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TOWARDS A GLOBAL ACTION PLAN FOR ENDANGERED BRYOPHYTES

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RESUMEN

La reducción, fragmentación y aislamiento de hábitats de las briofitas ha propiciado la pérdida de especies y de diversidad genética a nivel mundial. A pesar del limitado conocimiento científico, el Comité de Briofitas de la IUCN/IAB presenta el bosquejo de un Plan de Acción (AP) que propone la protección para muchas áreas y hábitats para reducir la pérdida de diversidad, especialmente en zonas tropicales mal conocidas aun cuando se necesitarán más recursos y ayuda a los briólogos. El AP intentará: Informar sobre la importancia de las briofitas para el hombre y los ecosistemas naturales, evaluar áreas geográficas específicas y "puntos críticos" que deben protegerse, informar sobre las amenazas para las briofitas, apoyar proyectos de conservación nuevos y relevantes, y documentar los casos de especies en peligro. Excepto por la contaminación atmosférica que parece ser un peligro más serio para las briofitas que, *e.g.*, para las angiospermas, otras amenazas son comunes. Estas incluyen la deforestación y usos silvícolas equivocados, el uso y urbanización del suelo, caminos, presas, minas, drenaje de pantanos y sobrepastoreo. Se reconoce que la introducción de especies agresivas puede ocasionar devastación de la flora nativa y que la fragmentación de los hábitats por la apertura para cultivos también empobrece la flora. El AP final revisará la situación en cada continente e identificará los centros de endemismo que requieren protección urgente. Para las briofitas la primera acción ha sido la identificación de ciertos hábitats. En Europa las especies raras o las de las listas rojas se han usado para justificar la preservación de hábitats naturales, pero en otros países se puede usar el enfoque de "especies sombrilla" en lugar de o paralelamente con el de las especies en peligro. También se pueden usar las briofitas como "especies clave" porque la protección a éstas afecta a muchas otras. Aunque existen pocos instrumentos legales para proteger a las briofitas, muchos países ya han ratificado la convención de las Naciones Unidas sobre diversidad biológica y en ella se incluyen

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briofitas que deben considerarse en el plan estratégico de cada país. Por ahora la conservación está mal financiada y se necesita más investigación, pero esto no debe usarse como pretexto para tomar acciones al respecto. En resumen, el Plan de Acción preliminar propone los mecanismos de conservación de la diversidad briológica protegiendo y explicando la importancia de las briofitas, las amenazas y su incorporación a programas de conservación, con énfasis en la necesidad de mayor conocimiento.

Palabras clave: briofitas, diversidad, protección, plan de acción.

ABSTRACT

The world-wide reduction, fragmentation and isolation of habitats important for bryophytes have led to a consequential loss of species richness and genetic diversity. Despite the incompleteness of our scientific knowledge about bryophytes world-wide, the IUCN/IAB Bryophyte Committee here presents the skeleton of an Action Plan (AP) for bryophytes. We will suggest better protection of a wide variety of areas and habitats to halt the decline of the diversity. Especially tropical areas are still poorly known. Their protection will need more resources and their bryologists more help. Aims of the AP will be: to inform people about the importance of bryophytes to man and natural ecosystems, to assess specific geographical areas and "hot spots" for protection, to inform about the causes of threats to bryophytes, to endorse new and relevant conservation projects, and to document individual cases of endangered species. Besides air pollution, which seems to cause a much greater threat to bryophytes than *e.g.*, flowering plants, many of the threats to bryophytes are similar. They include deforestation, thinning of forests, reclamation of land, urbanisation, roads, dam buildings, mining, drainage of wetlands, overgrazing. Invasive, introduced species can bring devastation to the native floras. Also, fragmentation of habitats caused by the increased use of land for cultivation is impoverishing the diversity of the flora. The final AP will review the situation, continent by continent, and identify the centres of endemism that need urgent protection. For bryophyte conservation, the most used action hitherto is to identify certain habitats. In Europe the use of red listed or rare species has been employed to justify the preservation of natural habitats with success. In some countries an "umbrella-species" approach can be used instead of, or parallel to, an endangered species approach. Also the use of bryophytes as "key-stone" species may be strategic input, because the protection of "key-stone" species affects many other species. Very few legal instruments can be applied to protect the bryophytes. Many countries have now ratified the UN convention of biological diversity. The convention includes bryophytes which should be included in the biodiversity strategy plan of each country. To date, conservation is in general grossly under-funded and more support as well as research is needed, though the need for more research should not be used as an excuse to delay any conservation action. To sum up, the draft AP focuses on different ways to conserve

the bryophyte diversity by protection, explaining the importance of bryophytes as well as threats to them, their incorporation in all conservation programmes, highlighting the need for more knowledge.

Key words: bryophytes, diversity, protection, action plan.

INTRODUCTION

Bryologists are aware of the changes in the moss and liverwort floras in temperate and tropical parts of the world (Geissler and Greene, 1982; Koponen, 1992). Not surprisingly, the conservationists have admitted the gross neglect in lower plant conservation (Akeroyd, 1995). In 1990, both the International Association of Bryologists (IAB) and the International Union of Nature Conservation (IUCN) constituted individual committees with important tasks of establishing a world-wide network to monitor the situation in bryophytes, to promote international co-operation and communication between bryologists and conservationists, to heighten awareness of bryophytes among conservation organisations, and explain the threats to bryophyte species as well as certain habitats and why they are in need of protection.

To achieve these goals, the bryophyte committees of IAB and IUCN arranged a workshop during the Conference entitled "Tropical Bryophytes: biology, diversity and conservation" held in Mexico City in 1995. The aim of the workshop was to focus on endangered species world-wide and to discuss the first draft version of an Action Plan (AP) for bryophytes. The committees invited several experts representing different parts of the world and taxonomic groups to attend the meeting.

It became apparent during the workshop that the protection of a wide array of areas and habitats is urgently needed in order to halt the decline of the diversity of bryophytes. Since tropical regions have ecosystems rich in bryophytes that are relatively little known and their protection receives less resources than many regions in northern countries, it was concluded that more efforts are needed to help the tropical countries. Urgent suggestions from scientists on how to preserve the vulnerable bryophytes best are needed. Even if the present knowledge about bryophytes is incomplete, the overall available information is sufficient for us to make a workable Action Plan for the conservation of important habitats and endangered species of bryophytes.

The following chapters will be presented in the Action Plan (AP): 1) aims of the AP; 2) the importance of bryophytes; 3) current threats to bryophytes; 4) present situation in different regions; 5) gaps in our knowledge; 6) present conservation measures and strategies (serving as positive examples), and, finally, and most important: 7) actions and priorities. The AP will end with a revised world red list of bryophytes as an appendix. Below follows a summary of the preliminary content in each chapter of the AP.

AIMS OF THE ACTION PLAN

The aims of the AP will be: 1) to inform about the importance of bryophytes to man and natural ecosystems; 2) to assess specific geographical areas or "hot spots", whose species and habitats are in need of protection or conservation management; 3) to elucidate the causes of threats to bryophytes; 4) to endorse new and relevant conservation projects; and 5) to document individual cases of endangered species and destruction of environments. Since the AP will hopefully be read by conservation groups, as well as governmental decision making officials all over the world, it is important that the AP will be written in a language that is easy to read for all these target groups as well as for the public.

IMPORTANCE OF BRYOPHYTES

The chapter "Importance of Bryophytes" will include information on: 1) the ecological roles played by bryophytes in nature, such as nutrient cycling, biomass production in humid habitats, high water retention capacity (holding moisture and contributing to the humidity of atmosphere), and stabilisation of soil crust through colonisation of bare grounds and rocks; 2) the use of bryophytes as pollution indicators; as habitat indicators, *e.g.*, of calcareous soil, and as process indicators, *e.g.*, stages of succession of forest communities; 3) the economic values, *e.g.*, *Sphagnum* peat for fuel, horticultural uses, and oil absorption, and as sources of a wide array of chemical compounds; 4) their cultural and aesthetic qualities, *e.g.*, the beauty and inspiration provided by bryophytes to artists and writers.; 5) the importance of bryophytes as experimental model organisms for morphogenetic and other studies.

CURRENT THREATS

Threat causes

This chapter will deal with threat causes, since they are crucial to understand fully the impoverishment of bryophyte floras. The threats must be examined closely in the AP.

The causes can be different from those for, *e.g.*, flowering plants. Since bryophytes lack cuticula on leaves and are depending on high air humidity and rain, air pollution and drought make more server threats to bryophytes than most other organisms. Bryophytes are, in general, considered as being just as sensitive to air pollution as lichens (Dässler and Ranft, 1969), but occur more often in less exposed sites than lichens, and can, because of their preference for sheltered microsites, survive, provided that pollution levels do not increase.

Bryophyte habitats are threatened by two kind of changes: habitat losses and habitat modifications. Habitat losses can be due to, *e.g.*, deforestation, reclamation of land, urbanisation, roads, dam buildings, and mining. The second serious type of threat to the habitats is habitat modification, which in many cases lead to a change in air and soil humidity, in turn causing, a drastic change in bryophyte flora. This is most apparent in epiphyllic and epiphytic species and in floras dominated by mesophytes. This type of change may be caused by the thinning of forests, drainage of wetlands, overgrazing, etc.

Invasive, introduced species of flowering plants and bryophytes can bring devastation to the native floras (T. Pócs, pers. comm.).

Fragmentation of habitats of natural vegetation caused by the increased use of land for cultivation is impoverishing the diversity of the flora. Consequently, islands of natural vegetation have become increasingly isolated. In some regions of the world, especially lowlands with fertile soil, these processes are already very advanced. At present, only in inaccessible areas like steep mountains, natural vegetation is still covering relatively large and continuous areas, *e.g.*, in Alaska, Ural mountain, Colombia and Venezuela.

Present situation in different regions

The AP will review the situation, continent by continent, and describe which plant geographical regions still have highly diverse and unspoiled bryophyte floras. The AP, in addition, will identify the centres of endemism that need urgent protection. The survey includes examples of "hot spots" in regions under severe threat. These "hot spots" may be either within protected areas, or in a regions without protection.

Gaps in our knowledge

Even if the major threats to bryophytes are known, there is still a serious shortage of knowledge about which species and what habitats are threatened, and the actual causes behind these threats.

This lack of knowledge is especially apparent in the tropical regions. Most of our detailed knowledge on bryophyte diversity and distribution is from the northern temperate zone. Research on threatened bryophytes and conservation has previously been focused on the developed countries in the world, especially Europe (Hodgetts, in press; Holdgate, 1991). The main reason for the lack of knowledge in the developing countries is the shortage of active bryologists.

The taxonomy of tropical bryophyte groups and the reproductive biology, the dispersal capacity and distribution of rare species are important basic research requirements and crucial to our conservation work. Most of this is lacking. Equally lacking is information about the specific threats to those taxa that are on the brink of extinction, about measures to counteract the decline of species and populations, and about measures for the recovery of those (Hallingbäck, in press).

Present conservation measures and strategies

The percentage of the areas already under protection which contains interesting moss and liverwort species varies considerably between different continents and regions. For example, while the majority of interesting habitats of bryophytes are under protection in Australia, only a very low percentage of the natural bryoflora in the Netherlands and Denmark is exempted from external threat. In some parts of the world, local bryophyte floras are by chance preserved through the establishment of large National parks and nature preserves to protect the large animals and flowering plants. However, the regions where bryophyte diversity is highest may not coincide with that of flowering plants and vertebrates, for example, the large protected areas Camargue in France or Coto Donana in Spain.

Conservation strategy

The AP will include a short review of conservation strategies. This is important since causes of threats to bryophytes can be different from those confronting animals or other organisms. Conservation of bryophytes should include several ecological and biological but also social and political aspects. Until today the directions in conservation biology research has followed two main directions: the decline of natural populations, and the small population paradigm outlined by Caughley (1994) for the animals. Both aspects of the study are important in our understanding of the conservation problems in bryophytes.

For bryophytes, the best approach to conservation is in most cases probably the habitat approach. For example, bryophytes in some elfin forests in Africa are protected because of their water holding capacity, which is needed to enable continued growth in the downhill coffee plantations (Pócs, 1980). Other bryophytes are preserved when found useful as bioindicators or monitoring organisms. A good example is the presence of many epiphyllous liverworts (Pócs, 1991) which can be taken to indicate a high atmospheric humidity in a primary forest and, indirectly, the existence of pristine and highly diverse plant and animal communities. Thus, a measure of the quality of an ecosystem can be developed and gauged by the presence of the local bryoflora.

In Europe the species approach, such as the use of red listed or rare species, have been employed to justify the preservation of natural habitats. Today, several countries in Europe have published national red lists of bryophytes. Europe as a political unit has a recent red list (Schumacker and Martiny, 1995) and a book of bryophyte sites in need of protection (Hodgetts, 1995).

One advantage of focusing on red listed species, is that the public awareness about endangered species is quite high today, because of the well publicised situations of panda bear, bald eagle and whooping crane. People find it easy to understand the same situation for lower plant species. At present, a world-wide red list of bryophytes has not been resolved because of the areas of the world where we do

not know the bryoflora. A number of critics have claimed that we can never be sure that a candidate species listed does not occur in a remote part of the world, *e.g.*, the Himalayas or New Guinea, since these areas lack complete inventories.

In tropical and developing countries an "umbrella-species" approach can be used, instead of or parallel to, an endangered species approach (Hunter and Hutchinson, 1994). This means focusing our attention and effort to protect the sites supporting a glamorous and enigmatic species, such as tiger or orang-gutang, which can then be invoked to attract sponsorship and funding. This can be done if there is a shared habitat between bryophytes and the umbrella species.

Using a "key-stone" species (Given, 1994) may be another strategic input, since the protection of key-stone species affects many other species which depend on the former for their survival. For example, a key-stone animal like moose leaves droppings which are an essential substrate for several dung mosses such as *Splachnum*, *Tayloria* and *Tetraplodon* to grow on.

Legal instruments

Very few international legal instruments can be applied to protect bryophytes. The UN convention of biological diversity was signed in Rio de Janeiro in 1992 and entered into force in 1993. More than 110 countries have now ratified it. The major principle of this document is to protect the natural habitats of species (Synge, 1995). Every country that joined the Biodiversity Convention has to prepare a national strategy and conservation plan for implementation. Bryophytes should be included in the biodiversity strategy plan of each country.

To date, bryophyte conservation is grossly under-funded and has hitherto received very little money support compared to flowering plants. This is because as a group of green plants, bryophytes are not considered important. This has resulted in the meagre knowledge about mosses and liverworts that many conservation bodies posses on hand.

Compared to what some European countries spend on the protection of rare animal species like wolf, peregrine falcon and seals, the funds for protecting the habitats essential for bryophyte are practically none. Recently, the European Bern convention has included a list of bryophytes for strict protection. Subsequently, the European Union has adopted part of the same list for protection under The Habitat Directive. There is now hope that bryophytes will be recognised more and more as an important part of nature worthy of protection.

Today, red lists for endangered, threatened and rare species of plants have been used with success in some countries in Europe.

As stated above, bryophyte vegetation is sometimes preserved thanks to the protection of species of animals and higher plants in national parks or other kinds of nature reserves. There are tropical countries, *e.g.*, Costa Rica, where virtually all the surviving forests are confined to protected areas (Holdgate, 1991). Unfortu-

nately, in many parts of the world, the designation of an area as a national park does not necessarily confer full protection for the bryophyte flora.

Action and priorities

More information needed

The need for more conservation research should never be used as an excuse to delay any conservation action (Tangley, 1988). However, to make the daily decisions in nature conservation, information must be at hand. Bryophytes need to be included into the administrative planning procedures as a routine.

One of the big problems is the lack of a general awareness and knowledge about mosses and liverworts among the conservation people. The bryologists need to be placed on line with conservation bodies and be able to forward more information about the environmental requirements of mosses and liverworts.

Apart from getting a general pledge from authorities to stop exploiting habitats needed by all threatened bryophytes, we need also to consider the air pollution as a top priority threat. We also need to consider the negative effects on the native flora caused by the invasive, exotic plants.

The AP will hopefully encourage all conservation people to co-operate with bryologists in any conservation campaigns where bryophytes are important part of vegetation (Sastre and Tan, 1995). The AP will also stress the need to hand over information about bryophytes to appropriate education centres and to the general public at all levels. Finally, the AP will endorse a number of important projects dealing with endangered bryophytes and habitats. An expanded and revised world red list will give conservation bodies an effective tool to use for specific species and site protection.

To sum up the suggested actions for bryophytes, we will focus on the different ways to include bryophytes in the conservation programmes and plans. We will attack the conservation problems at all levels for the benefit not only for mosses and liverworts, but also other kinds of similarly "inconspicuous" but important organisms which occur in the same type of habitats and use the same ecosystems.

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