Oceanic Macrolichens in the Incomappleux River Valley, southeastern British Columbia

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INTRODUCTION

Recent studies in moist forests of inland British Columbia have provided evidence for significant biological connections between the wettest of these forests and temperate coastal rainforests (Alaback et al. 2000; Goward & Spribille 2002). In a recent study, Goward & Spribille (2002) used the distribution patterns of epiphytic oceanic macrolichen species to delineate the occurrence of these "inland rainforests". They conclude that these forests are found in a discontinuous belt in the wettest valleys of the Columbia and Rocky Mountains between about 51°N and 54°N. However, the southern boundaries of the inland rainforest formation remained poorly known due to a gap in lichen collecting data between the Adams River Valley and the U.S. border.

The present study is part of an effort to document the southern limits of oceanic lichen species identified by Goward & Spribille (2002) as indicators of inland rainforest conditions. The study included sampling in the New Denver-Silverton area, the Duncan River Valley and the Incomappleux River Valley. The present report summarizes the results of the macrolichen inventory in the lower and upper Incomappleux River area.

MATERIALS AND METHODS

The study took place in multiple sites along the Incomappleux River Valley, which for the purposes of displaying lichen distribution are grouped into the "lower" and "upper" sites, respectively. The lower site is represented by a string of cursory reconnaissance sites from the mouth of the Incomappleux River on Arrow Lake to just above the canyon of the Incomappleux River. Of these sites, one along the Fish River Road near the confluence was collected moderately intensively. The upper site is represented by a string of intensive collection sites from the end of the present road to the confluence of the Incomappleux River with Battle Brook. The major vegetation characteristics of both sites are summarized in Table 1.

The topography of the valley is characterized by steep valley walls surrounded by 2500-3000 m peaks and a 1-2 km wide valley bottom; the headwaters of the watershed

Table 1: major attributes of sampling sites.

Location	Vegetation
1. Lower Incomappleux Site Lat/Long: 50°59' N 117°35' W Elev.: approx. 500 m s.m. Exposure: mainly W	Mostly second-growth *Tsuga heterophylla* forests, age est. 80-120 yr, with *Thuja plicata*; diverse rock outcrops in canyon. Many early seral species in forest, such as *Betula papyrifera*.
2. Upper Incomappleux Site Lat/Long: 50° 44' N 117°42' W Elev.: approx. 550 m s.m. Exposure: mainly W to NW	Mainly old-growth *Tsuga heterophylla-Thuja plicata* forest, age varying but estimated to be mainly ave >200 yr, with individual trees likely much older; early seral species largely absent, forests with antique character (Goward 1994).

are occupied by large glaciers. Observed geology is a mixture of granite and shale, although there are doubtless layers of other parent materials present and likely some base enrichment.

Field sampling

Field sampling for lichens followed standard methods. Epiphytic lichens are closely linked with local climate, in that they acquire nearly all of their moisture from the air. Because of this and in light of the stated objectives, the collecting concentrated almost exclusively on epiphytic lichens. An inventory of lichen species was made by collecting samples of all observed species with a knife or chisel and recording the tree species and whether or not the lichen occurred on the bole or twigs, as well as any other noteworthy microsite characteristics of the collected sample. Samples were later sorted and identified using a dissecting microscope and where necessary determined to species with a light microscope. Microlichens were also inventoried, but the identifications of most of these species have yet to be worked out. Calicioid lichens ("pin lichens"), which represent key indicators of old-growth conditions, were only cursorily sampled. Some bryophytes were also cursorily sampled. More field work is required before the full extent of the diversity of these species in the Incomappleux area will be understood.

The primary lichen references are Goward et al. (1994) and Goward (1999), while taxonomy follows Esslinger et al. (1997).

RESULTS

Distribution of diversity

A total of 59 epiphytic macrolichen species were collected, of which 24 were found at the lower site and 50 species at the upper site (Table 2). The vast majority (93%) of macrolichen species were found on western hemlock (55 species), with a much lower number present on western redcedar (14 species).

Table 2: Distribution of sampled lichens and substrates. + = species collected; p = observed but not collected; pb = on *Populus balsamifera*; rp = on *Rhamnus purshiana*; dz = on *Picea* in *Populus* dripzone; r = on rock; vo = on *Vaccinium ovalifolium*.

Part of Incomappleux:	lower	lower	lower	lower	upper	upper	upper	upper	upper
Substrate	*Tsuga heterophylla* branches	*Tsuga heterophylla* trunk	*Alnus incana* trunk	Other substrates*	*Thuja plicata* trunk	*Thuja plicata* branches	*Tsuga heterophylla* trunk	*Tsuga heterophylla* branches	Other substrates*
Alectoria sarmentosa	+					+		+	
Bryoria capillaris								+	
Bryoria lanestris	+								
Cladonia chlorophaea							+	+	
Cladonia coniocraea								+	
**Fuscopannaria ramulina*								+	
**Gyalideopsis piceicola*								+	
Hypogymnia metaphysodes						+			
Hypogymnia occidentalis	+					+		+	
**Hypogymnia oceanica*								+	
Hypogymnia physodes			+			+		+	
Hypogymnia rugosa		+			p				
Hypogymnia tubulosa								+	
Hypogymnia vittata						+		+	
Leptogium intermedium	+								
**Lichinodium canadense*								+	
Lobaria hallii			+	pb					
Lobaria linita								+	r
Lobaria pulmonaria	+		+		p	+		+	
**Lobaria scrobiculata*	+							+	
Melanelia spec.	+								
**Microlychnus epicorticis*								+	
Nephroma bellum								+	
**Nephroma helveticum*	+		+			+		+	
**Nephroma isidiosum*								+	
**Nephroma occultum*								+	
Nephroma parile	+		+					+	
Nodobryoria oregana								+	
Parmelia hygrophila	+	p	+			+		+	
Parmelia saxatilis								+	
Parmelia sulcata	+		+			+		p	
**Parmeliella parvula*								+	
Parmeliella triptophylla	+		+	rp					

Table 2 (cont.)

Part of Incomappleux:	lower	lower	lower	lower	upper	upper	upper	upper	upper
Substrate	*Tsuga heterophylla* branches	*Tsuga heterophylla* trunk	*Alnus incana* trunk	Other substrates*	*Thuja plicata* trunk	*Thuja plicata* branches	*Tsuga heterophylla* trunk	*Tsuga heterophylla* branches	Other substrates*
Parmeliopsis ambigua					+	+	+	+	
Parmeliopsis hyperopta					+		+	+	
Peltigera collina	+		+					+	
Platismatia glauca	+	p	p			+	+	+	
**Platismatia norvegica*								+	
**Polychidium dendriscum*								+	
**Pseudocyphellaria anomala*	+			dz				+	
Ramalina thrausta	+							+	
**Sphaerophorus globosus*					p		+	+	
**Sphaerophorus tuckermannii*	+				+	+	+	+	
Spilonemella americana								+	
**Sticta fuliginosa*	+							+	
**Sticta limbata*								+	
**Sticta oroborealis*								+	
Tuckermannopsis chlorophylla		p					+	+	
Usnea filipendula								+	
Usnea spec.	+								
Vulpicida pinastri								+	
Species only on trunks									
Cladonia umbricola							+		
Hypocenomyce friesii					+		+		
Nephroma arcticum							+		
Peltigera britannica							+		
Peltigera membranacea		+							
Protopannaria pezizoides							+		
Misc. crusts									
Caloplaca atrosanguinea			+						
Hypocenomyce cf leucococca	p							+	
Hypocenomyce cf xanthococca	p							+	
Mycoblastus sanguinarius	+					+		+	
Pyrrhospora cinnabarina	+								
Thelotrema lepadinum								+	
Non-epiphytes									
Cetraria ericetorum									vo
Pilophorus acicularis				r					r
Pilophorus clavatus									r

Table 2 (cont.)

Part of Incomappleux:	lower	lower	lower	lower	upper	upper	upper	upper	upper
Substrate	*Tsuga heterophylla* branches	*Tsuga heterophylla* trunk	*Alnus incana* trunk	Other substrates*	*Thuja plicata* trunk	*Thuja plicata* branches	*Tsuga heterophylla* trunk	*Tsuga heterophylla* branches	Other substrates*
Solorina saccata				r					
Stereocaulon grande				r					r
Misc. epiphytic bryophytes									
Antitrichia curtipendula	+					+		+	
Isothecium myosuroides	+					+		+	
Ptilidium californicum								+	
Ptilidium pulcherrimum						+		+	
Total epiphytic cyanolichens				10					17
Total epiphytic chlorolichens				13					27
Total oceanic * macrolichens				4					17
Total number of macrolichens				23					44

Unique species

Unique to the lower site was the occurrence of *Parmeliella triptophylla* and *Leptogium intermedium* on both conifer branches and *Alnus incana*. Also unique to the lower site, but not reflected in the data table, was the abundance and diversity of crustose *Bacidia* species typical of *Lobarion* communities in second-growth forests. These species were much more poorly represented in samples from the upper Incomappleux, where forests tended to be older.

Many species were found only in the upper Incomappleux (Table 2). Significant among these are *Fuscopannaria ramulina*, *Hypogymnia oceanica*, *Lichinodium canadense*, *Lobaria linita*, *Microlychnus epicorticis*, *Nephroma isidiosum*, *Nephroma occultum*, *Parmeliella parvula*, *Platismatia norvegica*, *Polychidium dendriscum*, *Sticta limbata* and *Sticta oroborealis*. Except for *L. linita*, which has not been previously recorded as a branch epiphyte, these species have all been identified as species with oceanic distributions characteristic of perhumid inland rainforests by Goward & Spribille (2002). Highly significant is the occurrence of *Spilonemella americana* on *Tsuga* twigs along Battle Brook. This recently described species (Henssen & Tønsberg 2000) is otherwise known in inland British Columbia only from waterfall spray zones; this is the first recorded occurrence in a regular riparian area, pointing to the high climatic moisture.

Other species

Several other species were collected that represent documentations of rare or uncommon species in the area. These include the oceanic species *Pilophorus acicularis* and *P. clavatus*. *P. clavatus* was only recently reported as occurring in inland regions by Spribille (2002), this being its third locality in inland North America. Another uncommon species found in the Incomappleux River canyon was *Solorina saccata*.

Index of Rainforestness

Goward & Spribille (2002) proposed the application of a numerical index value based on the ratios cyanolichen : chorolichen and oceanic : total diversity to assign an "index of rainforestness" to a given study area. They used the following formula:

$I_{Rain} = ((\Sigma_{cy}/\Sigma_{ch}) + (\Sigma_{oc}/\Sigma_{tot}))/2 \cdot 100$

cy = cyanolichen species on conifer twigs/branches
ch = chorolichen species " "
oc = Oceanic species " " (oceanic species are outlined in Goward & Spribille 2002)
tot = Total number of macrolichen species on conifer branches

Using this formula, the lower Incomappleux has an I_{Rain} value of 47 and the upper Incomappleux an I_{Rain} value of 51.

DISCUSSION

The upper Incomappleux valley in particular exhibits a high concentration of oceanic species. Many of these species (e.g., *Nephroma occultum*, *Polychidium dendriscum*, *Sticta oroborealis*) were not previously known to extend farther south in inland British Columbia than the Adams River Valley. Thus, the present survey has resulted in the southward extension of the known ranges of many species, especially those with oceanic affinities.

The upper Incomappleux Valley also represents one of the highest concentrations of oceanic lichen species anywhere in inland British Columbia. Its high Rainforestness Index (I_{Rain}) of 51 is directly comparable with coastal localities such as the McAndrew Forest in Oregon (50) and the Kispiox Valley (48) and is rivaled in inland regions only by the Robson Valley, which has an I_{Rain} of 47 (Goward & Spribille 2002). The high value reflects the high number of oceanic indicator species (18, surpassed only by the Robson Valley, 20) and the high number of cyanolichens (17, in the Robson: 19) combined with a lower number of chlorolichens (27, in the Robson: 34). All of these factors are naturally affected by the sampling intensity. It can be expected that further sampling will reveal more macrolichen species in the upper Incomappleux. It is likely that sampling will reveal more chlorolichen species. However, cyanolichens and oceanic species such as *Nephroma resupinatum* and *Cavernularia hultenii* could also be expected to be found in the upper Incomappleux Valley, somewhat compensating the effect of finding more chlorolichens. It is likely that further sampling will result in a slight net decrease in the currently very high rainforestness index value for the upper Incomappleux Valley.

The lower Incomappleux valley also exhibits a high rainforestness index. However, the total number of lichen species sampled was small (23) and can assumed to be incomplete. The rainforestness value could accordingly be expected to change with a more complete inventory of forests in the lower Incomappleux River valley. More work is needed.

Implications for delineation of inland rainforest

The discovery of so many oceanic species in the Incomappleux River area is compelling evidence in support of a southward extension to 51°N of the perhumid inland rainforest, a discontinuous band of moist forests in eastern and southeastern British Columbia otherwise extending from about 54° to 51°N (Goward & Spribille 2002). In fact, the presence of so many key indicator species suggests that the extent of the rainforest phenomenon in southern valley areas requires further study. It also points out the significance of the Incomappleux River Valley as a major centre of oceanic species diversity in southern interior British Columbia, and possibly as a source for colonisation of other areas.

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