Habitat associations of macrolichens on a boreal island in the Bay of Fundy, New Brunswick, Canada

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Although such factors may not pose problems for

(Peterson et al. 2005). Introduced to the archipelago in 1959, the hares were finally eradicated in 2007. This study will permit an evaluation of the effect of habitat change on lichen communities as the forest

We used Indicator Species Analysis to determine whether individual lichen species differed in their frequency of occurrence among forest types (Dufrêne & Legendre 1997). An indicator value for each species represents the likelihood of finding the particular species in each forest type. Monte Carlo simulations (4999 permutations) were conducted to test the significance of observed indicator values (alpha = 0.05). MRPP and Indicator Species Analysis were performed using PC-ORD software (McCune & Mefford 2005).

To illustrate habitat associations of particular lichen species and similarities in lichen communities between the five forest types (as well as between the 25 individual forest plots), we used hierarchical cluster analysis (SPSS 13 for Macintosh). Because rare species can reduce the reliability of clustering (McCune et al. 2000), we included only species found

2000; **F◄. 1**

T b 2). The cluster analysis and the Indicator Species values suggested three distinct lichen groups based on species' preferred forest types: (1) widely distributed and abundant generalist species (Parmelia squarrosa, Hypogymnia physodes); (2) common species that have a preference for heartleaf birch (Usnea ceratina, U. filipendula); and (3) species that have a preference for white spruce (Ramalina roesleri, R. farinacea and Punctelia subrudecta) (P. subrudecta = P. perreticulata; Hinds & Hinds 2007) (**F,◄. 3**). Note, however, that the three balsam fir specialists identified in the Indicator Species Analysis did not form a distinct group in the cluster analysis (**F,◄. 3**). Moreover, although five lichen species appeared to have non-random distributions with respect to forest type, Bonferronni corrections for multiple

taxa on the island (e.g., mosses: Futamura & Wheelwright 2000; ground beetles: Apigian & Wheelwright 2000; songbirds: Eliason 1986). Not surprisingly, species characterized as oceanic in distribution comprise almost half of Kent Island's lichen biota. Species in the genus *Usnea* appear to be especially successful at colonizing under Kent Island's conditions, based on the relatively high proportion of species shared with Fundy National Park (Gowan & Brodo 1988). We found no association, however, between growth form *per se* (fruticose vs. foliose) and the probability of occurrence on Kent Island.

Despite its small area, Kent Island has several different forest types. We found no difference between forest types in macrolichen species richness; on average individual 5 × 5 m plots had about a dozen species. Yet forest types varied significantly in terms of the species composition of their lichen communities. Two separate analyses (Multi-response Permutation Procedures, hierarchical cluster analysis) showed that deciduous and coniferous forests had quantitatively different lichen communities, although they shared many of the same species. White spruce forest plots in particular were distinctive. Deciduous trees appear to host different compositions of lichen species than coniferous trees in Fundy National Park and other sites as well (Ahti 1977; Gowan & Brodo 1988).

Indicator Species Analysis demonstrated that about one-sixth of Kent Island's macrolichens show significant habitat preferences. Likely factors explaining species-specific habitat associations on Kent Island are variation in forest light levels, the morphology and chemistry of the bark of different tree species and moisture (e.g., Antoine & McCune 2004; Frati et al. 2007; O'Hare 1974). The two most abundant and widespread species on Kent Island, *Hypogymnia physodes* and *Parmelia squarrosa*, are equally common in other boreal forests (Ahti 1983; Cameron 2002; Gowan & Brodo 1988); *H. physodes* was found in 76 of 90 survey plots in northern Maine and *P. squarrosa* in 43 of 92 (Hinds & Hinds 2007). Among the balsam fir specialists on Kent Island, *Platismatia glauca* is known to favor conifers elsewhere, while *Cladonia coniocraea* and *C. squamosa* often occur in shady habitats like Kent Island's balsam fir forest (Ahti 1983; Hinds & Hinds 2007). It is less obvious why *Ramalina roesleri* apparently favors white spruce on Kent Island and *Bryoria fuscescens* mixed coniferous forest.

Although cyanolichens are normal components of the Altatobviousies:su50Tymnia physodesbetween

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(found in 6–20 sites and with evidence of recent declines) and *U. rubicunda* as R1 (found in fewer than 6 sites and with good evidence of recent declines).

In conclusion, compared to the mainland of New Brunswick the macrolichen biota of Kent Island is depauperate and dominated by species with boreal and oceanic biogeographical affinities. Despite the

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