Crown of the ICH: Epiphytic Macrolichens of Old Growth Forests in the Interior Cedar-Hemlock Zone.

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The occurrence of rare lichens in British Columbia is not random, but is correlated with certain predictable habitats - many of which are themselves of more or less infrequent occurrence. Among the most important of these are: hotsprings, the spray zones of waterfalls, outcroppings of anomalous geological strata, talus slopes, undisturbed grasslands, and old growth forests.

In the following article, I will briefly discuss the relation of rare and/or uncommon epiphytic (tree-dwelling) macrolichens to the old growth forests of the Interior Cedar-Hemlock Zone (ICH). This zone occupies the humid valley bottoms of south-eastern British Columbia, within the Southern Interior Mountains Ecoprovince of Demarchi et al. (1990). The northern, outlying forest region also designated as ICH in Meidinger et al. (1991) is climatically (and epiphytically) anomalous, and will not be considered here.

It is sometimes asserted, especially by apologists for the forest industry, that old growth forests support fewer species than seral forests do. Though this claim is of course irrelevant to any intelligent discussions of biodiversity, it probably does hold true for some species groups, e.g., sparrows, annual herbs, butterflies, etc. On the other hand, it certainly does not hold true for epiphytic macrolichens. In British Columbia, epiphytic macrolichens are, for the most part, nowhere more diverse than in old growth forests.

Why this should be is not difficult to understand. Given that epiphytic lichens colonize the trunks and branches of trees, and given that structural heterogeneity is greater in old growth forests than in seral forests (Franklin et al. 1981), it is hardly surprising that epiphytic macrolichen diversity is also greater in old growth forest types.

Different from younger forest types, which tend to support only those species adapted to local macroclimatic conditions, old growth forests support two distinct ecological clusters of lichens: the macroclimatic species, which are located primarily in the mid and upper canopies; and various mesoclimatic species, which are usually restricted to the more sheltered lower canopy.

As a rule, lichen colonization in maturing forests follows a fixed pattern of increasing floristic diversity with forest age. Here it is interesting to note that the pioneering epiphytes of young seral forests are invariably species of rather wide, often circumpolar distribution. The most common lichen genera represented in such forests are: *Alectoria, Bryoria, Cetraria, Hypogymnia, Lobaria, Nephroma, Parmelia, Parmeliopsis, Platismatia* and *Usnea*.

Only much later, usually after the attainment of certain old growth characteristics (e.g. heterogeneous tree size and spacing), do various less widespread epiphytes begin to appear. In the ICH, for example, the following epiphytic macrolichens are more or less restricted to old growth forests: *Cetrelia cetrariodes*, Cavernularia hultenii, Collema auriforme*, Dendriscocaulon intricatulum, Hypocenomyce friesii, Hypogymnia enteromorpha, H. oceanica, H. rugosa, H. vittata, Lichinodium canadense, Lobaria oregana*, L. retigera*, Melanelia glabratula*, Nephroma occultum, Pannaria mediterranea*, Parmelia pseudosulcata*, Platismatia herrei*, P. norvegica, Polychidium dendriscum*, Pseudocyphellaria crocata*, Sphaerophorus globosus, S. tuckermanii, Sticta fuliginosa, S. limbata*, and *S. wrightii**. For the purposes of the present discussion, a majority of these lichens can be considered rare or infrequent in the ICH, though their exact frequency status has yet to be evaluated.

With the possible exception of *Hypogymnia rugosa*, all of the epiphytes are distinctly hygrophytic in ecology, and most of them are primarily restricted to rather oceanic localities, especially the Coastal Western Hemlock Zone. The species denoted by an (*), have not previously been reported from inland North America. Even so, I have lately detected a majority of them in the old growth forests of the Robson Valley, north of McBride. The presence of at least 15 of these "oceanic" macrolichens within 60 km of the B.C.-Alberta border is unexpected, to say the least. This area merits special attention both by lichenologists, and by those charged with the preservation of old growth forests.

Interestingly, the large-scale distribution of these species within ICH appears to be somewhat random; no single old growth forest, or

...continued on page 16

... from page 15

forest region, has yet been found to contain all of them. At the stand level, however, they do seem to exhibit at least one obvious pattern: more of them occur in older old growth forests than in younger old growth forests.

This is a point of fundamental significance for lichen conservation in British Columbia. At least two possible hypotheses can be offered to account for it. The first hypothesis is that environmental conditions may have been more favourable to lichen colonization in the past than they are at present. According to this view, which might be called the "relict hypothesis", some epiphytic lichens of old growth forests may be ecological left-overs: able to persist where already established, but currently incapable of dispersing to younger forest types. Here it is interesting to note that climatic conditions from about 1350 to 1870 A.D., i.e. during the Little Ice Age, were cooler, and therefore probably more humid, than they are today (Pielou 1991). The dispersal and establishment of some old growth epiphytes might well therefore have been favoured under such conditions.

The second hypothesis is that older old growth forests have simply been available for colonization over a longer period than younger old growth forests. According to this view (the "petri dish hypothesis"), lichen colonization may be thought of as a series of random hit-and-miss inoculations by lichen diaspores. In general, the rarer the species, the less likely that successful inoculation will occur (either because of diaspore scarcity, or poor germinating abilities, or both), and the more likely that colonization will require the passage of many years, perhaps even centuries.

Whatever the reason, it is clear that numerous lichen species currently inhabiting B.C.'s old growth forests depend for their existence on long-term environmental continuity. Such species are highly vulnerable to disturbance of any kind, whether fire, severe defoliation, prolonged drought, or clearcut logging. Needless to say, the ecological requirements of these lichens are incompatible with forest management as currently practiced in the ICH. In particular, the practice of clearcut logging at 80-year to 120-year harvest intervals is certain to have a devastating effect on many species. Although precise quantitative predictions are of course problematic, declines in epiphytic diversity as high as thirty percent seem not unlikely in some portions of the province.

Ironically, not even the 350-year rotations advocated by some proponents of New Forestry (e.g. Harris 1984) can be guaranteed to satisfy the ecological needs of all epiphytic lichens. According to island biogeography theory (MacArthur & Wilson 1967), increasing fragmentation and isolation of old growth forests will lead to ever slower rates of colonization among epiphytes; in time, colonization rates will probably be overtaken by opposing rates of local extirpation. If nothing else, this prediction underlines the need for a concerted effort to document what epiphytes currently exist in different subzones of the ICH.

It is probably safe to say that, all things being equal, old growth-dependent birds and mammals are well served by the preservation of younger old growth forest types, e.g. 120-200 years in age (Old Growth Strategy Project 1992). The same, however, cannot be said of old growth-dependent lichens which, as a group, are well represented only in the oldest old growth ecosystems. Any conservation strategy that fails to distinguish between differing degrees of "old growthness" (Franklin & Spies 1991) is certain to result in the extirpation of at least some old growth lichens.

In order to bring attention to this problem, I have lately introduced the concept of "antique forests" (Goward 1993). Antique forests, as I define them, are simply old growth forests of exceptional age and/or environmental continuity. Many such forests may in fact be older than the trees that comprise them. Earlier (op.cit.), I attempted to define antique forests with reference to various stages in forest succession. I now believe this practice to be unnecessary and, indeed, unhelpful. For the present purposes, the salient feature of antique forests is simply that they are unusually old, and, reflecting this, unusually rich in "oceanic" epiphytic lichens. In most portions of the ICH, antique forests can hardly be younger than about 350-400 years.

Besides signalling that not all old growth forests are equally suited to the conservation needs of rare epiphytic lichens, the antique forest concept also provides, I believe, a powerful tool for identifying B.C.'s oldest forest ecosystems. In western Europe, lichens have been used as indicators of forest continuity since the mid 1970s (Rose 1976; see also Goward 1993); there seems no reason why they could not be so adopted in western North America as well. The basic principles, at any rate, are simple:

1) the greater number of "oce-

anic" lichens present in a forest, the older the forest;

2) the older the forest, the more of British Columbia's prehistory it is likely to preserve; and

3) the more prehistory a forest preserves, the sounder the reason for preserving the forest itself.

Seen from one perspective, the epiphytic macrolichens of the ICH are just one problem among many for the land use manager. Seen, however, from a slightly different perspective, lichens are not so much a problem as part of the solution: powerful allies in our efforts to preserve British Columbia's most valuable old growth ecosystems into the future. Regardless of which perspective we choose to adopt, surely the time has come to bring lichens into the conservationist's fold. Our failure to do so can only lead, in time, to continued extirpation and, in the end, extinction.

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Editorial

Old growth forests are in the news in a big way these days, with a long summer of protest on the west coast of Vancouver Island. The articles in this edition of BioLine point out how much is still not known about old growth forests and the organisms associated with them. An article on soil microorganisms was intended to be included in this edition, but when the author sat down to write it, she realized that so little is known that it would not be worthwhile sharing it at this point of time. Hopefully, our knowledge gaps with be further filled, particularly regarding the so-called lesser species, before all opportunities are taken away for their study.

Old growth is not just the coastal rainforest old growth either. Garry oak old growth is far more threatened than the old growth on the west coast of Vancouver Island. Similarly, old growth stands in the Coastal Douglas-fir zone are all but gone. Forests will always exist in British Columbia, at least until the next ice age, but to keep biological diversity in British Columbia it is becoming fairly obvious that significant portions of old growth forests must be maintained.

This BioLine is my last one as editor. I have greatly enjoyed being involved, especially working with Andrew Harcombe and Steve Jasper, who have made this such a classy publication. I pass the co-editor job on to the capable hands of Lynne Bonner and I look forward to future editions.

Ted Lea, R.P. Bio.