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Conservation Status of Bryophytes in Eastern Australia

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Abstract: No bryophyte conservation programs are in place in Australia as the knowledge of bryophytes is poor, especially of their habitat preferences and distribution. The conservation of species against habitats is discussed and it is maintained on present evidence that areas conserved for vascular plants and/or animal habitats, as national parks and forest reserves, in most cases would adequately conserve bryophytes.

One of the first questions I am often asked by non-bryologists or by "conservationists" is what bryophytes are rare or endangered. My reply of "I have very little idea of what is endangered" leaves them speechless and they look at me as if to say "what sort of a bryologist are you if you don't know that". That brings to mind a comment the prominent Finnish bryologist Dr Timo Koponen made while we were together on field work in Lappland a couple of years ago. We were following a river and he kept picking up mosses and rattling off their names and eventually in frustration he exclaimed "how boring, Brotherus and Lindberg knew all this a hundred years ago". That sums up exactly the differences in bryological knowledge between Australia and the tropics, and Europe. We still have much to learn about Australian bryophytes in order to develop an understanding of their taxonomy, distribution, habit and habitat preferences. The Europeans have documented their bryophyte communities for nearly 200 years in some cases (Koponen 1992), but we in Australia still lack this basic information. Hopefully we can develop a conservation strategy for Australian bryophytes that will retain as much of the natural habitats as possible and reflect our bryological diversity. By doing that we will not be the same situation as in Europe where man-made habitats are conserved because most of the natural vegetation has been lost (Koponen 1992).

In this essay I will confine my discussion to tropical and sub-tropical forests of eastern Australia. The sub-alpine vegetation communi-

ties, the majority of which are in national parks in New South Wales, Victoria and Tasmania, are well protected under various Parliamentary Acts. These parks are constantly being extended, generally with adjacent forestry managed land.

HISTORY OF BRYOLOGICAL ACTIVITY

Between the 1880s and early 1900s there was a healthy amount of local bryological activity. In the forefront was the Rev. W.W. Watts who collected prolifically in New South Wales and later, to a lesser extent, in Victoria (Ramsay 1980). His most comprehensive collections originated from near Ballina in northern New South Wales and from the Blue Mountains behind Sydney. Tasmania was the only other state fortunate in having interested collectors during that period. They were R.A. Bastow, W.A. Weymouth and L. Rodway, the latter publishing a moss flora for Tasmania in 1914, the first for Australia. The only other collections of note during that time were obtained by the Queensland government botanist F.M. Bailey. While these collections form a valuable source of knowledge for species distribution, they are unfortunately of very limited value for conservation studies because very little information beside the locality, often vague, was noted. Most of these bryophyte collections were mosses and as a result our knowledge and collections of hepatics is poorer than that for mosses.

J.H. Willis, the Victorian government botanist, who had a wide interest in plants, published several small articles on bryophytes and assisted other workers with determinations from the late 1940s until the early 1970s. Since then interest in bryophytes has increased with I.G. Stone and H. Streimann commenceing extensive and intensive collecting in eastern Australia while L.D. Williams collected in South Australia. Tasmania was fortunate to have the Ratkowskys (D.A. & A.V.) and A.Moscal who were very active collectors, and lately R. Wyatt and A. Stoneburner (Stoneburner et al. 1993) have added to our knowledge of the Western Australian mosses. Unfortunately there are still too few bryophyte collectors in Australia, especially for hepatics, and large areas still remain unsampled. Gradstein (1992) lamented that large areas of tropical America are bryologically unknown, and that there is "a serious lack of information on the taxonomy, distribution and ecology of tropical bryophyte species." This is also true for tropical Australia.

STATE OF KNOWLEDGE

Clearly our knowledge of bryophytes lags considerably behind that of the flowering plants and is very patchy at species level. We cannot say with certainty how many species there are in the country, or how widespread or how common they may be, let alone which ones are endangered. Numerous recent revisions may have clarified some names, but for various reasons they are of little value in assessing conservation status. This is because of the poor data associated with the collections, especially on the older gatherings. Our knowledge only reflects the meagre historical collections we have available, often with limited habit and habitat information, on which to base comparisons with present day situations. In the past there have been no bryologists who made these observations or published their impressions. We could draw up lists of bryophyte species not well represented in herbaria, or not collected for the last hundred years, but this would reflect the lack of collecting, the limited collecting patterns, or collectors' preferences. We cannot say with any certainty which bryophyte species are in need of conservation.

There are areas, or vegetation types, that are better known and constantly attract attention because of the magnificent abundance of spectacular bryophytes. These are the Atherton Tablelands, the scenic Blue Mountains behind Sydney and the luxuriant National Parks of eastern Queensland. Even though these areas have attracted considerable interest, perhaps because of easy access and wide publicity, there are still many secrets to be discovered. The staff of the Cryptogamic Herbarium of the Australian National Botanic Gardens (CBG) follow a planned collecting program for the forests of Queensland and eastern Victoria that aims to fill in these great gaps in our bryophyte knowledge. I base my comments on the conservation of bryophytes from these limited collections and the observations made in the field.

VEGETATION TYPES AND BRYOPHYTES

The Australian tropical and sub-tropical regions apparently have a good diversity of bryophyte species, but not many studies have been undertaken of larger groups or families. Thiers (1990), in her studies of the Australian Lejeuneaceae, found that the tropical region contais about 80% (96) and the sub- tropical regions about 45% (55) of the known species (122). This she claims is a surprising diversity which could be due to the variety of forest types present.

Vegetation structure and composition is always dynamic and not static. Man-made changes are quick and often catastrophic, while natural changes generally are very slow and afford the organism time to to adapt to other suitable localities. Natural changes, due to cyclones, wind throw, death of old trees etc., allow for the development of bryophyte communities that would not be possible otherwise in a tropical forest because of lack of light and high humidity. However, natural changes can also lead to extinction.

Large expanses of the Australian landscape have adapted to fires and bryophyte communities reflect that adaptation. There has evolved a bryoflora capable of coping with these changes which has led to an increasing incidence of *Fabronia australis, Campylopus introflexus, Ceratodon purpureus, Funaria hygrometrica, Marchantia berteroana, Cephalociella exiliflora* etc. In an *Eucalyptus-Acacia* dominated woodland in north Queensland that was constantly affected by naturally occurring low intensity fires, the cryptogams were found at a considerable height up tree trunks, which made it necessary to climb the tree to obtain samples. At other localities where fire was not a major factor these species were generally found at tree base only.

During the 1984 field trip to the Big Tableland south of Cooktown, numerous interesting and new species of bryophytes and lichens were found. On a return visit in 1989 the vegetation had become denser to such an extent that the bryoflora and lichen flora were considerably poorer. Previously miners kept the forest edge cleared with resultant higher light intensities and lower humidities. A similar situation was encountered in a forest near Braidwood in New South Wales. A dense and spectacular carpet of *Leucobryum* and *Dicranoloma* covered a considerable area, but on returning about 6 to 8 months later most of these mosses were smothered by ferns and very little evidence of the moss colonies remained. It is not known why the ferns proliferated, but it may have resulted from a prolonged wet period.

Other species are naturally rare in nature. *Ulota* species, which occur in the temperate forests and prefer branches of shrubs and the crowns of antarctic beech (*Nothofagus*), only occur in small scattered colonies. These species, even though rare, are safe as long as the vegetation type is not drastically altered. As with flowering plants and animals there are bryophytes that are adapted to particular vegetation types.

Man-made habitats also provide suitable niches for various mosses. On a shaded, and generally moist, path leading to the herbarium at the Australian National Botanic Gardens, large colonies of regularly fertile *Amblystegium serpens* have established as well as *Lunularia cruciata*. Previously this species was only reported from Tasmania and South Australia (Streimann & Curnow 1989). Of course the common and widespread species *Tortula muralis* is also abundant on stonework in many parts of the Gardens.

Because of these changes it would be inadvisable generally to conserve areas, especially those of limited size, on a species basis. Even if we mentioned half a dozen species from an area it would be hard, if not impossible, to convince authorities and the public to conserve areas for small plants that they find hard to see or to recognize. If a reasonably large area of a vegetation type was conserved, the chances of the bryophyte flora surviving are greater because each species would be able to find a suitable niche in that larger area.

Thus I contend that the only reasonable approach which takes into consideration our limited bryophyte knowledge is to work on habitat conservation. I, and no doubt other bryologists, have noted the relationship between the different types of flowering plant flora and the resultant bryophyte communities. Habitats that contain unusual or rare flowering plants

often harbour some bryophyte surprises. Conservation by habitats takes into consideration the natural vegetation changes which make available a range of vegetation stages for the establishment and maintenance of viable bryophyte communities as well. Therefore, an area that also contains interesting flowering plants and animal habitats would have a better chance of being considered worthy of conservation than on its bryophyte or lichen content only.

PRESENT RESERVES

We are fortunate in Australia that a good network of National Parks has been established by State and Commonwealth governments which has conserved a wide range of habitats. From Queensland to Tasmania "rainforests" and similar vegetation types are well protected because of great public and scientific interest in them. In 1988 the tropical forests between Townsville and Cooktown were placed on the World Heritage List which excludes development. In the tropical forests south of Townsville logging is restricted and severely controlled. Logging in non-*Eucalyptus* forests has been phased out. These restrictions apply only to government controlled land, but in Victoria permission must also be obtained for the clearing of native vegetation on private land.

State forest authorities have also recognised the need to conserve unusual vegetation types, often in conjunction with fauna conservation. In New South Wales there are Flora Reserves while in Queensland sections of forest have been set aside as Scientific Areas. In both cases special permission must be obtained to undertake studies in these reserves.

These protected areas, national parks and forest reserves, even though initially reserved for flowering plants, animals or scenic value do also contain significant bryophyte diversity.

Remnant "rainforest" vegetation alongside roads in tropical areas affords an excellent habitat for bryophytes and lichens. The size and density of these remnants often varies within an area thus affording refuge to a considerable range of cryptogams, especially Meteoriaceae. Amongst the species noted from these roadside remnants in the Atherton area are: hepatics *Cololejeunea lanciloba, Frullania* (9 species), *Jackiella javanica, Jungermannia orbiculata, Lopholejeunea streimannii, Lopholejeunea subfusca*; mosses - *Cryphaea dilata, Eucamptodon muelleri, Hampeella pallens, Herpetineuron toccae, Hypnum cupressiforme, Macromitrium involutifolium ssp. ptychomitrioides, M. ligulaefolium, M. microstomum, Mesochaete taxiforme, Mesonodon flavescens, Meteorium buchananii, Papillaria crocea* and *Pinnatella kuehliana.*

The tropical and temperate forests of eastern Australia are well protected, and with it the bryophyte communities. To these areas there will be future additions, but this will not lead to a significant increase in area. All these reserves will give the few present bryologists and future generations time to study the composition of these communities.

FURTHER VEGETATION TYPES FOR PROTECTION

While the "conservationists" have been concentrating on the visually "spectacular" there are, however, other vegetation types which I feel may yield results as spectacular scientifically, if not more so, than those observed so far in the tropical and temperate forests.

From the limited results of field work conducted by Australian National Botanic Gardens staff and that by R. Fensham (Queensland Dept of Environment and Heritage, Townsville) it appears that the so-called "dry scrub" or monsoon-dependent vegetation must also be seriously considered for conservation. Much of this has been cleared and is now used for grazing and farming. The species numbers may not be as great, nor the colonies as spectacular, but they do contain an interesting and poorly studied bryophyte flora which may be bryogeographically exciting and significant.

Recently we identified *Erpodium beccarii,* a moss new to Australia and I suspect there is also another species of *Erpodium* new to Australia. *Stereophyllum radiculosum* was reported new to Australia by Enroth (1991) and now that species appears to be quite common and forms quite large communities in this vegetation type. Vitt & Ramsay (1985) reported *Macromitrium aurescens* as being rare, but it is also a very common component of the bryoflora

of the drier areas. One large area of this vegetation type has been conserved as the Forty Mile Scrub National Park in northern Queensland. Another similar vegetation type of interest is the Dan Dan Scrub in central Queensland which is presently under Forestry control (Pine State Forest) and subject to grazing. This grazing has been carried out for a considerable time and the bryophyte communities seem to be unaffected. However, what would be catastrophic is a severe fire leading to micro-climatic changes and possibly subsequent over grazing could hinder natural regeneration. This would allow for the invasion of exotic weeds like *Lantana* which would suppress natural regeneration, thus denying suitable substrata for the re-establishment of bryophyte communities.

Lowland coastal tropical forests were the first to be cleared on settlement and now most of this original forest has been lost to grazing, farming or sugar plantations. We have very little knowledge of the original bryophyte flora. There are only a few early collections and some of the species have not been found since. For instance, Amalia Dietricht collected *Papillaria intricata* from "Rockhampton" and this moss has not been recollected since she collected it in 1865. It is a reasonably common Pacific species (Streimann 1991, 1992) and this was the only report from a large land mass. Field work in 1993 was not successful in locating it. Generally the lowland tropical forests are considered to have a poor variety of bryophytes because the ground cover and the tree trunks have few scattered colonies. When large colonies do develop only a few species are represented. However, when examining the crowns of recently felled forest trees it becomes apparent that the diversity is much greater than can be seen from a walk in the forest. Therefore conservation of any remnant of lowland forest types, no matter how disturbed, must also be considered seriously. Similarly *Casuarina* dominated stream sides on coastal flats or similar non-sclerophyll vegetation should also be considered. Because of the diffuse light and the higher humidities these vegetation types have proved to contain suitable substrates for bryophyte and unusual lichen communities.

From the assessment of the results of our past and future field work, which are being entered into the CBG database (IBIS), we could have a "guess" at the bryo-diversity of various vegetation types or perhaps receive an indication of the vegetation types on which we should concentrate our limited resources in the future so as to conserve the best variety of our bryophyte flora. If more funding would be available for databasing the ANBG cryptogamic collections, and possibly those of other Australian herbaria also, then we would be in a better position to asses the state of our cryptogamic knowledge.

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