to encourage the maintenance and regeneration of juniper in woodland communities. (ACTION: CCW, EN, FC, SNH)

5.4.4 Develop and issue best practice guidance to encourage the restoration of treeline scrub woodland with juniper as a component. (ACTION: CCW, EN, FC, SNH)

5.5 Future research and monitoring

5.5.1 Review the taxonomic status of subspecies *hemisphaerica* and intermediates. (ACTION: CCW, EN, SNH)

5.5.2 Update the BRC database on the species to act as a base line for regional assessments of local conservation requirements for the species. (ACTION: CCW, EN, SNH)

5.5.3 Develop and carry out a programme for regional survey to assess the extent, age range and reproductive potential of juniper populations, classifying populations according to the risk of loss and potential for survival. Use the results of this survey to set priorities for regional action to maintain and, where necessary, restore populations. (ACTION: CCW, EN, SNH)

5.5.4 Identify suitable areas where new populations of juniper can be established to contribute to habitat biodiversity and replace unavoidable losses of existing populations. (ACTION: CCW, EN, SNH)

5.5.5 Undertake research into optimum levels of grazing disturbance and habitat management to encourage germination, regeneration and development of juniper. (ACTION: CCW, EN, FC, SNH)

5.5.6 Review methods for establishing juniper. (ACTION: CCW, EN, FC, SNH)

5.5.7 Clarify the classification of juniper communities within the British NVC. (ACTION: SNH)

5.5.8 Encourage research into possible sustainable economic uses of juniper as a means to encourage an expansion in the area of semi-natural juniper vegetation and to enhance management of existing areas. (ACTION: CCW, EN, FC, SNH)

5.6 Communications and publicity

5.6.1 Ensure that the significance of juniper, the threats to it and suitable management to maintain it are publicised, particularly in relation to the different land management systems in which it occurs - forestry, agriculture and recreation (the latter including deer stalking and shooting estates). (ACTION: CCW, EN, FC, MAFF, SNH, SOAEFD, WOAD)

5.6.2 Support a publication on the significance to biodiversity of montane scrub woodland including juniper as a component. (ACTION: CCW, EN, FC, SNH)

5.6.3 Continue and expand the exchange of information on the ecology and habitat requirements of juniper with European counterparts. (ACTION: CCW, EN, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with the habitat action plans for native pine woodland, upland heathland, lowland calcareous grassland and maritime cliff and slopes, and with the species action plan for twinflower.

Twinflower (*Linnaea borealis*)

Action Plan

1. Current status

- 1.1 Twinflower is found primarily on podsolic soils in the native pinewood remnants of north-east Scotland. It is also found, although much more rarely: in forestry plantations, almost always those that were planted with Scots pine; on moorland usually growing in the shade of mountain rocks; and occasionally in birch woods. It is a creeping woody perennial which is shallow-rooting and susceptible to drought. It freely regenerates vegetatively, producing clonal groups which may be self-incompatible. It requires slight shade to flower well.
- 1.2 Although twinflower has a favourable conservation status within Europe, its distribution in the UK has declined considerably in recent years. According to *Scarce plants in Britain*, the species has shown a 64% decline from pre-1970 records to those post-1970. It is found in about 50 locations from Caithness to the Borders, with a concentration of records around the Cairngorms. It was previously recorded from old pine plantings in northern England, but it is now extinct in this area and is entirely confined to Scotland.
- 1.3 In Great Britain twinflower is classified as *Nationally Scarce*. It has no special legal protection.

2. Current factors causing loss or decline

- 2.1 Mechanical harvesting of timber and ground preparation for replanting.
- 2.2 Unrestricted grazing by deer, sheep or cattle affecting the pinewood habitat.
- 2.3 Reproductive isolation of twinflower populations consisting of single clones.
- 2.4 Shade resulting from encouragement of dense tree regeneration.

3. Current action

- 3.1 The main habitat of twinflower is native pine woodland which is listed as a priority habitat in Annex 1 of the EU Habitats Directive 1992.
- 3.2 Twinflower is present in designated areas including the following: Abernethy Forest Reserve; Cairngorms NNR; Culbin Forest SSSI; Eastern Cairngorms SSSI; Glen Tanar NNR; Inverfarigaig SSSI; Loch Fleet SSSI; Loch Ussie SSSI; and Morrone Birkwood NNR.
- 3.3 Twinflower has been included as part of SNH's Species Action Programme, in a partnership with Plantlife, Aberdeen University and latterly Edinburgh University. Under this initiative a comprehensive survey of surviving populations is being undertaken to determine their regeneration potential under present conditions.

- 3.4 Twinflower is in cultivation at Aberdeen University Botanic Garden, Edinburgh University and RBGE.

4. Action plan objectives and targets

- 4.1 Prevent the further decline of twinflower, retaining populations as components of functioning pinewood ecosystems wherever possible.
- 4.2 Ensure that all populations are capable of sexual regeneration by 2010.
- 4.3 Restore, by 2005, the species to five historic sites.

5. Proposed action with lead agencies

The major thrust of this action plan relates to protection of the pinewood habitat and management of this habitat with consideration for the requirements of twinflower. The results of the current survey of populations and their regeneration need to be related to current management in order to provide appropriate management prescriptions. Actions are also defined to counter the isolation of self-incompatible clones in British populations.

5.1 Policy and legislation

- 5.1.1 Consider, and develop prescriptions for, the introduction of twinflower into new woodland sites created by the Native Pinewood Grant Scheme, and into old pine plantations. (ACTION: FC, SNH)

5.2 Site safeguard and management

- 5.2.1 Consider the representation of twinflower within the SSSI series and ensure that management prescriptions take its requirements fully into account. (ACTION: SNH)
- 5.2.2 Ensure that Caledonian Forest reserves, and other Forest Enterprise sites where twinflower is present, are managed with consideration for its ecological requirements. (ACTION: FE)
- 5.2.3 Ensure that management plans for Forest Reserves, NNRs, SSSIs and SACs where twinflower is present take account of the need to maintain viable populations of the species. (ACTION: SNH)
- 5.2.4 Ensure that where twinflower is located in plantation forests, consideration is given to modifying the management of the surrounding area to ensure the survival of the population. (ACTION: FC, SNH)

5.3 Species management and protection

- 5.3.1 Instigate measures to remedy chronic failure of fruit production in populations. (ACTION: SNH)

- 5.3.2 Reintroduce the species to five historic sites which now appear suitable to maintain a viable population. (ACTION: FE, SNH)

5.4 Advisory

- 5.4.1 Inform landowners, land managers and foresters of the presence and significance of twinflower and advise them of suitable management for its survival. (ACTION: FC, SNH)
- 5.4.2 Provide guidelines for managers of old Scots native pine plantations to maintain or restore twinflower populations. (ACTION: FC)

5.5 Future research and monitoring

- 5.5.1 Establish the current and past distribution of twinflower, and assess population size and sexual regeneration by encouraging and sponsoring appropriate botanical survey. (ACTION: SNH)
- 5.5.2 Develop an inventory of old Scots pine plantations of high conservation value as existing sources of twinflower or potential restoration sites. (ACTION: FC, SNH)
- 5.5.3 Assess the effect of current management practices on survival and seed-set of the species by examining existing populations. (ACTION: FC, SNH)
- 5.5.4 For a sample of populations use genetic markers to establish the distribution of clones. (ACTION: SNH)
- 5.5.5 Examine experimentally the efficacy of translocation between existing populations to overcome negative results of clonal isolation on fruit production. (ACTION: SNH)
- 5.5.6 Monitor the survival and performance of twinflower at a representative range of known sites including populations under a range of management conditions. (ACTION: FC, SNH)
- 5.5.7 Report on the value for a relatively wide-ranging species and difficulties of trying to maintain live clones or seed *ex situ*, primarily as material for research and as a means to encourage public awareness and to maintain the genetic diversity. (ACTION: RBGE, SNH)
- 5.5.8 Exchange information on the ecology and habitat requirements of twinflower with European counterparts and in particular on fruit production. (ACTION: RBGE, SNH)

5.6 Communications and publicity

- 5.6.1 Ensure that the rarity of the species and threats to its survival are widely understood by woodland managers and the general public. (ACTION: FC, SNH)
- 5.6.2 Create or manage at least one accessible population in its natural habitat to increase appreciation and understanding of this attractive and threatened species, and encourage the display of the species in *ex situ* collections to assist this process. This will act as a 'flagship' for

its habitat and will reduce botanical pressure on other populations. (ACTION: FE, RBGE, SNH)

5.7 Links with other action plans

- 5.7.1** Action for this species should be considered in conjunction with the habitat action plan for native pine woodland, and also with the species action plan for juniper.

Small cow-wheat (*Melampyrum sylvaticum*)

Action Plan

1. Current status

- 1.1 Small cow-wheat is an annual hemiparasitic herb found on ledges, grassy hollows and banks in woodland with a fairly open canopy in northern Britain and Northern Ireland. It also grows in tree-lined ravines, stream valleys, and, occasionally, on sloping lake shores with light tree cover. Most sites are flushed and distinctly humid, and usually are near waterfalls, burns or lochs. At higher altitudes it sometimes occurs on corrie ledges. It has a relatively restricted distribution, and a habitat preference which is vulnerable to changing land management. The species is a European endemic which is most widespread in Scandinavia and through the Alps and Balkans.
- 1.2 Small cow-wheat occurs locally in Scotland, northern England and Northern Ireland, with herbarium records from the last century in Wales (see 3.2). The latest data indicate that this species has only been confirmed from 25 ten km squares, so that it appears to have been lost from 70% of its former range in the British Isles, especially in the lowlands around the margins of its distribution.
- 1.3 In Great Britain small cow-wheat is classified as *Nationally Scarce* and is protected under Schedule 8 of the Wildlife (Northern Ireland) Order 1985, but receives no special protection elsewhere in the UK.

2. Current factors causing loss or decline

- 2.1 The development of non-native evergreen woody vegetation at extant sites, including the planting and development of conifers.
- 2.2 Inappropriate grazing of woodland; intense grazing and the cessation of grazing can both reduce its survival.
- 2.3 Agricultural intensification; intensive farming at the edge of its woodland habitat can result in fertiliser flushing leading to growth of rank competing vegetation.

3. Current action

- 3.1 In 1995 SNH commissioned a review of the ecology and distribution of small cow-wheat which included a review of previous records and a survey of a sample of sites, together with recommendations for further assessments at specific sites.
- 3.2 CCW has planned a survey of sites in the vicinity of two Welsh 19th century herbarium records of the species.

- 3.3** It is known to occur on three SSSIs managed as reserves: the Birks of Aberfeldy (Falls of Moness) (LNR), Keltneyburn (Scottish Wildlife Trust reserve) and Mar Lodge (National Trust for Scotland reserve, largely within NNR).

4. Action plan objectives and targets

- 4.1** Halt the decline of the species by 2005, maintaining existing populations as components of viable and functioning woodland ecosystems.
- 4.2** Restore, by 2010, small cow-wheat to five historic sites from which it has been lost.

5. Proposed actions with lead agencies

A major component of this action plan relates to protection of its open upland deciduous woodland habitat, and to management of this habitat with consideration for the requirements of small cow-wheat. Further survey of surviving populations is required to determine their viability (regeneration and mortality) and to relate this to current management so as to provide appropriate management prescriptions. Action is also proposed to counter past losses by experimental restoration of some populations.

5.1 Policy and legislation

- 5.1.1** None proposed.

5.2 Site safeguard and management

- 5.2.1** Consider the representation of small cow-wheat in the ASSI/SSSI series and ensure that management prescriptions for ASSI/SSSIs with small cow-wheat take its requirements into account. (ACTION: CCW, EHS, EN, SNH)
- 5.2.2** Use all available means to ensure that all sites with small cow-wheat are managed sympathetically to its requirements, with regard to forestry operations, grazing regimes and agricultural practices on adjoining land. (ACTION: CCW, DANI, EHS, EN, FC, MAFF, SNH, SOAEFD)
- 5.2.3** Assess and follow up where appropriate site assessments recommended in the 1995 SNH review of the species. (ACTION: SNH)
- 5.2.4** Use the Woodland Grant Scheme to create suitable habitats and maintain suitable management for small cow-wheat. (ACTION: FC)

5.3 Species management and protection

- 5.3.1** Reintroduce the species to five historic sites that appear to be ecologically suitable. (ACTION: CCW, EHS, EN, FC, SNH)

5.4 Advisory

- 5.4.1** Inform landowners and managers of sites on which small cow-wheat occurs of the presence and importance of species, and provide them with guidance on the requirements for the survival of the species. (ACTION: CCW, EHS, EN, FA, SNH)
- 5.4.2** As far as possible, ensure that relevant agri-environment project officers are advised of locations of this species, its importance and of the management needed for its conservation. (ACTION: CCW, DANI, EHS, EN, FC, MAFF, SNH, SOAEFD, WOAD)

5.5 Future research and monitoring

- 5.5.1** Survey current and historic sites to establish the full range of the species in the UK, the status of surviving populations, and to evaluate environmental variables in order to improve management prescriptions. (ACTION: CCW, EHS, EN, SNH)
- 5.5.2** Encourage research into the ecology of the small cow-wheat, particularly those aspects which are likely to define management for the maintenance of the species. Undertake population viability analyses. (ACTION: CCW, EN, SNH)
- 5.5.3** Promote European cooperation in the conservation of small cow-wheat by the exchange of information on ecological and habitat requirements. (ACTION: CCW, EN, SNH, Research Institutes)

5.6 Communications and publicity

- 5.6.1** Ensure that the scarcity of the species and threats to it are understood, and raise public awareness about the need to conserve this attractive plant. (ACTION: CCW, EHS, EN, FC, SNH)

5.7 Links with other action plans

- 5.7.1** This action plan should be considered in conjunction with the habitat action plans for upland oakwood and upland mixed ash woodland.

Irish lady's-tresses (*Spiranthes romanzoffiana*)

Action Plan

1. Current status

- 1.1** Irish Lady's-tresses is a species of marshy meadows, often close to streams, rivers and lakes and subject to inundation in winter. Although flowering spikes are produced, cross-pollination has not been confirmed in the UK, and populations here may reproduce entirely vegetatively. A lateral bud develops at the base of the stem during the growing season. This bud overwinters and produces the following year's aerial parts.
- 1.2** The species was first recorded at Brackagh Bog in Northern Ireland in 1892. It has never been widespread in Britain or Ireland, occurring locally in parts of Ireland, western Scotland and south Devon. Since 1980 the species has been recorded at 11 sites in Northern Ireland, mainly around Lough Neagh. In Scotland there are sites in Ardnamurchan, the Outer Hebrides, Colonsay, Islay, Mull and Coll. There is only one site in England (south Devon). Irish Lady's-tresses does not occur anywhere else in Europe, but is widespread in North America. The species may be under-recorded in the UK, as its grass-like leaves are very difficult to see when not in flower. Consequently changes in its status are not easy to assess. A recent SNH survey undertaken between 1995 and 1996 failed to find 58 out of 69 populations that had been recorded before 1990. No Scottish location recorded before 1981 is now known to be still present, although in some cases plants are present nearby. It is possible that this behaviour was the result of dormancy in unusually dry weather. An alternative explanation is that a large reservoir of unrecorded populations was revealed by surveys between 1980 and 1989 and has subsequently suffered a catastrophic decline. However, little is known of the natural fluctuations in this species. In Northern Ireland the species has disappeared from a number of historical sites around Lough Neagh, but in recent decades it has been discovered in three new localities that have substantially extended its range.
- 1.3** Irish Lady's-tresses is included in Schedule 8 of the Wildlife (NI) Order but is not specially protected in Great Britain. It is classified as *Near Threatened*. It was once included in the Red Data Book, but was removed after more sites were discovered in the 1980s. This species is a priority for conservation action because of the European importance of the UK populations.

2. Current factors causing loss or decline

- 2.1** Fertilisers and herbicide use in the vicinity of extant sites.
- 2.2** The species may be vulnerable to inappropriate stock densities, timing and type of grazing.
- 2.3** The switch from extensive cattle grazing to intensive sheep grazing in many of the crofting areas has been suggested as a possible cause of decline.

3. Current action

- 3.1** Five of the 76 Scottish sites are protected within SSSIs, while most of the populations in Northern Ireland are protected as ASSIs, and the single site in England is also an SSSI.
- 3.2** A comprehensive survey of the Scottish sites was contracted by SNH to the RBGE in 1995.

4. Action plan objectives and targets

- 4.1** Seek to maintain the range of Irish Lady*s-tresses by retaining viable populations the species within all major meta-population areas.

5. Proposed action with lead agencies

There is still some doubt about the current status of Irish Lady*s-tresses in the UK, perhaps because of its frequent periods of dormancy. There is even less information on suitable management for the species. The priority is therefore to seek urgent answers to these uncertainties by appropriate research. The results of this should be used to refine conservation strategy and implement guidelines for beneficial site management.

5.1 Policy and legislation.

- 5.1.1** Consider the designation of key sites as SSSIs/ASSIs where this is likely to ensure their long-term protection from damaging activities. (ACTION: SNH, EHS)
- 5.1.2** Ensure that the requirements of this species are considered during reviews of all relevant agri-environment schemes. (ACTION: EHS, DANI, MAFF, SNH)

5.2 Site safeguard and management

- 5.2.1** Ensure that all key sites receive management which is beneficial to the conservation of Irish Lady*s-tresses. This will include targeting relevant agri-environment schemes to sites which remain outside ASSI/SSSI protection. At all sites, particular attention should be given to establishing suitable grazing regimes. Management prescriptions should be refined as knowledge of the plant*s requirements improves. (ACTION: EHS, DANI, EN, SNH, SOAEFD)
- 5.2.2** Ensure that fertilisers and herbicides are not used on sites where the plant has been recently recorded. Also ensure that sites are not subjected to run-off of agri-chemicals from adjacent land. Agri-environment schemes should be targeted to sites that are not protected as ASSIs/SSSIs, to ensure that herbicides and fertilisers are not used. (ACTION: EHS, DANI, EN, SNH, MAFF, SOAEFD)

5.3 Species management and protection

- 5.3.1** Collect seed from a representative number of sites across the range of this species and supply to RBG Kew for propagation. (ACTION: EHS, EN, SNH, RBG Kew)

5.4 Advisory

- 5.4.1** Following the research outlined under section 5.5, produce a leaflet for landowners and managers outlining beneficial site management regimes. In order to help make the leaflet relevant for individual populations, site visits for interpretation should accompany its distribution. (ACTION: EHS, EN, SNH)
- 5.4.2** Ensure that all relevant agri-environment project officers and members of regional agri-environment consultation groups are advised of locations for this species, its importance and the type of management which needs to be targeted to its sites and surrounding land. (ACTION: EHS, DANI, MAFF, SOAEFD)

5.5 Future research and monitoring

- 5.5.1** Establish current status of species by re-examining lost sites and encouraging the identification of new sites. Monitor key sites to determine the nature of fluctuations in this species. (ACTION: EHS, EN, SNH)
- 5.5.2** Collate information and undertake further research if necessary in order to determine the reasons for, and implications of, the possible sterility of the UK population. A comparison should be made with the North American population. (ACTION: JNCC, SNH)
- 5.5.3** Monitor a representative sample of sites in sufficient detail to relate survival and performance of the species to environmental factors, including site management and vegetation structure in order to inform management advice. (ACTION: EHS, EN, JNCC, SNH)

5.6 Communications and publicity

- 5.6.1** Raise awareness of this species amongst botanists in Scotland. An article should be written for relevant newsletters encouraging them to report any records together with associated ecological information. (ACTION: SNH).

5.7 Links with other action plans

- 5.7.1** None proposed.

Annex 1. List of abbreviations and acronyms

ASSI	Area of Special Scientific Interest (Northern Ireland)
CC	County Council
CCW	Countryside Council for Wales
DANI	Department of Agriculture for Northern Ireland
DETR	Department of the Environment, Transport and the Regions
EA	Environment Agency
EC	European Community
EH	English Heritage
EHS	Environment and Heritage Service (Northern Ireland)
EN	English Nature
ESA	Environmentally Sensitive Area
FC	Forestry Commission
FE	Forest Enterprise
GCT	Game Conservancy Trust
HA	Highways Agency
IDB	Internal Drainage Board
IUCN	International Union for the Conservation of Nature
JNCC	Joint Nature Conservation Committee
LA	Local Authority
LEC	Local Enterprise Company
MAFF	Ministry of Agriculture, Fisheries and Food
MoD	Ministry of Defence
NAW	National Assembly for Wales
NGO	Non-governmental organisation
NNR	National Nature Reserve
NTS	National Trust for Scotland
RBG Kew/Edinburgh	Royal Botanic Gardens
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SE	Scottish Executive
SEPA	Scottish Environmental Protection Agency
SNH	Scottish Natural Heritage
SOAEFD	Scottish Office Agriculture, Environment and Fisheries Department
SPA	Special Protection Area
SSC	Species Survival Commission (IUCN)
SSSI	Site of Special Scientific Interest (Britain)
SWAs	Scottish Water Authorities
WGS	Woodland Grant Scheme
WOAD	Welsh Office Agriculture Department

Annex 2. Action plan costings

Summary table showing estimated additional costs in £K per year for the first and second five years of each Species Action plan.

		1st five years	2nd five years
Fungi			
<i>Armillaria ectypa</i>	an agaric	3.5	.08
<i>Boletus regius</i>	royal bolete	3.2	1.0
<i>Buglossoporus pulvinus</i>	oak polypore	6.2	4.4
<i>Hericium erinaceum</i>	a hedgehog fungus	4.8	2.2
Hydnoid fungi	14 threatened fungus	31.4	17.6
<i>Hygrocybe calyptraeformis</i>	pink meadow cap	8.7	6.9
<i>Hygrocybe spadicea</i>	date-coloured waxcap	11.4	5.7
<i>Hypocreopsis rhododendri</i>	an ascomycete fungus	8.1	3.8
<i>Microglossum olivaceum</i>	an earth-tongue	5.7	3.1
Lichens			
<i>Alectoria ochroleuca</i>	a lichen	5.1	2.2
<i>Arthothelium dictyosporum</i>	a lichen	8.9	6.4
<i>Arthothelium macounii</i>	a lichen	5.1	11.2
<i>Bacidia incompta</i>	a lichen	7.2	4.6
<i>Belonia calcicola</i>	a lichen	2.6	2.9
<i>Biatoridium monasteriense</i>	a lichen	3.6	3.0
<i>Bryoria smithii</i>	a lichen	4.2	2.0
<i>Calicium corynellum</i>	a lichen	2.1	0.3
<i>Caloplaca aractina</i>	a lichen	3.4	0.9
<i>Catapyrenium psoromoides</i>	tree catapyrenium	1.9	1.0
<i>Cladonia botrytes</i>	stump lichen	4.6	1.3
<i>Cladonia mediterranea</i>	a reindeer lichen	5.3	2.9
<i>Cladonia peziziformis</i>	a lichen	5.0	2.7
<i>Enterographa elaborata</i>	New Forest beech-lichen	1.4	0.9
<i>Enterographa soreliata</i>	a lichen	5.8	5.1
<i>Graphina pauciloculata</i>	a lichen	8.9	1.7
<i>Heterodermia leucomelos</i>	ciliate strap lichen	16.2	13.0
<i>Lecanactis hemisphaerica</i>	churchyard lecanactis	6.8	4.8
<i>Peltigera lepidophora</i>	ear-lobbed dog-lichen	1.2	0.7
<i>Squamarina lentigera</i>	scaly breck lichen	5.6	2.8
<i>Teloschistes chrysophthalmus</i>	a lichen	2.4	1.5
<i>Thelenella modesta</i>	warty wax-lichen	3.2	0.6

		1st five years	2nd five years
Liverworts			
<i>Acrobolbus wilsonii</i>	Wilson's pouchwort	9.1	7.8
<i>Adelanthus lindenbergianus</i>	Lindenburg's featherwort	1.8	1.3
<i>Cephaloziella nicholsonii</i>	greater copperwort	13.0	10.9
<i>Herbertus borealis</i>	northern prongwort	2.9	0.9
<i>Pallavicinia lyellii</i>	veilwort	11.7	10.2
<i>Riccia huebeneriana</i>	violet crystalwort	11.6	9.6
Mosses			
<i>Acaulon triquetrum</i>	triangular pigmy moss	1.8	2.2
<i>Andreaea frigida</i>	icy rock-moss	2.5	1.9
<i>Bartramia stricta</i>	rigid apple moss	3.4	2.2
<i>Brachythecium appleyardiae</i>	Appleyard's feather moss	4.7	3.6
<i>Bryoerythrophyllum caledonicum</i>	Scottish beard-moss	4.4	2.1
<i>Bryum mamillatum</i>	dune thread moss	1.7	1.2
<i>Bryum neodamense</i>	long-leaved thread moss	11.7	8.0
<i>Bryum warneum</i>	sea bryum	4.0	4.2
<i>Cryphaea lamyana</i>	multi-fruited river moss	7.7	5.5
<i>Desmatodon cernuus</i>	flamingo moss	18.7	12.6
<i>Didymodon mamillosa</i>	Perthshire beard-moss	3.0	1.3
<i>Didymodon tomaculosa</i>	sausage beard-moss	2.8	0.9
<i>Ditrichum plumbicola</i>	lead moss	16.6	13.5
<i>Ephemerum stellatum</i>	starry earth-moss	5.4	1.3
<i>Leptodontium gemmascens</i>	thatch moss	6.8	4.1
<i>Orthodontium gracile</i>	slender thread-moss	6.0	3.2
<i>Orthotrichum obtusifolium</i>	blunt-leaved bristle-moss	5.0	2.9
<i>Orthotrichum pallens</i>	pale bristle-moss	2.5	2.1
<i>Pohlia scotica</i>	Scottish pohlia	3.1	1.3
<i>Rhynchostegium rotundifolium</i>	round-leaved feather-moss	2.4	2.4
<i>Seligeria carniolica</i>	water rock-bristle	1.7	1.1
<i>Sematophyllum demissum</i>	prostrate feather moss	3.8	2.1
<i>Sphagnum balticum</i>	baltic bog moss	4.1	3.5
<i>Thamnobryum angustifolium</i>	Derbyshire feather-moss	1.7	1.3
<i>Tortula freibergii</i>	Freiberg's screw-moss	4.3	3.8
<i>Zygodon forsteri</i>	knothole moss	11.7	0.7
<i>Zygodon gracilis</i>	Nowell's limestone moss	2.8	2.4
Stoneworts			
<i>Chara connivens</i>	convergent stonewort	4.5	2.1
<i>Chara curta</i>	lesser bearded stonewort	17.1	15.5
<i>Nitella gracilis</i>	slender stonewort	9.3	6.1

		1st five years	2nd five years
<i>Nitella tenuissima</i>	dwarf stonewort	5.5	3.1
<i>Nitellopsis obtusa</i>	starry stonewort	4.7	2.3
<i>Tolypella intricata</i>	tassel stonewort	13.6	12.2
<i>Tolypella prolifera</i>	greater tassel stonewort	7.7	5.6
Vascular plants			
<i>Juniperus communis</i>	juniper	51.0	25.0
<i>Linnaea borealis</i>	twinline	27.0	14.7
<i>Melampyrum sylvaticum</i>	small cow-wheat	19.4	2.2
<i>Spiranthes romanzoffiana</i>	Irish lady's tresses	23.1	4.4
Annual total (£K)		570.2	342.1
5 year total (£K)		2850.9	1710.7

Costs exclude 10% administration, and the contribution of agri-environment schemes which is being estimated separately.

Annex 3. Contact Points and Lead Partners

Below is a list of Contact Points and Lead Partners for the species action plans published in this volume. In order to benefit from the geographical/habitat associations of some of the species, a number have been placed in small groups to each of which a contact point and lead partner/joint lead partners have been assigned. These groups are listed at the end of the table.

Species	Contact Point	Lead Partner	Group
Fungi			
<i>Armillaria ectypa</i> an agaric	English Nature	English Nature	-
<i>Boletus regius</i> royal bolete	English Nature	Plantlife ¹	-
<i>Buglossoporus pulvinus</i> oak polypore	English Nature	English Nature	11
<i>Hericium erinaceum</i> a hedgehog fungus	English Nature	English Nature	11
Hydnoid fungi northern group	Scottish Natural Heritage	Plantlife ^{1,2}	-
Hydnoid fungi southern group	English Nature	Plantlife ^{1,2}	-
<i>Hygrocybe calyptriformis</i> pink meadow cap	Countryside Council for Wales	Plantlife ^{1,2}	5
<i>Hygrocybe spadicea</i> data coloured waxcap	Countryside Council for Wales	Plantlife ^{1,2}	5
<i>Hypocreopsis rhododendri</i> an ascomycete fungus	Scottish Natural Heritage	to be determined	-
<i>Microglossum olivaceum</i> an earth-tongue	Countryside Council for Wales	Plantlife ^{1,2}	5
Lichens			
<i>Alectoria ochroleuca</i> a lichen	Scottish Natural Heritage	Cairngorm Partnership/Royal Society for the Protection of Birds	1
<i>Arthothelium dictyosporum</i> a lichen	Scottish Natural Heritage	Royal Botanic Gardens Edinburgh	9

Species	Contact Point	Lead Partner	Group
<i>Arthothelium macounii</i> a lichen	Scottish Natural Heritage	Royal Botanic Gardens Edinburgh	9
<i>Bacidia incompta</i> a lichen	Scottish Natural Heritage	Plantlife ¹	10
<i>Bellemerea alpina</i> a lichen	Species Statement	-	-
<i>Belonia calcicola</i> a lichen	English Nature	Plantlife ¹	-
<i>Biatoridium manasteriense</i> a lichen	Scottish Natural Heritage	Plantlife ¹	10
<i>Bryoria smithii</i> a lichen	English Nature	English Nature	-
<i>Calicium corynellum</i> a lichen	English Nature	Plantlife ¹	7
<i>Caloplaca aractina</i> a lichen	English Nature	Plantlife ¹	3
<i>Caloplaca nivalis</i> snow caloplaca	Species Statement	-	-
<i>Catapyrenium psoromoides</i> tree catapyrenium	Royal Botanic Gardens Edinburgh	Royal Botanic Gardens Edinburgh	-
<i>Cladonia botrytes</i> stump lichen	Scottish Natural Heritage	Royal Botanic Gardens Edinburgh/Royal Society for the Protection of Birds	-
<i>Cladonia mediterranea</i> a reindeer lichen	English Nature	Plantlife ¹	3
<i>Cladonia peziziformis</i> a lichen	English Nature	Plantlife ¹	3
<i>Enterographa elaborata</i> a lichen	English Nature	English Nature	11
<i>Enterographa soorediata</i> a lichen	English Nature	English Nature	11

Species	Contact Point	Lead Partner	Group
<i>Graphina pauciloculata</i> a lichen	English Nature	English Nature	-
<i>Heterodermia leucomelos</i> ciliate strap-lichen	English Nature	Plantlife ¹	3
<i>Lecanactis hemisphaerica</i> churchyard lichen	English Nature	Plantlife ¹	7
<i>Peltigera lepidophora</i> ear-lobed dog-lichen	Scottish Natural Heritage	Scottish Natural Heritage	-
<i>Pertusaria bryontha</i> Alpine moss pertusaria	Species Statement	-	-
<i>Squamarina lentigera</i> scaly breck-lichen	English Nature	English Nature	-
<i>Teloschistes chrysophthalmus</i> a lichen	English Nature	Plantlife ¹	3
<i>Thelenella modesta</i> warted wax lichen	Scottish Natural Heritage	Plantlife ¹	10
Liverworts			
<i>Acrobolbus wilsonii</i> Wilson's pouchwort	Scottish Natural Heritage	Forestry Commission	-
<i>Adelanthus lindenbergerianus</i> Lindenberg's featherwort	Scottish Natural Heritage	Scottish Natural Heritage	4
<i>Cephaloziella nicholsonii</i> greater copperwort	English Nature	English Nature/The Natural History Museum	8
<i>Herbertus borealis</i> northern prongwort	Scottish Natural Heritage	Scottish Natural Heritage	4
<i>Pallavicinia lyellii</i> veilwort	English Nature/ Countryside Council for Wales	Royal Botanic Gardens Kew/Plantlife ¹	-
<i>Riccia huebeneriana</i> violet crystalwort	Environment Agency	Plantlife ¹	12
Mosses			

Species	Contact Point	Lead Partner	Group
<i>Acaulon triquetrum</i> triangular pigmy moss	English Nature	English Nature	-
<i>Andreaea frigida</i> icy rock-moss	Scottish Natural Heritage	Cairngorm Partnership/Royal Society for the Protection of Birds	1
<i>Bartramia stricta</i> rigid apple-moss	Countryside Council for Wales	Countryside Council for Wales	-
<i>Brachythecium appleyardiae</i> Appleyard's feather-moss	English Nature	English Nature	-
<i>Bryoerythrophyllum caledonicum</i> Scottish beard-moss	Scottish Natural Heritage	National Trust for Scotland	-
<i>Bryum mamillatum</i> dune thread-moss	English Nature	Plantlife ¹	2
<i>Bryum neodamense</i> long-leaved thread-moss	English Nature	Plantlife ¹	2
<i>Bryum warneum</i> sea bryum	English Nature	Plantlife ¹	2
<i>Cryphaea lamyana</i> multi-fruited river-moss	Environment Agency	Plantlife ¹	13
<i>Desmatodon cernuus</i> flamingo moss	English Nature	Plantlife ¹	-
<i>Didymodon mamillatum</i> Perthshire beard-moss	Scottish Natural Heritage	Scottish Natural Heritage	-
<i>Didymodon tomaculosus</i> sausage beard-moss	Ministry of Agriculture, Food and Fisheries	Plantlife ¹	6
<i>Ditrichum plumbicola</i> lead-moss	English Nature	English Nature/The Natural History Museum	8
<i>Ephemerum stellatum</i> starry earth-moss	Ministry of Agriculture, Food and Fisheries	Plantlife ¹	6
<i>Leptodontium gemmascens</i> thatch moss	English Nature	English Nature	-
<i>Orthodontium gracile</i> slender thread-moss	English Nature	English Nature/Royal Botanic Gardens Kew	-

Species	Contact Point	Lead Partner	Group
<i>Orthotrichum obtusifolium</i> blunt-leaved bristle-moss	Scottish Natural Heritage	Plantlife ¹	10
<i>Orthotrichum pallens</i> pale bristle-moss	Scottish Natural Heritage	Plantlife ¹	10
<i>Pohlia scotica</i> Scottish pohlia	Scottish Natural Heritage	to be determined	-
<i>Rhynchostegium rotundifolium</i> round-leaved feather-moss	English Nature	English Nature	-
<i>Seligeria carniolica</i> water rock-bristle	Environment Agency	Plantlife ¹	13
<i>Sematophyllum demissum</i> prostrate feather-moss	Countryside Council for Wales	Countryside Council for Wales	-
<i>Sphagnum balticum</i> Baltic bog-moss	English Nature	Plantlife ¹	-
<i>Thamnobryum cataractarum</i> Yorkshire feather-moss	English Nature	English Nature	-
<i>Tortula freibergii</i> Freiberg's screw-moss	English Nature	The Natural History Museum	-
<i>Zygodon forsteri</i> knothole moss	English Nature	English Nature	-
<i>Zygodon gracilis</i> Nowell's limestone-moss	English Nature	English Nature	-
Stoneworts			
<i>Chara connivens</i> convergent stonewort	Environment Agency	Plantlife ¹	12
<i>Chara curta</i> lesser bearded stonewort	English Nature	Plantlife ¹	2
<i>Nitella gracilis</i> slender stonewort	Environment Agency	Plantlife ¹	12
<i>Nitella tenuissima</i> dwarf stonewort	Countryside Council for Wales	The Wildlife Trusts (North Wales)	-
<i>Nitellopsis obtusa</i> starry stonewort	Environment Agency	Plantlife ¹	12
<i>Tolypella intricata</i> tassel stonewort	Environment Agency	Plantlife ¹	12

Species	Contact Point	Lead Partner	Group
<i>Tolypella prolifera</i> great tassel stonewort	Environment Agency	Plantlife ¹	12
Vascular plants			
<i>Juniperus communis</i> juniper	Forestry Commission	Plantlife ¹	-
<i>Linnaea borealis</i> twinflower	Forestry Commission	Plantlife ¹	-
<i>Melampyrum sylvaticum</i> small cow-wheat	Forestry Commission	The Wildlife Trusts (Scotland)	-
<i>Spiranthes romanzoffiana</i> Irish lady's tresses	Environment and Heritage Service	Plantlife ¹	-

Species groupings

Group number	Description	Species
1	Montane - alpine group Cairngorm Mountains	<i>Alectoria ochroleuca</i> and <i>Andreaea frigida</i>
2	Sand dune bryophytes and stoneworts	<i>Bryum mamillatum</i> , <i>Bryum neodamense</i> , <i>Bryum warneum</i> and <i>Chara curta</i>
3	Species of south western Britain - coastal areas	<i>Caloplaca aractina</i> , <i>Cladonia mediterranea</i> , <i>Cladonia peziziformis</i> , <i>Heterodermia leucomelos</i> and <i>Teloschistes chrysophthalmus</i>
4	Upland heathland Atlantic hepatic communitiy species	<i>Adelanthus lindenbergianus</i> and <i>Herbertus borealis</i>
5	Grassland fungi group	<i>Hygrocybe calyptriformis</i> , <i>Hygrocybe spadicea</i> and <i>Microglossum olivaceum</i>
6	Cereal field margins group (arable bryophytes and other ephemeral species)	<i>Didymodon tomaculosus</i> and <i>Ephemerum stellatum</i>
7	Churchyard species	<i>Calicium corynellum</i> and <i>Lecanactis hemisphaerica</i>
8	Metal-rich mine substrates/spoil bryophytes	<i>Cephaloziella nicholsonii</i> and <i>Ditrichum plumbicola</i>
9	Western oceanic wood species (especially/including hazel)	<i>Arthothelium dictyosporum</i> and <i>Arthothelium macounii</i>
10	Species growing on wayside trees (roadside/hedgerow trees & parkland)	<i>Bacidia incompta</i> , <i>Biatoridium manasteriense</i> , <i>Orthotrichum obtusifolium</i> , <i>Orthotrichum pallens</i> and <i>Thelenella modesta</i>
11	Ancient woodland and wood pastures	<i>Buglossoporus pulvinus</i> , <i>Enterographa elaborata</i> , <i>Enterographa soledata</i> and <i>Hericium erinaceum</i>
12	Stoneworts and liverworts of water bodies	<i>Chara connivens</i> , <i>Nitella gracilis</i> , <i>Nitellopsis obtusa</i> , <i>Riccia huebeneriana</i> , <i>Tolypella intricata</i> and <i>Tolypella prolifera</i>
13	Species of rivers and streams	<i>Cryphaea lamyana</i> and <i>Seligeria carniolica</i>

Note:

¹ Given the substantial number of species for which Plantlife will be Lead Partner, it is anticipated that the commencement of works on the species will be a rolling programme over a minimum of three years.

² Management of these projects and the nature of Plantlife's lead partnering role for fungi will be explored during the ongoing consultation with the mycological community.