

# The 2000 IUCN World Red List of Bryophytes

(available at <<http://www.dha.slu.se/guest/WorldBryo.htm>>)

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## Introduction

The World Red List of Bryophytes currently includes 92 species. This list is only a small subset of globally threatened species. It has been constructed to provide the public with general information as to which bryophytes are threatened with extinction.

## Method

The selection of species was based on the following three criteria:

1. The species must be threatened worldwide.
2. The species must be confined to a threatened habitat.
3. The species must have a narrow distribution range.

The list of candidates was first presented for public comment via the bryological listserver (BRYONET<sup>1</sup>) on the Internet. We received several responses, many of which contained information on the local geography of the threatened species, information for which we are most thankful. We then assessed each species against the IUCN Red List Criteria (IUCN 1994), using the guidelines presented in Hallingbäck *et al.* (see Appendix 1).

## Discussion

Selecting species for a World Red List of Bryophytes is a difficult task. Sound threat assessments are difficult to determine. For example establishing the threats to European and Macaronesian species, where the actual distribution should be relatively well known, is not easy. For many other regions, particularly tropical areas, the bryophyte flora is even less well known. Where recent literature still reports large regions of presence, with many localities within the distribution area, the species were provisionally categorised as Lower Risk (near threatened) i.e., those not considered to be threatened at present and not included in this Appendix. Similarly, all taxa that have been taxonomically queried are not yet included or were considered as Data Deficient (DD). Information on these

Lower Risk and Data Deficient species can be provided upon request.

Several of the species not included on the World Red List are taxa whose current range or distribution is difficult to determine worldwide. Others are inconspicuous ruderal species of disturbed sites whose habitats do not appear to be threatened by human activities. Many are simply rare, local endemics whose habitat threat has not been observed or identified, but not rare enough to apply criteria D. Some species have recently been described and, therefore, their total range and habitat threats require assessment.

## The List

### MOSSES (MUSCI)

*Acritodon nephophilus* H. Rob.

**Family:** Sematophyllaceae.

**Distribution:** Mexico (less than five localities in Oaxaca State).

**Habitat:** On tree bark in forested ravines in cloud forest belt, 3,000–3,200m a.s.l.

**Threat:** Known only from one small region, which is heavily disturbed and where large areas of forest have been felled recently.

**Source:** C. Delgadillo pers. comm.

**IUCN:** There are less than five localities and the population is suspected to have declined because its habitat has been severely destroyed by human activity. It, therefore, meets the IUCN criteria for Endangered based on the small area of occupancy (less than 500km<sup>2</sup>), the less than five localities, and the decline in the quality of its habitat resulting from high level of exploitation by humans. – EN (B1,2c).

*Archidium elatum* Dixon and Sainsbury

**Family:** Archidiaceae.

**Distribution:** New Zealand (north Auckland). Known from less than five localities.

**Habitat:** On coastal rock.

**Threat:** Human activities.

**Source:** A. Fife pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup>, known to exist at no more than five localities, and the species' habitats seem to be declining in extent and quality. It, therefore, meets the IUCN criteria for Endangered

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1. To join BRYONET please contact Prof. Janice M. Glime (jmglime@mtu.edu).

based on the small fragmented area and the decline of habitat quality. – EN (B1,2c).

*Aschisma kansanum* A.L. Andrews

**Family:** Pottiaceae.

**Distribution:** USA (from three counties in Kansas).

**Habitat:** Known from an unusual habitat of quartz pebbles in sandy Pleistocene gravel, covered partly by the persistent protonema of this species.

**Threat:** Because of its rarity, the populations are now severely threatened by over-collection and also by cattle grazing in the area.

**Source:** Crum and Anderson 1981, Smith-Merrill pers. comm.

**IUCN:** The species seems to have a very restricted distribution. It, therefore, meets the IUCN criteria for Vulnerable, based on an estimation that the number of localities are fewer than five. – VU (D2).

*Brymela tutezona* Crosby and B.H. Allen

**Family:** Hookeriaceae.

**Distribution:** Panama (Cerro Arizona, Veraquas Province). Not known outside the type locality.

**Habitat:** Epiphytic in tree crowns in elfin cloud forest.

**Threat:** Rapid deforestation.

**Source:** Gradstein 1992a,b.

**IUCN:** The known area of occupancy is less than 10km<sup>2</sup> and deforestation is continuing. It, therefore, meets the IUCN criteria for Critically Endangered based on the small fragmented area, the only known locality, and the decline of habitat quality. – CR (B1,2c).

*Bryoxiphium madeirense* A. Löve and D. Löve

**Family:** Bryoxiphiaceae.

**Distribution:** Portugal (Madeira). There are less than five known recent localities for the species.

**Habitat:** On moist and dripping volcanic rocks, in shaded streams in *Laurus* forest.

**Threat:** Habitat threatened by the recent logging and clearing of *Laurus* forest for agricultural development and pasture land.

**Source:** Löve and Löve 1953, ECCB 1995.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat seems to be declining in quantity and quality. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the less than five localities, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

*Distichophyllum carinatum* Dixon and W.E. Nicholson

**Family:** Hookeriaceae.

**Distribution:** Known only from four localities. Germany (two sites in Bayern), Austria (RE), Switzerland (RE), Japan (one site in Honshu), and China (one site in Sichuan).

**Habitat:** On wet cliffs in wooded ravines, and on tree trunks in deciduous forest in mountains.

**Threat:** Seems to be very sensitive to subtle changes of habitat conditions; for example, changes caused by air pollution.

**Source:** Urmi 1984, Noguchi 1991, R. Lübenau pers. comm., H. Deguchi pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitats seem to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small area, the less than five localities, and the decline of habitat quality and number of locations. – EN (B1,2c).

*Ditrichum cornubicum* Paton

**Family:** Ditrichaceae.

**Distribution:** Great Britain (Cornwall). Known from only one locality.

**Habitat:** The species is known from copper mine waste in three granite areas, but has disappeared from one. Plants grow on compacted, well-drained peaty, loamy, or gravelly soil where the vegetation is sparse and open.

**Threat:** In recent years, the population is known to have disappeared from one of the three original sites. Habitat is threatened by encroachment of rank vegetation and excessive human disturbance, for example vehicular activity.

**Source:** Paton 1976, ECCB 1995.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the less than five localities, and the decline of habitat quality. – EN (B1,2c).

*Donrichardsia macroneuron* (Grout) H.A. Crum and L.E. Anderson

**Family:** Amblystegiaceae.

**Distribution:** USA (Edwards County, Texas). Only one locality remains.

**Habitat:** Growing on boulders in calcareous spring water.

**Threat:** The calcareous spring habitat is unusual and is easily degraded by settlements, dam constructions, and water pollution.

**Source:** Wyatt and Stoneburner 1980.

**IUCN:** The species seems to have a very restricted distribution. It, therefore, meets the IUCN criteria for Vulnerable based on an estimation that the number of localities is less than five. – VU (D2).

*Echinodium renauldii* (M.A. Cárdenas) Broth.

**Family:** Echinodiaceae.

**Distribution:** Portugal (Azores). Less than 10 known localities on five islands.

**Habitat:** On rocks in forested, deeply shaded ravines and craters above 500m. The species is also known from a Pliocene fossil from the Canary Islands.

**Threat:** Because of changes in land policy the *Laurel* forest habitat is threatened by logging.

**Source:** Churchill 1986, ECCB 1995, Sjögren 1997.

**IUCN:** The species has a very restricted distribution and seems to have declined. It, therefore, meets the IUCN criteria for Vulnerable based on an estimate that the present number of localities is less than 10, the area of occupancy is less than 2,000km<sup>2</sup>, and the population is declining because of declining habitat quality. – VU (B1, 2cd)

***Echinodium setigerum*** (Mitt.) Jur.

**Family:** Echinodiaceae.

**Distribution:** Portugal (NW Madeira). Confined to less than five localities.

**Habitat:** On stones in deep and narrow valleys, among shading ferns.

**Threat:** Confined to localities where the natural forest habitat is potentially threatened by changing land uses.

**Source:** Hedenäs 1992.

**IUCN:** The species seems to have a very restricted distribution area. It, therefore, meets the IUCN criteria for Vulnerable based on an estimation that the number of localities is less than five. – VU (D2).

***Fissidens hydropogon*** Spruce ex Mitt.

**Family:** Fissidentaceae.

**Distribution:** Amazonian Ecuador (southeastern area at the foot of the Andes, along Rio Bombonasa). Known only from the type collected in 1857.

**Habitat:** Submerged in flowing rivers in rainforest.

**Threat:** The forest in the area has been disturbed.

**Source:** Pursell *et al.* 1988, R. Pursell pers. comm.

**IUCN:** The known area of occupancy is less than 10km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small fragmented area, the only known locality, and the decline of habitat quality. – CR (B1,2c).

***Flabellidium spinosum*** Herzog

**Family:** Brachytheciaceae.

**Distribution:** Bolivia (Santa Cruz Cordillera). Known only from the type collection made in 1911.

**Habitat:** Epiphytic.

**Threat:** The forest of the type locality and vicinity has been logged and cultivated over the years.

**Source:** Enroth 1995, idem pers. comm.

**IUCN:** We consider that there is no reasonable doubt that the last locality for this species has been destroyed and that the last individual has died. – EX.

***Gradsteinia torrenticola*** Ochyra, C.Schmidt, and Bültmann

**Family:** Amblystegiaceae.

**Distribution:** Spain (Known only from a single locality on Tenerife in the Canary Islands).

**Habitat:** Grows submerged on rocks in a waterfall.

**Threat:** A change in waterflow or pollution of the river is a potential threat.

**Source:** Ochyra *et al.* 1998.

**IUCN:** The species seems to have a very restricted distribution. It, therefore, meets the IUCN criteria for Vulnerable based on an estimation that the number of localities is less than five. – VU (D2).

***Hypnodontopsis apiculata*** Z. Iwats. and Nog.

**Family:** Rhachithecaceae.

**Distribution:** Japan (Honshu). Less than 10 localities are known. It has disappeared from at least one of these (the type locality) by cutting of host trees. The others are only small colonies.

**Habitat:** Restricted habitat on the bark of *Cryptomeria japonica* (it may occasionally also grow on the bark of pines; *Pinus* sp.) in gardens of Buddhist temples, Shinto shrines, and old castles.

**Threat:** The subpopulation at the type locality has disappeared because the trees have been felled or damaged by typhoons. At the remaining sites the growth is threatened by tree removal, most of the sites being very close to human settlements.

**Source:** Z. Iwatsuki pers. comm.

**IUCN:** The area of occupancy is currently less than 2,000km<sup>2</sup>, occurring in less than 10 localities, and the quality of its main habitat has continuously declined, mainly because of human activities. It, therefore, meets the IUCN criteria for Vulnerable based on a decline of suitable trees, high level of human exploitation, and heavy air pollution. – VU (B1,2c).

***Jaffuelobryum arsenei*** (Thér.) Thér.

**Family:** Grimmiaceae.

**Distribution:** Mexico (States of Querétaro and Zacatecas). Four localities. One of the sites in Zacatecas may have been destroyed by human interference. The other three are situated close to urban developments.

**Habitat:** On soil-covered rocks in dry lands.

**Threat:** Habitats are threatened by farmland expansion and housing.

**Source:** Churchill 1987, Claudio Delgadillo pers. comm.

**IUCN:** The known area of occupancy is today less than 500km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the less than five localities, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

***Lepidopilum grevilleanum*** Mitt.

**Family:** Daltoniaceae.

**Distribution:** Ecuador (western coastal region of the Andean foothills). Known only from two localities.

**Habitat:** On trees in humid premontane forests.

**Threat:** The massive deforestation in western Ecuador may account, in part, for the rarity or even possible extinction of this species. According to Churchill (1992), this very conspicuous species is likely to be collected even by non-bryologists.

**Source:** Churchill 1992.

**IUCN:** The known area of occupancy is less than 10km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small fragmented area, the decline of habitat quality, and the declining number of locations. – CR (B1,2cd).

*Leucoperichaetium eremophilum* Magill

**Family:** Grimmiaceae.

**Distribution:** Namibia (Witpütz). Known only from the type collection.

**Habitat:** On quartzite outcrops in dwarf succulent shrublands.

**Threat:** The small locality is surrounded by diamond mines. The threat is resulting from these mining activities that may be on the increase.

**Source:** Magill 1981, C. Hilton-Taylor pers. comm.

**IUCN:** The species seems to have a very restricted distribution. It, therefore, meets the IUCN criteria for Vulnerable based on an estimation that the number of localities is less than five. – VU (D2).

*Limbella fryei* (R.S. Williams) Ochyra.

**Family:** Pterobryaceae.

**Distribution:** USA (coastal Oregon, Sutton Lake Swamp Preserve). Known from two localities, but has been found again recently at only one of these. It has been extensively looked for in the region, but no new locality has been found.

**Habitat:** Near a road adjacent to a lake on wet, rotten wood, leaf litter, etc.

**Threat:** Housing developments, water pollution, earthquake-related subsidence, and human-induced changes in hydrology are the primary threats (Christy and Wagner 1996).

**Source:** W. B. Schofield pers. comm.

**IUCN:** The known area of occupancy is less than 10km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small fragmented area, the only locality, and the decline of habitat quality. – CR (B1,2c).

*Mamillariella geniculata* Laz.

**Family:** Leskeaceae.

**Distribution:** Russian Federation (Russian Far East near Khabarovsk). Known only from between five and seven localities. However, fewer than five of these are recent.

**Habitat:** In mixed deciduous forest.

**Threat:** The forests in the Russian Far East are today seriously threatened by on-going economic development in the region.

**Source:** Buck 1981, M.S. Ignatov pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

*Merrillibryum fabronioides* Broth.

**Family:** Fabroniaceae.

**Distribution:** Philippines (mountains of northern Luzon). Known from less than five localities. All of the records are old, but Tan, based on his knowledge of the area (pers. comm.), believes it must still be present in at least some localities.

**Habitat:** Epiphytic on trees in montane mossy forests.

**Threat:** Habitat has been disturbed for decades by agricultural expansion, logging, and mining operations.

**Source:** Gradstein 1992a, B. C. Tan pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the less than five localities, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

*Mitrobryum koelzii* H. Rob.

**Family:** Dicranaceae.

**Distribution:** India (Uttar Pradesh). First reported in 1968 from the type and later from one other collection in the area at 3,300m a.s.l.

**Habitat:** On forest soil.

**Threat:** Habitat threatened by human activities.

**Source:** Vohra 1987.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the less than five localities, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

*Neckeropsis pocsii* Enroth and Magill

**Family:** Neckeraceae.

**Distribution:** Comoros (Mayotte). Only one locality.

**Habitat:** On boulders in mesic evergreen forest.

**Threat:** The species is threatened by excessive logging.

**Source:** Enroth and Magill 1994; T. Pócs pers. comm.

**IUCN:** The known area of occupancy is today less than 10km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area, the only locality, and the decline in habitat quality due to logging. – CR (B1,2c).

*Neomacounia nitida* (Lindb.) Ireland

**Family:** Neckeraceae.

**Distribution:** Canada (Ontario, Hastings County). Known only from the type and two other collections made in the same general locality between 1862 and 1864.

**Habitat:** On elms in a swamp.

**Threat:** Extinct

**Source:** Ireland 1974.

**IUCN:** The known localities were not rediscovered during several expeditions by bryologists since 1864, including fieldwork in the 1970s. The species may, therefore, be considered Extinct – EX.

***Ochyraea tatrensis*** Váða

**Family:** Hypnobartlettaceae.

**Distribution:** Slovakia (Nizke Tatry Mountains). Known only from two localities, but has vanished from one of these recently.

**Habitat:** On granite stones in streams at subalpine elevation.

**Threat:** Habitat threatened by human activities.

**Source:** J. Váňa pers. comm., J. Váňa 1976.

**IUCN:** The species seems to have a very restricted population size. It, therefore, meets the IUCN criteria for Critically Endangered based on an estimation that the number of individuals are fewer than 50. – CR (D).

***Orthodontopsis bardunovii*** Ignatov and B.C. Tan

**Family:** Bryaceae.

**Distribution:** Russian Federation (Siberia in Altai Mountains and Western Sayan Mountains). Known only from a few localities.

**Habitat:** On rotten old logs in *Pinus-Larix* forest.

**Threat:** The species seems unable to survive outside the fast disappearing old-growth forest.

**Source:** M.S. Ignatov pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

***Orthotrichum scanicum*** Grönvall

**Family:** Orthotrichaceae.

**Distribution:** Austria, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Norway, Poland, Russian Federation, Spain, Sweden, Switzerland, and Yugoslavia. However, this distribution is based mostly on old reports, except Spain, and it is considered Endangered or Regionally Extinct in several countries. Its overall range is declining in Europe. Many local subpopulations are now extinct.

**Habitat:** On trunks and branches of conifers, as well as broadleaf deciduous trees.

**Threat:** Threatened by the felling of host trees and by air pollution.

**Source:** ECCB 1995, M.S. Ignatov pers. comm.

**IUCN:** The population is suspected to have declined by at least 20% over the last 15 years (three generations) because host trees have been cut and air pollution has lowered the vitality of this species. It, therefore, meets the IUCN criteria for Vulnerable. – VU (A1ce).

***Orthotrichum truncato-dentatum*** C. Muell.

**Family:** Orthotrichaceae.

**Distribution:** Uruguay (Montevideo) and Argentina (Isla Recreo). It is not currently known from any locality. The old collections were made more than 100 years ago. The genus *Orthotrichum* may be under-recorded in southern South America and, therefore, more field work is needed to confirm its extent and population size.

**Habitat:** On trees near human settlements.

**Threat:** The known old localities are heavily urbanised today.

**Source:** Lewinsky 1992.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> with fewer than five localities and the species' habitats seem to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, less than five localities, and the decline of habitat quality. – EN (B1,2cd).

***Ozobryum ogalalense*** G. L. S. Merrill.

**Family:** Pottiaceae.

**Distribution:** USA (Kansas). Known only from a single locality.

**Habitat:** Confined to an unusual habitat – strongly calcareous, porous rock outcrop ledges charged with moisture, and surrounded by prairie.

**Threat:** The location is threatened by cattle grazing and human disturbance.

**Source:** Merrill 1992, Merrill pers. comm.

**IUCN:** The known area of occupancy is today less than 10km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small and unique locality and the declining habitat quality resulting from high pressure from cattle grazing and other human disturbances. – CR (B1,2c).

***Pinnatella limbata*** Dixon

**Family:** Neckeraceae.

**Distribution:** India (Uttar Kanad, formerly North Kanara, District of Karnataka State). Known only from a single locality.

**Habitat:** A rheophyte attached to rocks in a fast flowing stream.

**Threat:** Threatened by the rapid destruction of forests in SW India due to population expansion.

**Source:** Enroth 1994, B. O'Shea pers. comm.

**IUCN:** The known area of occupancy is less than 10km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small fragmented area and the decline of habitat quality. – CR (B1,2c).

***Renauldia lycopodioides*** Bizot ex Pócs

**Family:** Pterobryaceae.

**Distribution:** Tanzania (Sagara Ridge of West Usambara Mts and Uzungwe Mts). Known only from two localities.

**Habitat:** Epiphyte on branches in mossy montane forest.

**Threat:** The forest habitat is threatened by illegal deforestation.

**Source:** T. Pócs pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat appears to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the less than five localities, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

*Sciaromiopsis sinensis* (Broth.) Broth.

**Family:** Amblystegiaceae.

**Distribution:** Known from three small localities, all in China (Sichuan, Daliang-shan at Yanyuan, Lungdschushan at Huili and Yunnan, Lidjiang). In spite of recent expeditions to the area, it has not been found again.

**Habitat:** Submerged in clean, flowing rivers.

**Threat:** The natural vegetation at the sites is seriously disturbed today by a growing human population, deforestation, and industrialisation, which cause rivers to be heavily blocked with silt.

**Source:** Ochyra 1986, C. Tong pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat seems to be degrading. It, therefore, meets the IUCN criteria for Endangered based on the small remaining potential area, the less than five localities, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

*Skottsbergia paradoxa* M.A. Cardenas

**Family:** Ditrichaceae.

**Distribution:** Argentina (South Georgia and part of Fuegian Island). Known only from a few localities.

**Habitat:** Associated with *Sphagnum* in boggy areas.

**Threat:** The localities are highly threatened by increasing human activities.

**Source:** C. Matteri pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the less than five localities, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

*Sphagnum leucobryoides* T. Yamag., Seppelt and Z. Iwats.

**Family:** Sphagnaceae.

**Distribution:** Australia (SW Tasmania). Few localities.

**Habitat:** Buried in wet, sandy soil in alluvial wash sites.

**Threat:** Uncontrolled, intensive burning of the sedge vegetation.

**Source:** Yamaguchi *et al.* 1990.

**IUCN:** The species seems to have a very restricted distribution. It, therefore, meets the IUCN criteria for

Vulnerable based on an estimation that the number of localities is less than five. – VU (D2).

*Sphagnum novo-caledoniae* Paris and Warnst.

**Family:** Sphagnaceae.

**Distribution:** New Caledonia (Plateau de Dogny, Forêt de Tao, and Mt Panie). Confined to very few localities.

**Habitat:** Growing on rocks in small streams in shaded forest, between 730m and 1,200m a.s.l.

**Threat:** Pollution of stream water.

**Source:** T. Engelmark and T. Hallingbäck pers. comm.

**IUCN:** The species seems to have a very restricted distribution. It, therefore, meets the IUCN criteria for Vulnerable, based on an estimation that the number of localities is less than five. – VU (D2).

*Takakia ceratophylla* (Mitt.) Grolle

**Family:** Takakiaceae.

**Distribution:** India (Sikkim), Nepal, China (Xizang, Yunnan), and USA (Aleutian Islands). The largest subpopulation seems to occur on one of the Aleutian Islands (Smith and Davison 1993).

**Habitat:** On shaded, damp cliffs and very wet ground with late snow cover.

**Threat:** Its habitats are threatened by human activities.

**Source:** Hattori *et al.* 1968, Smith and Davidson 1993.

**IUCN:** The known area of occupancy is today less than 2,000km<sup>2</sup>, with less than ten localities and the species' habitat seems to be declining. It, therefore, meets the IUCN criteria for Vulnerable based on the small fragmented area, the decline of habitat quality, and the declining number of locations. – VU (B1,2cd).

*Taxitheliella richardsii* Dixon

**Family:** Fabroniaceae.

**Distribution:** Malaysia (Sarawak). Known only from the type collection made in 1932.

**Habitat:** Epiphytic on rotten logs and lianas inside primary lowland rainforests.

**Threat:** The primary lowland forest in Sarawak is seriously threatened today by logging.

**Source:** Gradstein 1992a, B. C. Tan pers. comm.

**IUCN:** The known area of occupancy is less than 10km<sup>2</sup> and the deforestation at the localities continues. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area, the single locality, and the decline of habitat quality. – CR (B1,2c).

*Thamnobryum angustifolium* (Holt) Crundw.

**Family:** Neckeraceae.

**Distribution:** Great Britain (only one locality in Derbyshire, England).

**Habitat:** Shaded cliff beside a calcareous spring or on limestone in a stream.

**Threat:** Although in a nature reserve, this species is sensitive

to disturbance from a possible new footpath, rock-climbers and cavers, and collection by bryologists. Any pollution of the spring in which it grows may also threaten it. Possibly the greatest threat is desiccation caused by extensive periods of drought when the spring does not flow.

**Source:** Hodgetts and Blockeel 1992, ECCB 1995, B. O'Shea pers. comm.

**IUCN:** The known area of occupancy is less than 10km<sup>2</sup> and the species is subject to a number of threats and potential threats. The number of old herbarium specimens clearly shows that it has declined. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area, the only locality, and the decline. – CR (B1,2c).

*Thamnobryum fernandesii* (Sérgio) Ochyra [syn. *Crassiphylllum fernandesii* (Sérgio) Ochyra].

**Family:** Neckeraceae.

**Distribution:** Portugal (Madeira). Restricted to less than five locations.

**Habitat:** In permanently wet habitats, such as dripping rocks or waterfalls, in the central part of the island at high elevation above 1,000m.

**Threat:** Habitat is threatened by the expansion of agriculture and grazing.

**Source:** R. Ochyra 1991, L. Hedenäs pers. comm.

**IUCN:** The known area of occupancy is less than 500km<sup>2</sup> and the species' habitats appear to be declining. It, therefore, meets the IUCN criteria for Endangered based on the small fragmented area, the less than five localities, the decline of habitat quality, and the declining number of locations. – EN (B1,2cd).

## LIVERWORTS (HEPATICAE) and HORNWORTS (ANTHOCEROTAE)

*Aitchinsoniella himalayensis* Kashyap

**Family:** Aitchinsoniellaceae.

**Distribution:** India (Western Himalaya: Uttar Pradesh and Himachal Pradesh), in at least eight localities. However, six of them are old and probably destroyed (Kashyap 1929). During fieldtrips in 1988 and 1991, it was found at only two localities.

**Habitat:** On muddy, exposed slopes, moist rocks, and seeping cliffs, 2,000–2,950m a.s.l.

**Threat:** Habitat destruction (road construction) and sparse reproduction.

**Source:** Udar and Srivastava 1983a, Bischler *et al.* 1994, Pant *et al.* 1994.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> and known from less than five recent localities. The species was considered to be fairly common in western Himalaya before the 1920s (Kashyap 1929), and the population must have declined considerably since then. It, therefore, meets the IUCN criteria for Endangered based on fewer than

five recent localities and an observed decline in its small area of occupancy. – EN (B1,2b).

*Andrewsianthus ferrugineus* Grolle

**Family:** Jungermanniaceae.

**Distribution:** Nepal (east, three localities) and Bhutan (one locality) in eastern Himalaya

**Habitat:** On trunks of *Juniperus* in damp *Abies*/*Juniperus* forests.

**Threat:** Habitat destruction (deforestation).

**Source:** D. Long pers. comm., Grolle 1966, Hattori 1975, Long and Grolle 1990.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup>, in less than five localities, and deforestation of the habitat is under way. It, therefore, meets the IUCN criteria for Endangered based on the small area, number of locations, and the decline in habitat quality and extent. – EN (B1,2cd).

*Anthoceros neesii* Prosk.

**Family:** Anthocerotaceae.

**Distribution:** Czech Republic, Germany, Poland, and Austria. There are only two recent localities (from many past recorded localities), both situated in Austria (Köckinger pers. comm.).

**Habitat:** Clayey-loamy soils in open areas. Seems to be restricted to crop fields (primary habitat unknown).

**Threat:** Its habitat has undergone drastic changes due to changes in agricultural practices.

**Source:** J. Váňa pers. comm., ECCB 1995, Köckinger pers. comm.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup>, in only two localities, and there has been an observed decline in habitat quality. It, therefore, meets the IUCN criteria for Endangered based on the small area, less than five localities, and the decline in habitat quality. – EN (B1,2c).

*Bazzania bhutanica* N. Kitag. and Grolle

**Family:** Lepidoziaceae.

**Distribution:** Bhutan (southern part), known from only one locality.

**Habitat:** On crumbling, shaded rock faces in subtropical forest of the Himalaya (Long and Grolle 1990).

**Threat:** Forests in the subtropical zone of the Himalaya are threatened by deforestation and other human activities.

**Source:** D. Long pers. comm., Long and Grolle 1990.

**IUCN:** The area of occupancy is less than 10km<sup>2</sup>, in only one locality, and the quality of the habitat appears to be declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area and the decline in habitat quality and extent. – CR (B1,2c).

*Bryopteris gaudichaudii* Gottsche

**Family:** Lejeuneaceae.

**Distribution:** Madagascar (northern part) and Réunion.

Only known from very few localities and found only once (Réunion) since 1900, in 1996.

**Habitat:** Epiphyte in rainforest.

**Threat:** Habitat destruction. Madagascar and Réunion are being rapidly deforested.

**Source:** S.R. Gradstein pers. comm., T. Pócs pers. comm., Gradstein 1992a.

**IUCN:** Facing an extremely high risk of extinction in the immediate future (IUCN category Critically Endangered) based on its small distribution (area of occupancy less than 10km<sup>2</sup> in only one locality) in combination with the declining extent of its habitat. – CR (B1,2c).

*Calypogeia rhynchophylla* (Herzog) Bischl.

**Family:** Calypogeiaceae.

**Distribution:** Costa Rica. Three localities on the mainland and one recently found in a nature reserve on Cocos Island off the coast of Costa Rica.

**Habitat:** Epiphytic on trunks in rainforest.

**Threat:** The small number of localities makes it vulnerable to stochastic events.

**Source:** S.R. Gradstein pers. comm., Bischler 1962, Morales 1991, Gradstein 1992b.

**IUCN:** The area of occupancy is less than 100km<sup>2</sup> in less than five localities. There is currently no evidence of decline. – VU (D2).

*Caudalejeunea grolleana* Gradst.

**Family:** Lejeuneaceae.

**Distribution:** Northern Madagascar (two localities).

**Habitat:** On bark of stems and dead wood in undisturbed lowland rainforest (Vanden Berghen 1984).

**Threat:** Habitat destruction. Rainforests, especially lowland rainforests, have decreased in area and are still decreasing. Less than 15% of the original area remains and the forest area, including the reserves, is threatened by destruction.

**Source:** Gradstein 1974, 1992a, Vanden Berghen 1984.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup>, the number of localities is less than five, and the habitat quality is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area, few localities, and the decline in habitat quality and extent. – EN (B1,2cd).

*Cladolejeunea aberrans* (Steph.) Zwickel

**Family:** Lejeuneaceae.

**Distribution:** Tanzania (East Usambara Mountains). Known from two nearby localities.

**Habitat:** Epiphyllous on ferns in mountain forests (Pócs 1985).

**Threat:** Habitat destruction. Mountain forests are declining in area and habitat quality, and the species is declining in number.

**Source:** T. Pócs pers. comm.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> in less than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent – EN (B1,2cd).

*Cololejeunea magnilobula* (Horik.) S. Hatt.

**Family:** Lejeuneaceae.

**Distribution:** Known from the type locality in Taiwan (not seen since 1934) and two recently discovered localities in mainland China (Zhejiang Province).

**Habitat:** Epiphyllous and epiphytic on trunks.

**Threat:** Suitable forests for this species in East Asia are declining in habitat quality and extent. Although the two recent localities in mainland China are in protected reserves, this does not necessarily mean that they are safe.

**Source:** Zhu *et al.* 1994, Zhu 1995.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> in less than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent – EN (B1,2c).

*Dactylolejeunea acanthifolia* R.M. Schust.

**Family:** Lejeuneaceae.

**Distribution:** Dominica in the Caribbean. Used to be known from only two localities, but has recently been found at a number of new localities (I. Schaefer-Verwimp pers. comm. to P. Geissler). However, the total number of localities is still less than 10.

**Habitat:** Epiphyllous in old-growth rainforest.

**Threat:** Deforestation and habitat degradation.

**Source:** P. Geissler pers. comm., Gradstein 1992a, Schuster 1970.

**IUCN:** The area of occupancy is less than 2,000km<sup>2</sup> in less than 10 localities, and the habitat quality appears to be declining. It, therefore, meets the IUCN criteria for Vulnerable based on the small area and the decline in habitat quality and extent. – VU (B1,2c).

*Dendroceros japonicus* Steph.

**Family:** Anthocerotaceae.

**Distribution:** Taiwan, Japan (central part, Ryukyu Is. and Bonin Is.), and Federated States of Micronesia (Kusaie).

**Habitat:** On tree trunks or rocks in evergreen forest.

**Threats:** Disappearing from the northern parts of its range due to destruction of habitat and forest quality.

**Source:** T. Furuki pers. comm., J. Hasegawa pers. comm., Shin 1970, Hasegawa 1980, Miller *et al.* 1983.

**IUCN:** It is suspected to have declined by at least 20% in the last 30 years (three generations) due to declining habitat quality. It, therefore, meets the IUCN criteria for Vulnerable based on recent decline. – VU (A1c).



*Diplocolea sikkimensis* Amakawa

**Family:** Jungermanniaceae.

**Distribution:** Known from two localities in India (Sikkim) and one in Nepal.

**Habitat:** Epiphytic on bark in humid forest, 3,650–4,000m a.s.l.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** J. Váňa pers. comm., Amakawa 1963, Hattori 1968, Váňa 1973.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> in less than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2c).

*Drepanolejeunea aculeata* Bischl.

**Family:** Lejeuneaceae.

**Distribution:** Known from two localities in southeastern Brazil (Rio de Janeiro and São Paulo States). Not found since 1922.

**Habitat:** Epiphyllous in old-growth rainforest.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** A. Schäfer-Verwimp pers. comm., Bischler 1964, Gradstein 1992b.

**IUCN:** It is assumed that this species has declined due to habitat destruction and may, in fact, have already become extinct. However, until suitable localities are searched it cannot be considered extinct without reasonable doubt. The area of occupancy is less than 500km<sup>2</sup> in less than five localities and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent – EN (B1,2c)

*Drepanolejeunea bakeri* Herzog

**Family:** Lejeuneaceae.

**Distribution:** Philippines (Luzon Island). Known from three localities.

**Habitat:** Epiphyllous in moist forest.

**Threat:** Threatened by extensive logging and agricultural expansion.

**Source:** Tixier pers. comm.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> with fewer than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2cd).

*Drepanolejeunea senticosa* Bischl.

**Family:** Lejeuneaceae.

**Distribution:** Cuba. Only known from the type specimen. Perianth and capsules unknown, but males frequent.

**Habitat:** Epiphyllous.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** Bischler 1964.

**IUCN:** Only one locality known. It, therefore, meets the criteria for the IUCN category Critically Endangered based on the small area and decline in habitat quality, and the probable extremely small number of individuals. It may even be extinct. However, until several searches in its old locality and in similar habitat around have proved unsuccessful, it must be considered Critically Endangered. – CR (B1, 2bcde; D).

*Eopleurozia simplicissima* (Herzog) R.M. Schust.

**Family:** Pleuroziaceae.

**Distribution:** Malaysia (Sarawak, two localities), Indonesia (Kalimantan)

**Habitat:** Submontane rainforest.

**Threat:** Habitat destruction (deforestation).

**Source:** Gradstein 1992a.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> in less than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2c).

*Fulfordianthus evansii* (Fulf.) Gradst.

**Family:** Lejeuneaceae.

**Distribution:** It is currently known from three localities in Belize and Costa Rica. Four old records are known from Guatemala, Belize, and Panama.

**Habitat:** Shade epiphyte in undisturbed, wet lowland rainforest.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** S.R. Gradstein pers. comm., Gradstein 1992b.

**IUCN:** The area of occupancy is less than 2000km<sup>2</sup> in less than 10 localities, and the habitat quality is declining. It, therefore, meets the IUCN criteria for Vulnerable based on the small area and the decline in habitat quality and extent. – VU (B1,2cd).

*Geothallus tuberosus* Campb.

**Family:** Sphaerocarpaceae.

**Distribution:** USA (southern California). Previously known

only from the immediate vicinity of San Diego, but recently found in a reserve 110km to the north (Doyle 1998).

**Habitat:** On soil in extremely xeric conditions.

**Threat:** Threatened by urbanisation. Wolery and Doyle (1969) searched for it in the wild and found eight subpopulations in less than five localities in a small area around San Diego. Since then, the human population of the urban area has doubled, and rapid and intense urban development has occurred. The most recently found subpopulation is, however, not immediately threatened.

**Source:** Whittemore (in letter), Wolery and Doyle 1969, Doyle 1998.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> in less than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2c).

***Haesselia roraimensis*** Grolle and Gradst.

**Family:** Cephaloziaceae.

**Distribution:** Guyana, found in less than five localities at the foot of Mt Roraima.

**Habitat:** On rotten logs in periodically flooded, riverine forest, and in dense, submontane "mossy" forest between 550 and 1,550m a.s.l.

**Threat:** Small distribution.

**Source:** Grolle and Gradstein 1988, Gradstein 1992a.

**IUCN:** The small area of occupancy and the less than five localities means that this species meets the IUCN criteria for Vulnerable. – VU (D2).

***Hattoria yakushimensis*** (Horik.) R.M. Schust.

**Family:** Jungermanniaceae.

**Distribution:** Southern Japan. Formerly known from three localities. It is currently known only from one of these sites.

**Habitat:** Epiphyte.

**Threat:** The main threats are deforestation of evergreen forest in the vicinity, and the subsequent changes in humidity and light conditions.

**Source:** T. Furuki pers. comm., Kitagawa 1966, Vána 1973.

**IUCN:** The small area of occupancy and the less than five localities mean that this species meets the IUCN criteria for Vulnerable. – VU (D2).

***Jamesoniella undulifolia*** (Nees) K. Muell.

**Family:** Jungermanniaceae.

**Distribution:** Austria, Czech Republic, Denmark, Finland, France, Germany, Poland, Sweden, Switzerland, Great Britain, Greenland (two sites), Russian Federation (Siberia, Chukotka, Kamchatka), China (Manchuria), and Democratic Peoples Republic of Korea. Several old localities are known, but it has disappeared from most of these in Europe; very few sites are unspoiled today except for several recently found sites in northern Asia, where it may be more common than is currently known.

**Habitat:** In fens and mires.

**Threat:** Habitat destruction by drainage, flooding for reservoirs, forest planting, and cattle grazing.

**Source:** N. Konstantinova pers. comm., Grolle 1971, Piippo 1990, ECCB 1995, Konstantinova and Czernjadieva 1995, Konstantinova and Potemkin 1996, Schuster and Konstantinova 1996, Yamada and Choe 1997.

**IUCN:** A decline of populations has occurred in at least part of its distribution area, and more than 20% of its populations have probably disappeared within the last 30 years (three generations). This species, therefore, meets the IUCN criteria for Vulnerable. – VU (A1ac).

***Kurzia sinensis*** Chang

**Family:** Lepidoziaceae.

**Distribution:** China (Zhejiang Province). Only known from the type specimen.

**Habitat:** Humid forest, 300m a.s.l.

**Threat:** Habitat destruction caused by rapid development resulting from growth in the tourism industry.

**Source:** Mizutani and Chang 1986, Zhu *et al.* 1994.

**IUCN:** The area of occupancy is less than 10km<sup>2</sup> in only one locality, and the habitat is declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area, single locality, and the decline in habitat quality and extent. – CR (B1,2c).

***Leptolejeunea tridentata*** Bischl.

**Family:** Lejeuneaceae.

**Distribution:** Colombia (Chocó Department). Known only from the type specimen found in 1957. It has been looked for since then, but without success.

**Habitat:** Epiphyllous in old-growth lowland rainforest.

**Threat:** Habitat destruction.

**Source:** Bischler 1969, Gradstein 1992b.

**IUCN:** The area of occupancy is less than 10km<sup>2</sup> in only one locality and the habitat is declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area, the single locality, and the decline in habitat quality and extent. – CR (B1,2c).

***Luteolejeunea herzogii*** (Buchloh) Piippo

**Family:** Lejeuneaceae.

**Distribution:** Panama, Colombia, and Peru, at less than five localities.

**Habitat:** Dead wood in lowland to submontane forests.

**Threat:** The major threat is the deforestation of the lowland rain forest.

**Source:** Piippo 1986, Gradstein 1992a.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> in less than five currently known localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2c).

*Myriocolea irrorata* Spruce

**Family:** Lejeuneaceae.

**Distribution:** Ecuador (along the Rio Topo in the Amazonian sector). Known only from the type collection made in 1857. Recent efforts to relocate the species have been unsuccessful.

**Habitat:** On twigs of shrubs located near streams in undisturbed rainforest areas, about 1,000m a.s.l.

**Threat:** Deforestation and deterioration of water courses.

**Source:** S.R. Gradstein pers. comm., Spruce 1884, Gradstein 1992b.

**IUCN:** The unsuccessful efforts to locate it at the original locality suggest that it is extinct, but the area has not received enough study to be certain of this. However, if not extinct, it is facing an extremely high risk of extinction in the immediate future. The area of occupancy might be less than 10km<sup>2</sup> in only one locality, and the habitat is declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area and the decline in habitat quality and extent. – CR (B1,2c).

*Myriocoleopsis fluviatilis* (Steph.) Reiner and Gradst.

**Family:** Lejeuneaceae.

**Distribution:** Endemic to the state of Sao Paulo (SE Brazil) and known from only three localities, two from the 19th century and one from 1975.

**Habitat:** A rheophyte, occurring in and along rivers.

**Threat:** Deforestation and deterioration of water courses due to hydroelectric schemes and water pollution.

**Source:** S.R. Gradstein pers. comm., Gradstein and Vital 1975.

**IUCN:** The area of occupancy is less than 2,000km<sup>2</sup> in less than 10 localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Vulnerable based on the small area and the decline in habitat quality and extent. – VU (B1,2c).

*Nardia huerlimannii* Grolle and Váňa

**Family:** Jungermanniaceae.

**Distribution:** South part of New Caledonia. Known only from three localities within a small area, 580–880m a.s.l.

**Habitat:** On rotten logs and bark in moist forest.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Since neither sexual nor asexual reproduction has been found, the future of this species is by no means assured. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** H. Hürlimann and J. Váňa pers. pers. comm., Váňa 1970.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> and known only from one locality, however we have no information about any decline. Therefore, this species meets the IUCN criteria for Vulnerable. – VU (D2).

*Nowellia wrightii* Grolle

**Family:** Cephaloziaceae.

**Distribution:** Cuba. Four localities in the Orient Province in east Cuba. Váňa (in letter) assumes there are less than five localities, according to Pócs.

**Habitat:** On bark and rotten logs in undisturbed lower montane rainforest.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** T. Pócs pers. comm., J. Váňa pers. comm., Grolle 1968, Gradstein 1992b.

**IUCN:** The area of occupancy is less than 2,000km<sup>2</sup> in less than 10 localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Vulnerable based on the small area and the decline in habitat quality and extent. – VU (B1,2c).

*Phycolepidozia exigua* R.M. Schust.

**Family:** Phycolepidoziaceae.

**Distribution:** Dominica. Known only from the type collection.

**Habitat:** On tree bark in humid rainforest, 450m a.s.l.

**Threat:** Habitat destruction. Original locality destroyed by a hurricane. Efforts to relocate the species have been unsuccessful.

**Source:** Schuster 1967, Gradstein 1992b.

**IUCN:** The only known locality has been destroyed and the species has not been located since. It could thus be regarded as extinct. However, other species with similar habitat requirements have been rediscovered on Dominica, and it cannot be assumed that this species will not be found following further searches. It is thus best treated as facing extremely high risk of extinction in the immediate future, meeting the IUCN criteria for Critically Endangered based on the small area, the single site, and the decline in habitat quality and extent. – CR (B1,2bc).

*Perssoniella vitreocincta* Herzog

**Family:** Personiellaceae.

**Distribution:** Endemic to New Caledonia. Known from five localities.

**Habitat:** On tree trunks in montane *Araucaria* forests.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Sources:** Herzog 1952, Hürlimann 1978, Gradstein 1992a.

**IUCN:** The area of occupancy is less than 2000km<sup>2</sup> with less than 10 localities and the habitat is declining. It, therefore, meets the IUCN criteria for Vulnerable based on the small area and the decline in habitat quality and extent. – VU (B1,2c).

***Plagiochila wolframii*** Inoue

**Family:** Plagiochilaceae.

**Distribution:** Peru. Only known from one locality.

**Habitat:** Subalpine forests.

**Threat:** The major threats are deforestation and forest fire.

**Source:** Inoue 1987, Gradstein 1992a,b.

**IUCN:** The area of occupancy is less than 10km<sup>2</sup> with only one locality, and the habitat is declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area and the decline in habitat quality and extent. – CR (B1,2cd).

***Radula jonesii*** Bouman, Dirkse, and Yamada

**Family:** Radulaceae.

**Distribution:** Spain (Canary Islands) and Portugal (Madeira).

**Habitat:** On wet, shaded rocks in evergreen forests.

**Threat:** Habitat destruction (deforestation).

**Source:** Bouman and Dirkse 1992, ECCB 1995.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> with less than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2cd).

***Radula visianica*** C. Massal.

**Family:** Radulaceae.

**Distribution:** Italy. Known from two localities and not seen since 1938.

**Habitat:** Poorly known. On soil or the base of trees.

**Threat:** Extinct.

**Source:** ECCB 1995.

**IUCN:** Searched for several times without success and therefore regarded as Extinct. – EX.

***Riccia atlantica*** Sérgio and Perold

**Family:** Ricciaceae.

**Distribution:** Portugal (east Madeira in a restricted area).

**Habitat:** On volcanic deposits near cliffs exposed to the sea.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** ECCB 1995.

**IUCN:** The area of occupancy is less than 20km<sup>2</sup> with less than five localities. It, therefore, meets the IUCN criteria for Vulnerable based on the small area of occupancy and the less than five localities. – VU (D2).

***Scapania sphaerifera*** Buch and Tuom.

**Family:** Scapaniaceae.

**Distribution:** Russian Federation (Kola Peninsula, one old locality which probably was destroyed, and southern Siberia, four more recent localities).

**Habitat:** On acidic boulders in dry habitats.

**Threat:** Small distribution.

**Source:** N. Konstantinova (in letter), Váňa 1993, Konstantinova and Potemkin 1994, ECCB 1995.

**IUCN:** The area of occupancy is very small but there is no evidence of continuing decline. It, therefore, meets the IUCN criteria for Vulnerable based on its small area of occupancy and less than five recent localities. – VU (D2).

***Scaphophyllum speciosum*** (Horik.) Inoue

**Family:** Jungermanniaceae.

**Distribution:** Taiwan (five localities, Váňa (in letter)), China (Yunnan), Bhutan (one locality), and recently found in East Nepal. A subsp. *villosum* Schust. has recently been separated and the Himalayan (and probably also the Yunnan) specimens belong to this subsp., while the subpopulations on Taiwan belong to subsp. *speciosum* (Schuster 1998).

**Habitat:** In Taiwan, occurring on forest floor at 2,000–2,400m a.s.l. In Bhutan, on a damp, mossy log in a shady ravine in wet, mixed broadleaved forest (Long and Grolle 1990).

**Threat:** Habitat destruction.

**Source:** Váňa and Inoue 1983, Zhu *et al.* 1994, Long and Grolle 1990, Schuster 1998, Lai 1999.

**IUCN:** The area of occupancy is less than 2,000km<sup>2</sup> in less than 10 localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Vulnerable based on the small area and the decline in habitat quality and extent. – VU (B1,2cd).

***Schistochila macrodonta*** W.E. Nicholson

**Family:** Schistochilaceae.

**Distribution:** China (Yunnan) and Bhutan, in one locality each.

**Habitat:** On plant stems in rainforest (Nicholson 1930). In Bhutan, on a damp, mossy log in a shaded ravine in wet, mixed broadleaved forest (Long and Grolle 1990).

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, using the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** D. Long pers. comm., Nicholson *et al.* 1930, Long and Grolle 1990.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> with only two localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2cd).

***Schistochila undulatifolia*** Piippo

**Family:** Schistochilaceae.

**Distribution:** Papua New Guinea (West Sepik Province). Only known from the type locality.

**Habitat:** On fallen trunks in undisturbed tropical rainforest, 800–1,050m a.s.l.

**Threats:** Mining of copper and logging activities near the locality.

**Source:** Piippo 1986, Gradstein 1992a.

**IUCN:** The area of occupancy is less than 10km<sup>2</sup> with only one locality, and the habitat is declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area, the single locality, and the decline in habitat quality and extent. – CR (B1,2c).

*Sewardiella tuberifera* Kashyap

**Family:** Fossombroniaceae.

**Distribution:** India (western Himalaya: Himchal Pradesh and Uttar Pradesh). Recorded from several localities at 1,000–2500m a.s.l., but has disappeared from some of them.

**Habitat:** Moist rocks at high altitudes.

**Threats:** Habitat destruction at lower altitudes, where it has not been seen recently at some localities around Naini Tal.

**Source:** S.R. Kashyap 1929, Pant *et al.* 1994.

**IUCN:** The area of occupancy is less than 2,000km<sup>2</sup> with less than 10 localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Vulnerable based on the small area and the decline in habitat quality and extent. – VU (B1,2bc).

*Sphaerocarpos drewei* Wigglesw.

**Family:** Sphaerocarpaceae.

**Distribution:** USA (California). Known from seven localities within one small region around San Diego (some of them, however, having been recently destroyed), plus a recent one on Santa Rosa Plateau, approximately 110km north of the localities around San Diego (Doyle 1998).

**Habitat:** Under shade of coastal sage brush (Doyle 1998). Appears to be associated with *Geothallus tuberosus*.

**Threat:** Most localities are within urbanised areas and are, therefore, threatened by urban development. However, the recently discovered new locality is in an ecological reserve without any immediate human threat.

**Source:** A. Whittemore (in letter), Wolery and Doyle 1969, Doyle 1998.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area, the less than five localities, and the decline in habitat quality and extent. – EN (B1,2cd).

*Sphaerolejeunea umbilicata* Herzog

**Family:** Lejeuneaceae.

**Distribution:** Colombia (Cauca Department). Known only from the type collection.

**Habitat:** Epiphyllous in montane forest.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following

the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** Gradstein 1992a,b.

**IUCN:** The area of occupancy is less than 10km<sup>2</sup> with only one locality, and the habitat is declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area, the single locality, and the decline in habitat quality and extent. – CR (B1,2c).

*Spruceanthus theobromae* (Spruce) Gradst.

**Family:** Lejeuneaceae.

**Distribution:** Ecuador (El Ríos Department, western Ecuador). Only one extant locality known.

**Habitat:** On the bark of five old cacao trees, in a site at the bottom of a narrow valley and close to remnant natural forest influenced by periodical flooding.

**Threat:** The forest in the area has now mostly been destroyed.

**Source:** Gradstein 1992a,b, and 1999b.

**IUCN:** The area of occupancy is less than 10km<sup>2</sup> with only one locality, and the habitat is declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area and the decline in habitat quality and extent. – CR (B1,2c).

*Stephensoniella brevipedunculata* Kashyap

**Family:** Exormothecaceae.

**Distribution:** India (western Himalaya: Himachal Pradesh and Uttar Pradesh), 1,000–2,700m a.s.l.

**Habitat:** Exposed soil.

**Threat:** Habitat destruction due to urbanisation at lower altitudes.

**Source:** G. Pant (in letter), Pant *et al.* 1994.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> with less than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2cd).

*Symbiezidium madagascariensis* Steph.

**Family:** Lejeuneaceae.

**Distribution:** Northeast Madagascar and the Seychelles. Found in less than five localities.

**Habitat:** On bark in lowland rainforest.

**Threat:** Deforestation.

**Source:** Gradstein and van Beek 1985, Gradstein 1992a.

**IUCN:** The area of occupancy is less than 500km<sup>2</sup> with less than five localities, and the habitat is declining. It, therefore, meets the IUCN criteria for Endangered based on the small area and the decline in habitat quality and extent. – EN (B1,2cd).

*Vandiemenia ratkowskiana* Hewson

**Family:** Vandiemeniaceae.

**Distribution:** Australia (Tasmania). Only known from the

type locality, where it has been looked for recently without success.

**Habitat:** On rotten logs.

**Threat:** Although the threats to this species are not well understood, it is clearly extremely rare, and grows in a generally threatened area and habitat. Therefore, following the precautionary principle, we consider it important to highlight the species on the Red List.

**Source:** H. Streimann pers. comm.

**IUCN:** The area of occupancy is less than 10km<sup>2</sup> with only one locality, and the habitat is declining. It, therefore, meets the IUCN criteria for Critically Endangered based on the small area, the single locality, and the decline in habitat quality and extent. – CR (B1,2c).

## Assessors

<i>Acritodon nephophilus</i>	Tan, B.C.	<i>Jaffueliobryum arsenei</i>	Tan, B.C.
<i>Aitchinsoniella himalayensis</i>	Geissler, P.	<i>Jamesoniella undulifolia</i>	Söderström, L.
<i>Andrewsianthus ferrugineus</i>	Söderström, L.	<i>Kurzia sinensis</i>	Söderström, L.
<i>Anthoceros neesii</i>	Geissler, P.	<i>Lepidopilum grevilleanum</i>	Tan, B.C.
<i>Archidium elatum</i>	Tan, B.C.	<i>Leptolejeunea tridentata</i>	Geissler, P.
<i>Aschisma kansanum</i>	Tan, B.C.	<i>Leucoperichaetium eremophilum</i>	Tan, B.C.
<i>Bazzania bhutanica</i>	Söderström, L.	<i>Limbella fryei</i>	Tan, B.C.
<i>Brymela tutezona</i>	Tan, B.C.	<i>Luteolejeunea herzogii</i>	Geissler, P.
<i>Bryopteris gaudichaudii</i>	Geissler, P.	<i>Mamillariella geniculata</i>	Tan, B.C.
<i>Bryoxiphium madeirense</i>	Tan, B.C.	<i>Merrillibryum fabronioides</i>	Tan, B.C.
<i>Calypogeia rhynchophylla</i>	Geissler, P.	<i>Mitrobryum koelzii</i>	Tan, B.C.
<i>Caudalejeunea grolleana</i>	Geissler, P.	<i>Myriocolea irrorata</i>	Geissler, P.
<i>Cladolejeunea aberrans</i>	Geissler, P.	<i>Myriocoleopsis fluviatilis</i>	Gradstein, S.R.
<i>Cololejeunea magnilobula</i>	Geissler, P.	<i>Nardia huerlimannii</i>	Söderström, L.
<i>Dactylolejeunea acanthifolia</i>	Geissler, P.	<i>Neckeropsis pocsii</i>	Tan, B.C.
<i>Dendroceros japonicus</i>	Geissler, P.	<i>Neomacounia nitida</i>	Tan, B.C.
<i>Diplocolea sikkimensis</i>	Söderström, L.	<i>Nowellia wrightii</i>	Geissler, P.
<i>Distichophyllum carinatum</i>	Hallingbäck, T.	<i>Ochyraea tatrensis</i>	Tan, B.C.
<i>Ditrichum cornubicum</i>	Unspecified	<i>Orthodontopsis bardunovii</i>	Tan, B.C.
<i>Donrichardsia macroneuron</i>	Tan, B.C.	<i>Orthotrichum scanicum</i>	Tan, B.C.
<i>Drepanolejeunea aculeata</i>	Geissler, P.	<i>Orthotrichum truncato-dentatum</i>	Tan, B.C.
<i>Drepanolejeunea bakeri</i>	Geissler, P.	<i>Ozobryum ogalalense</i>	Tan, B.C.
<i>Drepanolejeunea senticosa</i>	Geissler, P.	<i>Perssoniella vitreocincta</i>	Söderström, L.
<i>Echinodium renauldii</i>	Tan, B.C.	<i>Phycolepidozia exigua</i>	Söderström, L.
<i>Echinodium setigerum</i>	Tan, B.C.	<i>Pinnatella limbata</i>	Tan, B.C.
<i>Eopleurozia simplicissima</i>	Söderström, L.	<i>Plagiochila wolframii</i>	Söderström, L.
<i>Fissidens hydropogon</i>	Tan, B.C.	<i>Radula jonesii</i>	Söderström, L.
<i>Flabellidium spinosum</i>	Tan, B.C.	<i>Radula visianica</i>	Söderström, L.
<i>Fulfordianthus evansii</i>	Geissler, P.	<i>Renaudia lycopodioides</i>	Tan, B.C.
<i>Geothallus tuberosus</i>	Geissler, P.	<i>Riccia atlantica</i>	Geissler, P.
<i>Gradsteinia torrenticola</i>	Hallingbäck, T.	<i>Scapania sphaerifera</i>	Söderström, L.
<i>Haesselia roraimensis</i>	Geissler, P.	<i>Scaphophyllum speciosum</i>	Söderström, L.
<i>Hattoria yakushimensis</i>	Söderström, L.	<i>Schistochila macrodonta</i>	Söderström, L.
<i>Hypnodontopsis apiculata</i>	Tan, B.C.	<i>Schistochila undulatifolia</i>	Söderström, L.
		<i>Sciariomopsis sinensis</i>	Tan, B.C.
		<i>Sewardiella tuberifera</i>	Söderström, L.
		<i>Skottsbergia paradoxa</i>	Tan, B.C.
		<i>Sphaerocarpos drewei</i>	Geissler, P.
		<i>Sphaerolejeunea umbilicata</i>	Geissler, P.
		<i>Sphagnum leucobryoides</i>	Hallingbäck, T.
		<i>Sphagnum novo-caledoniae</i>	Hallingbäck, T.
		<i>Spruceanthus theobromae</i>	Geissler, P.
		<i>Stephensoniella brevipedunculata</i>	Geissler, P.
		<i>Symbiezidium madagascariensis</i>	Geissler, P.
		<i>Takakia ceratophylla</i>	Tan, B.C.
		<i>Taxitheliella richardsii</i>	Tan, B.C.
		<i>Thamnobryum angustifolium</i>	Tan, B.C.
		<i>Thamnobryum fernandesii</i>	Tan, B.C.
		<i>Vandiemenia ratkowskiana</i>	Geissler, P.

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