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THREATENED BRYOPHYTES IN THE IBERIAN PENINSULA – SOME RESULTS AND COMMENTS

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SUMMARY — The Red List of the Iberian bryoflora includes 399 rare or threatened species (121 liverworts and 278 mosses), which represent 38% of the bryophyte flora. Among these, based on criteria adapted from those of IUCN, 10 taxa are considered extinct, 38 endangered, 70 vulnerable and 281 rare. Special attention is given to endemic bryophytes and those that are threatened at a European level. Taxa to be included in priority conservation programmes are selected.

KEYWORDS — Species conservation, endemic bryophyte species, threat status, Iberian Peninsula

ZUSAMMENFASSUNG — Gefährdete Moose der Iberischen Halbinsel – Einige Ergebnisse und Kommentare
Die Rote Liste der iberischen Bryoflora umfasst 399 seltene oder gefährdete Arten (121 Lebermoose und 278 Laubmoose), die 38% der Moosflora ausmachen. Von diesen werden, nach den angepassten IUCN-Kriterien, 10 Taxa als ausgestorben (Ex), 38 als bedroht (E), 70 als gefährdet (V) und 281 als selten (R) eingestuft. Besonders berücksichtigt sind endemische Moose und diejenigen, die europaweit gefährdet sind. Eine Auswahl von Taxa wird für prioritäre Schutzprogramme vorgeschlagen.

Introduction

The wide ecological diversity, the environmental and climatic stability and its favoured position over the different geological periods, have facilitated the development of a fairly rich flora in the Iberian Peninsula, including a significant number of endemics, vicariad species and taxa occurring in geographically distant areas.

The Iberian bryoflora is extremely rich and includes 1044 species, about 62% of the total European flora, including Macaronesia. This flora is important because it contains species which are unique in Europe, species with remarkable phytogeographical or ecological value, and also species requiring a relatively unpolluted environment.

The bryophyte flora of Portugal was relatively well known in the past, when compared with Spain, the other country of the Iberian Peninsula. There is some literature on the bryophytes of Portugal dating from the beginning of this and the last centuries. The lack of previous knowledge of the bryoflora of Spain as well as of important areas in Portugal has led to the discovery of a considerable number of species over the last decade (Casas 1991, Sérgio & al. 1994). Currently, Iberian bryophytes are being surveyed and mapped in detail (Casas & al. 1985, 1989, 1992a) and floristic studies have increased, particularly in some important areas.

With the exception of restricted areas near large industrial centres and some scattered sites, pollution is relatively unimportant in large areas of the Peninsula. Although there is a clear regression of the bryophyte flora in certain areas, mainly in southern regions subjected to desertification (Varo & al. 1992) or drainage (Casas & al. 1992b), the problems are not so serious as in Central Europe, where the effects of air and water pollution are more or less general.

In the Iberian Peninsula, the conservation of bryophytes has received little attention, because basic knowledge of the occurrence and distribution of the bryophytes of many regions has had a higher priority. For conservation programmes, it is essential that areas with high biological value are identified and that their bryophyte flora is studied. Spain and Portugal are signatories to the Bern Convention and the European Community Habitats and Species Directive, which embraces the protection of 26 bryophytes, 9 of which are present in the Iberian region.

Status of the Iberian bryophytes

The first step for bryophyte conservation is to evaluate the degree of threat to each species. After checking all available sources and taking our own experience into account, the Red List of Bryophytes of the Iberian Peninsula was prepared (Sérgio & al. 1994). The nomenclature follows, in general, Casas (1991), Corley & al. (1981) and Corley & Crundwell (1991) for mosses and Grolle (1983) for hornworts and liverworts.

We have used the same criteria as the IUCN but have adapted them according to auxiliary definitions. These adaptations were necessary mainly because older studies were scarce, as already mentioned. The definition of criteria is as follows:

Ex Extinct species, or species that have probably vanished.

Species recorded before 1950 but not collected afterwards. Some species were not confirmed due to lack of herbarium material.

E Endangered species.

Species found in few sites, some of which no longer exist and therefore the possibility of finding those species again in those sites is remote. Species in small populations or in directly threatened environments.

V Vulnerable species.

Species collected in few sites, some of which have vanished or are threatened; species found in just one site, without imminent danger. Species from vulnerable habitats.

R Rare species.

Species known from few sites, or in small populations, but without imminent danger. Species which are nowadays geographically restricted (recently described), or which still exist in rare environments or habitats, or in restricted areas that are presumably not threatened.

Tab. 1 and Fig. 1 summarize the results. 118 bryophytes (11.3%) are classified as Ex, E or V in the Iberian Peninsula and a further 281 (27%) are rare (R). Rare species obviously constitute the largest portion of the taxa included in the Red List (Sérgio & al. 1994). Although some bryophytes are threatened on a regional scale in Portugal or Spain individually, they may not be threatened on a wider scale.

Status of the Endangered European Bryophytes in the Iberian Peninsula

About 12% of European bryophytes are seriously threatened and another 12% are rare, out of a total of 1687 species occurring in Europe including Macaronesia (according to an earlier version to ECCB, in press).

The Iberian bryophytes are not exposed to as many threats as the bryophytes of other parts of Europe, but considering the recent evaluation, the percentage of the threatened (Ex, E and V) species is similar (Tab. 2). However, the proportion of taxa classified as rare (R) is higher in the Iberian Peninsula (27%) than in Europe (12.3%).

| | Ex | E | V | R | N | Total |
|------------------|----|----|----|-----|-----|-------|
| Total | 10 | 38 | 70 | 281 | 623 | 1044 |
| Musci | 10 | 28 | 49 | 191 | 483 | 780 |
| Hepaticae | 0 | 10 | 21 | 90 | 140 | 264 |

TABLE 1. Total numbers of bryophyte species from the Iberian Peninsula included in the Red List, according to categories of threat (Ex, E, V, R), and of species that are not threatened (N). Hepaticae include hornworts and liverworts. The total values include the insufficiently known species and taxa with a poorly known distribution or taxonomy.

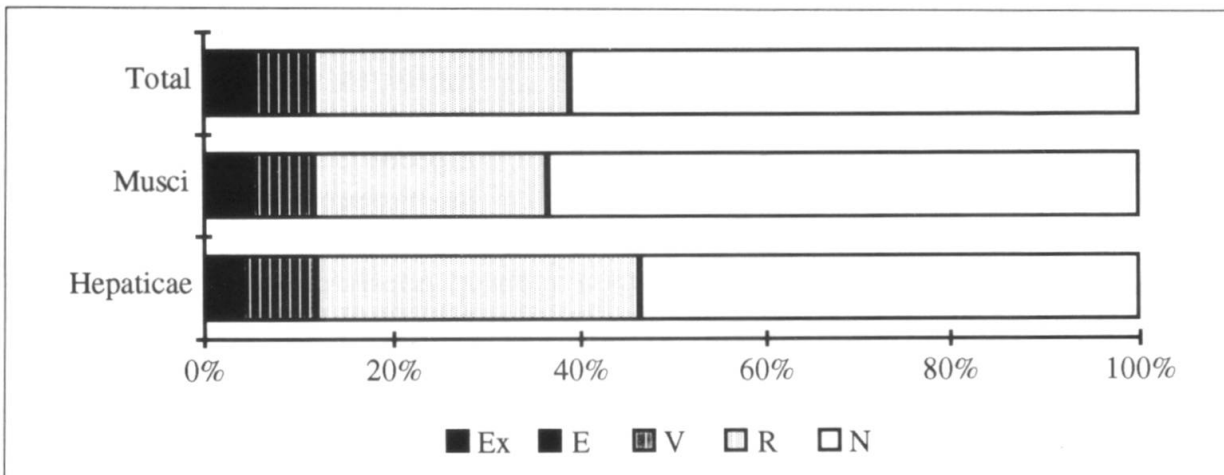


FIGURE 1. Relative values (%) of bryophytes from the Iberian Peninsula included in the Red List, according to categories of threat (Ex, E, V, R), and of species that are not threatened (N). Hepaticae include liverworts and hornworts.

| | PI total | PI % | Eur total | Eur % |
|-------------------------|------------|-------------|------------|-------------|
| Ex | 10 | 1 | 5 | 0.3 |
| E | 38 | 3.6 | 56 | 3.3 |
| V | 70 | 6.7 | 143 | 8.5 |
| R | 281 | 27 | 208 | 12.3 |
| TOTAL (Ex,E,V,R) | 399 | 38.4 | 412 | 24.4 |

TABLE 2. Total and relative values (%) of threatened bryophyte species in the Iberian Peninsula (PI) and in Europe as a whole (Eur).

Some threatened species, such as those included in group A of Tab. 3, are considered vulnerable (V), endangered (E) or extinct (Ex) in Europe and also threatened in the Iberian Peninsula. These bryophytes should receive particular attention so that their status can be accurately determined. This involves new visits to their sites at different times of the year in order to reach a better understanding of their ecology. This group A is a potential group of bryophytes for inclusion in lists of protected species in international legislation, as the annexes of future Habitats and Species Directives.

Group B in Tab. 3 includes some species that are rare (R) but not in imminent danger or not threatened (N) in the Iberian Peninsula, but are seriously threatened (E, V) at the European scale. The Iberian countries have an international responsibility to protect those or to propose sites for the conservation of the species in this group. It should be emphasised that nine of the bryophytes selected in Tab. 3 are present in Appendix I of the Berne Convention and in the Annexes of the European Community Habitats and Species Directives.

Important taxonomic groups

From the global conservation point of view, it is very important to have a correct notion of the present vulnerability of the Iberian bryoflora. In fact there is an impressive number of threatened taxonomic groups in Central and Northern European countries, particularly species of mediterranean or oceanic tendencies, which are relatively frequent in the Iberian Peninsula. Some genera show great diversity in this region, e.g., *Riccia* with 30 species or about 85% of the total European taxa; *Acaulon* with 6 species (about 83% of the total European taxa); *Ephemerum* with 5 species (about 83% of the total European taxa); *Fissidens* with 23 species (about

| Species A | PI | Eur | Species B | PI | Eur |
|---|----|-----|---------------------------------|----|-----|
| <i>Frullania oakesiana</i> | V | E | <i>Ephemerum stellatum</i> | R | E |
| o <i>Petalophyllum ralfsii</i> | V | E | <i>Pyramidula algeriensis</i> | R | E |
| <i>Riella affinis</i> | E | E | <i>Zygodon forsteri</i> | N | E |
| <i>Riella cossoniana</i> | E | E | <i>Exormotheca pustulosa</i> | R | V |
| <i>Riella notarisii</i> | E | E | <i>Exormotheca welwitschii</i> | R | V |
| o <i>Bruchia vogesiaca</i> | V | E | *o <i>Marsupella profunda</i> | R | V |
| o <i>Bryoerythrophyllum campylocarpum</i> | E | E | <i>Pallavicinia lyellii</i> | R | V |
| <i>Clasmatodon parvulus</i> | E | E | <i>Riccia crustata</i> | N | V |
| <i>Entodon cladorrhizans</i> | Ex | E | <i>Riccia sommieri</i> | N | V |
| <i>Isopterygium tenerum</i> | E | E | <i>Tetralophozia filiformis</i> | R | V |
| o <i>Orthotrichum rogeri</i> | Ex | E | <i>Andreaea crassinervia</i> | R | V |
| <i>Pterygoneurum lamellatum</i> | V | E | * <i>Andreaea frigida</i> | N | V |
| <i>Athalamia spathysii</i> | V | V | <i>Anomodon rostratus</i> | N | V |
| <i>Haplomitrium hookeri</i> | E | V | <i>Aschisma carniolicum</i> | N | V |
| o <i>Jungermannia handelii</i> | V | V | <i>Bryum neodamense</i> | R | V |
| <i>Lophozia ascendens</i> | V | V | o <i>Buxbaumia viridis</i> | R | V |
| <i>Riccia huebeneriana</i> | V | V | <i>Campylostelium saxicola</i> | R | V |
| o <i>Riella helicophylla</i> | E | V | <i>Campylostelium strictum</i> | R | V |
| <i>Brachydontium trichodes</i> | E | V | <i>Crossidium aberrans</i> | R | V |
| <i>Brachythecium oxycladum</i> | Ex | V | <i>Ephemerum recurvifolium</i> | R | V |
| <i>Cryphaea lamyana</i> | V | V | <i>Ephemerum sessile</i> | R | V |
| <i>Desmatodon guepinii</i> | E | V | <i>Fissidens grandifrons</i> | N | V |
| <i>Hamatocaulis vernicosus</i> | V | V | <i>Grimmia sessitana</i> | R | V |
| <i>Pleuridium palustre</i> | E | V | <i>Orthotrichum stellatum</i> | N | V |
| * <i>Rhamphidium purpuratum</i> | Ex | V | * <i>Phascum cuynetii</i> | R | V |
| * <i>Tortula freibergii</i> | E | V | <i>Sematophyllum demissum</i> | R | V |
| | | | o <i>Sphagnum pylaisii</i> | N | V |
| | | | <i>Timmiella flexiseta</i> | R | V |
| | | | <i>Tortula fragilis</i> | R | V |
| | | | <i>Tortula handelii</i> | N | V |

TABLE 3. Status of threat of bryophytes occurring in the Iberian Peninsula that are considered threatened in Europe. Abbreviations: A=species vulnerable (V) or endangered (Ex, E) in Europe and also threatened in the Iberian Peninsula. B=species that are not in imminent danger (R) or not threatened (N) in the Iberian Peninsula, but are threatened (Ex, E, V) in Europe. * =European endemics including Macaronesia; o=species listed in the Bern Convention and in the European Community Habitats and Species Directives.

| Endemic | PI total | PI % | Eur total | Eur % |
|-------------|----------|------|-----------|-------|
| Ex, E, V, R | 36 | 60 | 133 | 62 |
| TOTAL | 60 | 5.7 | 216 | 12.8 |

TABLE 4. Total and relative values (%) of the threatened and not threatened bryophytes endemic to Europe in the Iberian Peninsula (PI) and in Europe as a whole (Eur).

70% of the total European taxa); *Grimmia* with 28 species (about 87% of the total European taxa); *Orthotrichum* with 22 species (about 63% of the total European taxa); *Racomitrium* with 16 species (about 80% of the total European taxa) and *Tortula* with 33 species (about 91% of the total European taxa).

Species endemic to Europe found in the Iberian Peninsula

A large number of species endemic to Europe including Macaronesia are present in the Iberian Peninsula (Sérgio & al. 1994), comprising 19 liverworts and 41 mosses (Tab. 4). This corresponds to 27% of all the European endemics. Non-European archipelagos of Macaronesia (Madeira and the Canary Islands) are included in Europe according to ECCB (in press).

Considering the European endemic bryophytes that are endangered or vulnerable in Europe as a whole, two are included in the rare species group (Tab. 3, B), *Rhamphidium purpuratum* and *Tetrastichium virens* have vanished, *Tortula freibergii* is considered endangered and *Andreaea frigida* is not threatened in the Iberian Peninsula (Tab. 3, A).

Of the other European endemics (including Macaronesia) not treated as threatened on a European level *Hypnum uncinulatum* is considered endangered in the Iberian Peninsula and *Isothecium algarvicum*, *Ulota calvescens*, *Pterygoneurum sampaianum*, *Ptychomitrium nigrescens*, *Frullania teneriffae* and *Radula holtii* are considered vulnerable. Nevertheless, some species such as *Plagiochila killarniensis*, *Saccogyna viticulosa*, *Bryum gemmiferum*, *Radula aquilegia*, *Campylopus brevipilus*, *Jubula hutchinsiae*, *Isothecium holtii*, *Tortella densa* and *Rhynchostegium alopecuroides*, are not threatened in the Iberian Peninsula.

It is important to notice that exclusive Iberian endemics such as *Racomitrium hespericum*, *Triquetrella arapilensis* and *Schizymenium pontevedrensis* are common on the Peninsula. In general, however, Iberian endemics are considered rare in the Iberian Red List, for example *Acaulon casasianum*, *A. dertosense*, *Anomobryum lusitanicum*, *Orthotrichum ibericum*, *Phascum longipes* and *Racomitrium lusitanicum*.

Note added in proof

The knowledge of the discovery of *Tetrastichium virens* in Spain, Algeciras, Sierra de Luna by Nils Hakelier (S) was received too late for reconsideration of its status in the Iberian Peninsula.

Acknowledgements

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