



New Zealand's threatened bryophytes: Conservation efforts

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The New Zealand bryophyte flora is highly diverse with latest figures for the number of formally described species recognized being 534 mosses, 616 liverworts and 13 hornworts. A relatively high percentage of the bryophyte species is considered to be endemic (c. 21% of mosses, c. 50% of hepatics, and c. 60% of hornworts). Additionally, the New Zealand landscape is highly modified, particularly in lowland areas and in eastern portions of the two main islands. There, lowland forests and grasslands have largely been converted to pastoral and agricultural land uses with a consequent reduction of native plant diversity. These and other factors have led in recent years to an increased conservation focus on New Zealand's rarer bryophytes. While bryophyte conservation efforts to date have focused on documentation, some tentative moves have been made towards active management of our rarest taxa.

Under the auspices of the New Zealand Department of Conservation (hereafter DOC), a "specialist panel" of bryologists has met on a roughly three-yearly basis since 1992 to rank poorly documented and rare bryophyte taxa using a nationally developed "New Zealand Threat Classification System". Since 1992 this ranking of bryophytes has gone through four iterations, with the most recent commencing in May 2009 but not yet wholly completed. The current bryophyte specialist panel (hereafter "BSP") consists of J.E. Beever, J.E. Braggins, P.J. Brownsey, A.J. Fife, D.G. Glenny, M.A.M. Renner, and R. Hitchmough (convenor, DOC).

In its current form the New Zealand Threat Classification System (hereafter "NZTCS") uses criteria outlined by Townsend *et al.* (2008); this classification system parallels the IUCN Red List conservation status listing and ranking system, with criteria developed to suit particular New Zealand requirements (e.g. fine-scale local endemism in many groups). The categories defined by Townsend *et al.* (2008) and considered in the most recent evaluation are shown in Table 1.

TABLE 1. Number of New Zealand bryophytes in evaluated threat categories and non-evaluated Data Deficient categories for the 2009 New Zealand Threat Classification System list (as per draft of March 2010).

Overriding category	Primary category	Secondary category	Mosses	Hepatics and hornworts
Evaluated	Extinct	-	0	0
	Threatened	Nationally Critical	14	15
	Threatened	Nationally Endangered	3	6
	Threatened	Nationally Vulnerable	1	3
	At Risk	Mostly Naturally Uncommon	48	77
	Not Threatened	-	c. 447	c. 409
Not evaluated	Data Deficient	-	21	119

No bryophytes have been judged to be extinct. A few bryophyte species, e.g. *Bartramia alaris* Dixon & Sainsbury (1933: 221), have not been observed for many decades, but the panel considered it impossible to be certain of their extinction in this country.

The classification involved two forms of assessment: current status (current numbers of individuals and numbers of separate populations) and a prediction of rate of decline in the next 10 years. Most of the bryophytes listed in the Threatened primary category are included because they fulfilled the criterion of occupying less than a specified area nationwide (≤ 1 ha for Nationally Critical; larger areas for the other secondary categories) and no assessment of population trends was required for species that fit these criteria. Only in exceptional cases were predictions made of population trends for the next 10 years.

Although the "2009" NZTCS bryophyte listing is still not finalized, the previous 2005 version of this list is available at <http://www.doc.govt.nz/upload/documents/science-and-technical/sap236.pdf>; a discussion of this listing was provided by Glenny & Fife (2005).

In contrast to rare plant schedules in Australia and the United States, the listed taxa do not have legal protection. Rather, the function of the list is to help DOC, regional councils, and community groups to manage threatened species on lands that they administer for conservation and to advocate for their protection on other, including private, land. Whenever permission is sought to develop land under the Resource Management Act 1991 (RMA), if there is any threat to conservation interests, DOC makes submissions to a regional council, and, if the development is opposed, to the Environment Court, which has ultimate authority over controversial land developments in New Zealand. The presence of a species on the threatened plant list ensures attention by DOC staff preparing RMA submissions. The bryophyte lists have been used for a number of such hearings since their inception. The NZTCS also influences how DOC itself develops facilities within the conservation estate.

Thus, bryophytes are now officially recognised and have equal conservation status to vascular plants and animal species.

Entering into a rigorous three-yearly evaluation review has forced New Zealand bryologists to critically evaluate rarer taxa and to consider the limitations of our knowledge of them. For example, a reconsideration of the threat classification of the moss *Chorisodontium aciphyllum* (Hooker & Wilson 1844: 541) Brotherus (1908: 1048) has led to the conclusion that its New Zealand reports were based on misidentifications of epilithic populations of the relatively widespread and predominantly epiphytic *Holomitrium trichopodium* (Mitten in Hooker 1867: 411) Klazenga (2006: 301).

During recent meetings of the specialist panel fewer changes have been made to the moss list than to the hepatic list. This reflects the fact that the mosses historically were the relatively better known fraction of the bryophyte flora, were dealt with by a substantive mid-20th century Flora (Sainsbury, 1955), and attracted attention from more New Zealand workers over a period of many decades. The hepatics, the larger group in the New Zealand bryoflora, were treated mainly in scattered and relatively inaccessible publications and attracted attention from fewer workers here. The problem of scattered literature has been partly and recently addressed by the publication of Engel & Glenny (2008). In the previous (2005) iteration of the NZTCS bryophyte listing we attempted to classify many hepatic species using preliminary field data and in a manner that reflected the precautionary approach favoured by DOC.

Repeated evaluations of the threatened bryophyte list have resulted in a gradual increase in the relative number of moss taxa and a reduction in the relative number of hepatic taxa included. Eleven species of mosses were removed and four species of mosses were added from/to the Nationally Critical list in 2009. By comparison 32 species and one variety of hepatic were removed. Comparable and roughly proportionate changes were made in the Nationally Endangered and Nationally Vulnerable categories. Most of the species with changed status were removed to the Data Deficient category, reflecting both the above cited historical factors and changes in the NZTCS listing criteria (Townsend *et al.* 2008).

A large number of species (21 mosses and 121 hepatics and hornworts) were considered by the 2009 BSP to be too poorly documented to permit evaluation and were classed as Data Deficient (DD). In the 2009 NZTCS listing, as in the IUCN listing, management efforts with DD taxa are not considered further.

Because of the numbers of DD bryophytes, some DOC funding has been made available for targeted bryological exploration. Nine species of hepatics associated with forest streams in North Auckland were listed as DD in the 2005 NZTCS list (Hitchmough *et al.* 2007). In most cases these nine taxa were known from only one or two records and in almost all cases they had been found in the last decade. D. Glenny and M.A.M. Renner were funded to search for additional populations of these hepatics in early 2009. New populations were documented for five of the nine taxa and estimates of the population sizes for all taxa were made. The survey resulted in changes in threat category for eight of the nine targeted taxa, provided new population data on seven other hepatics listed in the 2005 NZTCS list, and made a collection of a possibly undescribed species of *Telaranea*.

NZTCS listing at the Nationally Critical level has also focused attention on two endemic species of mosses. *Lindbergia maritima* Lewinsky (1977: 193) was first recognized from coastal breccia outcrops on the northwest coast of the North Island. Since 2000, observations by J.E. Beever and J.E. Braggins suggested that the only re-locatable population of *L. maritima* was in rapid decline, probably due to wave action from vigorous westerly storms. Extensive shoreline searches to locate new populations have been made without success. Support from the Auckland Regional Council was received and their staff have made dedicated searches while abseiling down nearby coastal cliffs in the hope of finding more colonies, with no success. *Lindbergia maritima* has been proposed for inclusion in the IUCN Species Red List.

Epipterygium opararensense Fife & Shaw (1990: 375) was described from a single granitic rock outcrop in the Oparara Valley in the NW South Island. It is less well documented at Kakapo Saddle, some 30 km SE of the type locality. The Oparara Valley type locality is in the immediate vicinity of a heavily used walking track within a scenic reserve. The inclusion of this species in the NZTCS list has resulted in modification of DOC plans to alter this track (Fife & Knightbridge 2005). Unfortunately a forest windthrow event in 2008 severely damaged the main population at the type locality. The current population there is fewer than 50 plants, most growing in an area less than 80 mm in diameter. In March 2010 three stems were collected and sent to Jeff Duckett at Queen Mary College in London. If his efforts to culture this species *in vitro* are successful, attempts to augment the existing population are planned. *Epipterygium opararensense* has also been proposed for inclusion in the IUCN Species Red List.

The same BSP has also been involved since May 2007 with a parallel but distinct “optimization process” initiated by DOC. This process is an attempt to evaluate all threatened organisms in the New Zealand biota to determine what management actions would ensure their survival for the next 50 years, and what further actions would be needed to restore their populations to safe levels within the next 300 years. This process is motivated by a wish to save from extinction as many species as possible within a limited budget, without consideration of the organism’s size or “iconic” status. For the 42 bryophyte species in the Threatened category (see Table 1), an estimate of management effort (time, resources) for all projected management methods was made, together with subjective estimates of the projected rate of species’ decline and their causes. Management techniques that were suggested included weed control, exclusion and/or trapping of animals, restriction of public access to protected areas, fencing of selected habitats, transplantation, and attempts at population augmentation. A “prescription” for each species was written incorporating these management methods.

The bryophyte species prescriptions and subjective projections of their survival/recovery-rates with/without the management efforts will be considered together with those for all taxa of threatened biota to establish a national ranking of species conservation projects. Because of the relatively modest costs required to manage bryophyte populations it is anticipated that this process will yield government funding for a number (perhaps tens?) of the most threatened bryophyte species in the foreseeable future.

The bryologists involved in the optimization process have had some reservations. First, our knowledge of bryophyte distributions generally lags behind that for the more conspicuous vascular plants and animals. This is due partly to the relatively small number of trained bryologists in the country. We can never be really confident, to the same extent that flowering plant botanists can, that we have documented all subpopulations of a bryophyte taxon. We have advocated, with some success, for greater funding for targeted searches for DD bryophyte taxa. One likely effect of the optimization process is that less conspicuous and less iconic organisms, including bryophytes, will receive a larger part of the available future conservation funding. The exercise required that we make very subjective probability estimates of a species’ long-term survival chances assuming (1) no management effort, and (2) the application of the proposed management efforts. These estimates were very subjective and hence difficult to make.

Species ranked highly in either the NZTCS list or in DOC’s optimization process will also influence other conservation efforts based on ecosystems rather than species.

We consider education an integral part of conservation efforts. Since 1983, cryptogamic botanists in New Zealand have held multi-day field workshops, often in relatively remote or under-explored parts of the country. Participants typically include students, amateurs, DOC fieldworkers, and overseas visitors (particularly colleagues from Australia). A direct result of these workshops is that the number of “bryologically trained eyes” in New Zealand has increased dramatically. Further, because relatively under-explored sites are often visited by the workshops, the bryophyte holdings in New Zealand herbaria have increased greatly. Finally, numerous records of bryophytes in all categories of the NZTCS list are derived from the field trips of the workshops (e.g. Fife 2009). For the past several years lichenologists have actively participated, and in 2009 the name of the workshops was changed to the John Child Bryological and Lichenological Workshops to reflect this. A less direct consequence is that in 2009 lichenologists participated for the first time in the NZTCS listing process.

In recent years DOC fieldworkers have taken a greater interest in bryophytes, particularly on trips to offshore islands. Peter de Lange, in particular, has become an assiduous bryophyte collector. His efforts on the Chatham and Kermadec islands have resulted in numerous moss (Fife & de Lange 2009) and hepatic (Renner & de Lange 2009) additions to the New Zealand Flora. Many of the bryophytes discovered by de Lange are predominantly tropical species occurring near their southern distributional limits. However, several have been added to the NZTCS list as DD and at least one, *Calymperes tenerum* Müller (1872: 174), has been classed as Nationally Critical due largely to grazing damage of the Chatham Island forest remnants where it grows.

We believe that bryophyte conservation in New Zealand, including education efforts, has progressed greatly since 1983. A conscious decision by bryologists to engage in programmes initiated by DOC has resulted in bryophytes achieving equal treatment with vascular plants, and even with iconic animal species, in the competition for limited species conservation funding. Some of the benefits in terms of additional funding for bryophyte exploration and documentation have begun to accrue and we expect that funding from government sources for active management of some of our rarest bryophyte species will increase.

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