

## HOW TO USE THE NEW IUCN RED LIST CATEGORIES ON BRYOPHYTES. GUIDELINES PROPOSED BY THE IUCN SSC BRYOPHYTE SPECIALIST GROUP

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### RESUMEN

El Consejo de la IUCN recientemente aprobó su nuevo sistema de categorías de la lista roja para evaluar el riesgo de extinción de especies vegetales y animales a nivel global. Este también se puede usar para briofitas. Se presentan y explican las categorías brevemente, se discuten sus problemas de aplicación a las briofitas y se proponen pautas prácticas y algunos ejemplos.

Palabras clave: IUCN, lista roja, amenazadas, conservación, briofitas.

### ABSTRACT

The new IUCN Red List category system for assessing the extinction risk for plant and animal species at a global level has recently been approved by the IUCN Council. This system can also be used on bryophytes. The categories are briefly presented, explained and the problems involved when applying the system to bryophytes are discussed and some practical guidelines are proposed with some examples given.

Key words: IUCN, Red list, threatened, conservation, bryophytes.

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## INTRODUCTION

The International Union for the Conservation of Nature and Natural Resources (IUCN) launched in the 1960s a system to assess the extinction risk for species (IUCN, 1978). It has until today been used world-wide and has become the standard system used in Red Data Lists at a global level as well as at national levels. The threat categories used were: Extinct (Ex), Endangered (E), Vulnerable (V), Rare (R), Indeterminate (I), Out of danger (O) and Insufficiently known (K). This system was originally intended mainly for vertebrates but was later also used for invertebrates and plants (including bryophytes), despite some difficulties. The system has been a source of recurrent uncertainty and dissatisfaction especially used on invertebrates and plants.

During the last ten years, this 30-year old category system has been under revision. In November 1994, the new version of the Red List categories to be used on the global level were finally approved by IUCN to replace the old system. The IUCN Specialist group for bryophytes has had the opportunity to comment on an early draft of the new system for determining threatened species status. It seems likely that the new threat categories will work better for bryophytes than the old ones, being more explicit, objective and clear, and causing less confusion than the old system.

The new categories consist of Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Lower Risk (LR), Data Deficient (DD) and Not Evaluated (NE).

The new system is similar to the old one, in that it is based solely on the probability of extinction at a world level. Some additional supplements will be needed to the system for use at regional or national levels. One important difference between the new and old systems is that the category Rare (R) has disappeared. Most taxa which were formally classified as Rare will now meet the criteria under the new definition of Vulnerable or be included in completely new category called "Lower Risk".

The new categories are decided by different thresholds in 5 main criteria (A, B, C, D, E).

They appear to work reasonably well for bryophytes, if the relevant criteria, subcriteria and definitions are used in a lower plant-oriented way, which we will try to explain below.

## DATA APPROPRIATE WHEN ASSESSING BRYOPHYTES

Compared to the old system the new one has many numerical thresholds which require quantitative data, for example, population size, decline over the last 10 years, number of mature individuals, etc. Since bryologists completely lack data from PVAs (Population Viability Analysis), cannot usually count individuals or

measure 'generation length' (*sensu* IUCN), and seldom have information about bryophyte population sizes or data on decline over the last 10 years, some of the criteria are simply not applicable or are inappropriate when dealing with bryophytes.

Be aware that the guidelines discussed below for bryophytes include only part of the original text about the new categories. We therefore recommend all those who want to adopt them to read also the original IUCN publication carefully.

The most relevant data on hand that can be used for bryophytes are as follows:

- (1) Present distribution (*i.e.*, area of distribution plus area of occupancy, see explanation below).
- (2) Estimated degree of fragmentation of the world population.
- (3) Estimated decline of the number of sites over the last 10-100 years.
- (4) Estimated loss or degeneration of relevant habitats over the last 10-100 years.

We believe that most of the above four criteria can be applied to bryophyte species that have been relatively well monographed or studied on a world-wide basis. However, our global overview of bryophyte distribution is very poor —mainly because there are too few bryologists.

### LACK OF KNOWLEDGE

The preamble to the new categories (IUCN, 1994) emphasises the importance of attempting also to classify poorly-known species by estimating and extrapolating the current or potential threats into the future and allocating them a threat status on the precautionary principle. This is important for the assessment of bryophytes since it enables us to use indirect factors such as deforestation, habitat destruction and air pollution. Without it, most bryophyte species would end up in the category Data Deficient, because bryophytes in general are less known compared to vascular plants and vertebrates. However, taxa that are likely to be overlooked should be placed in DD (Data Deficient).

### DECLINE OF THE QUALITY OF HABITAT

This option can be very useful if up-to-date information about the population status of the species is lacking, but information about changes in habitat quality is present. The problem is to collate the up-to-date information about destruction of the habitat for all known sites for a taxon. This means that while bryologists usually know the taxa well, they seldom have access to appropriate data on recent habitat destruction, exploitation or air pollution throughout the range of a taxon.

## EXPLANATION OF TERMS

**Population.** The term population is used by IUCN to mean the total number of individuals of the taxon.

**Fragmented distribution.** How does fragmented distribution apply to bryophytes? Since many bryophytes have a world-wide distribution but are often at the same time rare throughout their distribution area (Vitt and Li, 1993), the pattern of distribution is often patchy. The reason for this can be natural because bryophytes are often confined to specific micro-sites which are and always have been rare and patchily distributed.

On the other hand, the occurrences can be relictual from a time when the species had a much wider distribution range. The widest global distribution ranges have probably resulted from slow, step-wise migration subject to topographic and climatic control in the past (Crum, 1972). There are no accurate data showing that long-range dispersal of bryophytes occurs without human help. Some bryologists suggest that long-range dispersal has little significance in bryophyte migration (Crum, 1972; *cf.* also Frahm and Vitt, 1993; Tibell, 1995). Others (van Zanten and Pócs, 1981; van Zanten and Gradstein, 1988) claim that long-range dispersal can be an important means of dispersal for some groups of bryophytes. For some easily dispersed species a distance of 100 km does not indicate isolation, but for others that are not capable of long-range dispersal, 100 km between locations can represent total isolation.

The crucial question is, is there a gene flow between more or less geographically separated populations or patches, or are populations functionally separated by some kind of barrier? We suggest that this has to be decided on a species-by-species basis, because of the different reproductive systems, dispersal mechanisms, etc. used by different species.

**Distribution area ("Extent of occurrence").** In the IUCN categories the term "Extent of occurrence" is used, and defined as "the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon".

In practice this can be difficult with very widely scattered taxa, since bryophytes in general have wider total distribution areas than flowering plants. However, does this automatically give them a better chance of survival?

**Number of sites ("Area of occupancy").** In the IUCN criteria the term "Area of occupancy" is used and is recommended to be the sum of all grid squares where at least one site occurs. The grid size should be sufficiently small, preferably 1 km<sup>2</sup>. Since most rare bryophyte distributions are patchy on a very small scale, with scattered small sites (less than 1 km<sup>2</sup>) and often more than 1 km between each occurrence, we would from a biological point of view prefer to use 1 km<sup>2</sup> square information. But since we, for most bryophyte taxa, lack precise geographical information to apply on a 1x1 km mesh size, we have to recommend the 5 x 5 km or 10 x 10 km squares as the approximate equivalent to the IUCN "Area of occupancy" for consistency.

**Location or sites.** We regard the IUCN term "location" to be equivalent to what bryologists normally call a "site". The definition in the IUCN manual is "Location defines a geographically or ecologically distinct area in which a single event (*e.g.*, pollution) will soon affect all individuals of the taxon present. A location usually, but not always, contains all or part of a subpopulation of the taxon, and is typically a small proportion of the taxon's total distribution."

Since no size limit is given for a "location" in the IUCN system, we suggest, when dealing with bryophytes, a location should be a single continuous area up to 10,000 km<sup>2</sup>. However, the issue of site definition is a considerable problem in biological recording and, in practice, each site must be chosen on its own merits, in accordance with a set of sensible and definable boundaries, the nature of the terrain, and various other factors. There should not, therefore, be a rigid "cut-off area limit" for a single site.

### THREATS AND PRIORITIES

As stressed in the preamble to the new categories, the threat categories alone are not sufficient to determine priorities for conservation. A system of assessing priorities for action should include other factors, such as taxonomic uniqueness, logistics, chances of success and perhaps costs.

### THE EVALUATING PROCESS

All candidate species should be evaluated against all categories, beginning with EX and proceeding to EW, CR, EN, etc. The first category which sufficiently meets the situation of the species is the appropriate Red Data Category for that taxon. For Red Data List species (CR, EN, VU), also evaluate the subcriteria after the major category criteria have been met.

### DEFINITIONS OF THE NEW CATEGORIES AND AN INTERPRETATION FOR BRYOPHYTES

All taxa listed as EX, EW, CR, EN, VU are all classified as "Threatened", LR as "Not threatened" and DD as neither "Threatened" nor "Not threatened". The following remark from IUCN 1995 (preamble, 5) is most important: "Listing in the categories of Not Evaluated and Data Deficient indicates that no assessment of extinction risk has been made, though for different reasons. Until such time as an assessment is made, species listed in these categories should not be treated as if they were non-threatened, and it may be appropriate (especially for Data Deficient forms) to give them the same degree of protection as threatened taxa, at least until their status can be evaluated."

**Extinct (EX).** "A taxon is Extinct when there is no reasonable doubt that the last individual has died."

Comment: For bryophytes, this means in theory that no living material of the taxon exists in the world. See the comment under the next category (EW).

**Extinct in the Wild (EW).** "A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range."

Comment: Since bryophytes have a very high regenerative potential with each cell, this implies that no living material (not even a single living cell) exist in the world in the wild.

To interpret them in a reasonable way, EX and EW need additional definition. Often, we have to base our judgement on a great amount of survey work to determine the actual range of a taxon. For the purposes of the European bryophyte Red List (Schumacker and Martiny, 1995), extinct (including EW) is defined as: "Taxa for which all known localities have been checked in the last 30 years without success, or taxa listed as extinct or vanished in all available Red Lists, if the total area of distribution is covered by Red Lists."

For a world list, it is not possible at present to check all localities, especially those in remote areas with vague geographical information. Therefore we have to use losses of habitat over the entire range of a taxon as indirect evidence of vanishing localities for a species. Nor can we use national or regional Red Lists, since most tropical countries for example lack a Red List. The lapse of time since the last record was made, which will be different from region to region, according to intensity of survey, can also be taken into consideration.

**Critically Endangered (CR).** "A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E)":

A) "An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years" based on a decline in distribution area, number of sites or quality of habitat or because of predicted exploitations and/or pollution.

B) A restricted distribution area (for well known taxa less than 100 km<sup>2</sup> or the sum of occupied 1 km<sup>2</sup> grid squares km<sup>2</sup>, and continuously declining (*e.g.*, because of habitat destruction) and estimates indicating both of the following subcriteria:

1) The distribution is "severely fragmented" or known to exist in only one isolated site ("location").

2) "Continuing decline, observed, inferred or projected," in number of sites and/or quality of habitat.

C) Population declining and "estimated to number less than 250 mature individuals".

Comment: Not applicable to bryophytes, because of the difficulty in determining what an individual is.

D) "Population estimated to number less than 50 mature individuals".

Comment: Generally not applicable to bryophytes.

E) "Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or 3 generations, whichever is the longer."

Comment: Only in very few regions are there good enough data to make this kind of analysis.

**Endangered (EN).** "A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E)":

A) "An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years" based on a decline in distribution area, number of sites or quality of habitat, or because of predicted exploitation and/or pollution.

B) A restricted distribution area (for well known taxa less than 5000 km<sup>2</sup>) or the sum of the occupied grid squares less 500 km<sup>2</sup> and continuously declining (*e.g.*, because of habitat destruction) and estimates indicating both of the following subcriteria:

1) The distribution is severely fragmented or known to exist in less than 5 sites.

2) "Continuing decline, inferred, observed or projected," in number of sites and/or quality of habitat.

C) Population declining and "estimated to number less than 2500 mature individuals".

Comment: Not applicable to bryophytes.

D) "Population estimated to number less than 250 mature individuals."

Comment: Generally not applicable to bryophytes.

E) "Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or 5 generations, whichever is the longer".

Comment: Only in very few regions are there good enough data to make this kind of analysis.

**Vulnerable (VU).** "A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E)":

A) "An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years" based on a decline in distribution area, number of sites or quality of habitat, actual or predicted exploitations and/or pollution.

B) Restricted distribution area (less than 20 000 km<sup>2</sup> or the sum of the occupied grid squares less than 2000 km<sup>2</sup> and estimates indicating both of the following subcriteria:

1) The distribution is "severely fragmented" or known to exist in less than 10 sites ("locations").

2) "Continuing decline, inferred, observed or projected", in number of sites and/or quality of habitat.

C) Population declining and "estimated to number less than 10 000 individuals".

Comment: Often not applicable to bryophytes, since it requires a counting of individuals, but can be used on bryophytes that clearly have a very small world population; for example, some epiphytes and other taxa occurring in separate tufts. Normally it would be difficult to distinguish between a population of less than 2500 individuals or one of less than 10 000 individuals, so one should err downwards (to VU) if this criterion is used.

D) "Population very small or restricted in the form of either of the following":

1) "Population estimated to number less than 1000 mature individuals".

Comment: Not applicable to bryophytes.

2) "Population is characterised by an acute restriction in its area of occupancy" (the sum of the occupied grid squares less than 100 km<sup>2</sup>) "or in the number of locations (typically less than 5). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time". Comment: Very rare taxa; for well known taxa, restriction can be fewer than 100 small sites and for less known taxa, less than 5 sites.

E) "Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years".

Comment: (E) is possible to use only for very few bryophyte taxa and in a few regions where there may be good enough data available to make this kind of quantitative analysis.

The "D" criteria indicate the risk of extinction inherent in species with highly restricted ranges: they could easily disappear before a threat to them has even been recorded. VU (D) will probably be one of the most used categories for bryophytes. The interpretation of the data available should be used with some discretion and common sense since some small bryophyte species are certainly overlooked and under-recorded.

**Lower Risk (LR).** A taxon is Lower Risk when it has been evaluated and does not satisfy the criteria for any of the categories CR, EN or VU. The LR category is divided into three: least concern (lc), conservation dependent (cd) and near threatened (nt). Taxa in the last subcategory are close to qualifying for VU but are unlikely to face extinction in the foreseeable future. Be aware of the importance of the LR-species as any of them could rapidly become threatened and they should therefore be re-evaluated at appropriate intervals. A list of LR species include many that are close to qualifying for VU, and should therefore always be included in an appendix to a Red Data List.



The LR (cd) "conservation dependent", is probably not applicable to bryophytes since conservation programmes are rarely directed specifically to bryophyte species.

**Data Deficient (DD).** A taxon is Data Deficient when there is not enough adequate information to make a direct or indirect assessment of its risk of extinction. DD is therefore not a category of threat but taxa meeting DD criterion should be put on an appended candidate list. Listing the taxa in this category indicates that more information is required. Many DD species are likely to meet the criteria for inclusion in a Red List when better known.

**Not Evaluated (NE).** A taxon is Not Evaluated (NE) when it has not yet been assessed against any of the criteria.

## SOME EXAMPLES

### Example 1

*Anthoceros neesii* Prosk.

Status: Endemic to Europe.

Only a few known sites, and one collection since 1950.

Limited to Central Europe: Germany, Poland and Czech Republic. In the Czech Republic and Poland it is regarded as Ex (extinct) and in Germany it is considered as E (Endangered), using old criteria.

Its habitat (fields) has changed drastically due to very intense agricultural practice in most of the area.

Contributors: E. Urmi, R. Schumacker and J. Vána

Meets the IUCN Criteria: **Critically Endangered** because of "a ... suspected reduction of at least 80% of the (total) population .... based on a decline in quality of habitat."

### Example 2

*Nardia huerlimannii* Vána et Grolle

Status: Endemic to New Caledonia.

Only 3 collections known, all made in 1950/51 from higher mountains in southern New Caledonia between 580-880 m elevation, growing in humid or mesic forest on living or dead trees. One of the three stations (region of Mt. Dzumac) may be endangered by forestry activities as an access road has been built nearby. The other two stations will probably not suffer from human interference. However, as neither sexual nor asexual reproduction has been observed, the future of the species is by no means assured.

Contributors: H. Hürlimann and J. Vána

Meets the IUCN Criteria: **Vulnerable** because "Population is very small or restricted ... and ... (distribution) restricted in the number of locations (typically less than 5) ... If human activities increases ... it is capable of becoming Critically Endangered ..."

### Example 3

*Calypogeia rhynchophylla* (Herz.) Bischl.

Status: endemic to Costa Rica and is known from three localities on the mainland and from several localities on Cocos island. The species grows on humic soil and bases of trees in very humid, tropical montane cloud forest, at ca. 1000-2000 m on the mainland and above 500 m on Cocos Island. The species is only known from dense, undisturbed forests. The cloud forests of Costa Rica have largely disappeared except in a few protected areas. All collections, except for the type specimen, are recent gatherings and are from Natural Parks (Tapanti 1980's, Monteverde 1993, Cocos Island 1994). In Cocos island the species is still locally abundant at higher elevations (G. Dauphin, pers. comm. 1994). Although its geographical range is very narrow, its occurrence in the relatively well-managed Natural Parks of Costa Rica and its commonness on the remote, uninhabited (and protected) Cocos Island, indicates that the species may not be considered endangered, at least at present but "only" vulnerable.

Contributor: S. Rob Gradstein

Meets the IUCN Criteria: **Vulnerable**, because of "an acute restriction in its area of occupancy"

### Example 4

*Caudalejeunea grolleana* Gradst.

Status: endemic to Madagascar where it is known from two localities: Nossi-BÚ Island (1971) and Antsohy forest (1973). The species grows on bark in lowland rain forest and is only known from undisturbed habitats. Changes in the area where it occurs: massive deforestation.

The status of the lowland rain forests of Madagascar, the habitat of *Caudalejeunea grolleana*, is very critical. Less than 15% of the original area is remaining and almost every forest area, including the reserves, is threatened with destruction. Even though the two localities known are in forest reserves, the species should be considered critically endangered.

Contributor: S. Rob Gradstein

Meets the IUCN Criteria: **Critically Endangered** because "suspected reduction of at least 80% ... based on ... a decline in quality of habitat".

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