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LICHENS OF SCATARIE ISLAND WILDERNESS AREA

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In 2001, 2005 and 2007 sixty-one species of lichens were collected from Scatarie Island. Over half the species had a boreal or arctic distribution and slightly less than half had a coastal affinity. New records include five species for Cape Breton of which three species are also new records for Nova Scotia. Cyanolichen diversity is very low for Scatarie Island compared to other coastal collections from Nova Scotia.

En 2001, 2005 et 2007 on a recueilli soixante et une espèces de lichens dans l'île Scatarie. Plus de la moitié de ces espèces avaient une aire de répartition boréale ou arctique, et un peu moins de la moitié étaient des espèces plutôt côtières. Cinq espèces étaient répertoriées pour la première fois au Cap-Breton, trois d'entre elles étant également observées pour la première fois en Nouvelle-Écosse. La diversité des cyanolichens dans l'île Scatarie est très faible comparée à celle d'autres collections recueillies sur les côtes de la Nouvelle-Écosse.

INTRODUCTION

The purpose of this study was to develop a lichen checklist for Scatarie Island as the Island's geographic position, with minimal human disturbance and variety of habitat types suggested the possibility of high lichen diversity. Additionally, although there have been several unpublished vascular plant surveys as well as museum records from the Island, there are no published lichen records or Nova Scotia Museum collections of lichens for Scatarie Island.

Scatarie Island is home to several species of rare vascular plants for Nova Scotia (Cameron 2004); many of these have an arctic or alpine distribution and others include those with a boreal and tem-

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perate distribution. Habitats on the island are varied with barrens, wetlands, rocky shores, cliffs and forests all providing a diversity of niches and substrates for lichen colonization.

As Scatarie Island falls within the Atlantic Climate Region there is abundant atmospheric moisture for lichen growth (Davis & Browne 1996). In addition, the Atlantic Ocean provides plants with airborne nutrients from salt spray and large wetlands throughout the island further increase atmospheric moisture.

A lichen is a symbiotic association of a fungus and a photosynthetic microorganism, usually an alga (or occasionally a bacterium). The algae produce carbohydrates by photosynthesis, which are then used by the fungus. In about 10% of the known species of lichens the photosynthesizing partner is a

cyanobacterium in which case it fixes nitrogen and supplies it in organic form to the fungus. The scientific name for the lichen is provided by the name of the fungal partner. Lichens are important pioneers in the initiation and sustenance of ecosystems in otherwise uninhabitable situations. Lichens obtain nutrients through interception of aerosols, particulates, and precipitation (Nash 1996). Water is obtained from the atmosphere or rain, thereby requiring the lichen to remain dormant during times when atmospheric moisture is not available. These same traits of dormancy and nutrient absorption mean lichens tend to grow slowly compared with vascular plants and thus are poor competitors. The ability to remain dormant for long periods and to obtain nutrients through the atmosphere allows lichens to live in harsh conditions. Scatarie Island, with exposed headlands, rocky shores and cool summers, make conditions difficult for vascular plant growth, but ideal for lichens.

METHODS

Extensive collecting occurred between 20 and 25 August, 2001, 8 and 11 August, 2005 and 23 and 24 July, 2007. All fruticose (shrub-like) and foliose (leaf-like) species found were identified in the field or collected for later identification. Some crustose (crust-like) species were identified, but no attempt was made to document all crustose species. Each species was characterized as abundant, common, occasional or rare. Growth form and substrate were also noted. Voucher specimens for twenty-five species were deposited at the Nova Scotia Museum of Natural History (Halifax). Geographic affinity and habitat were taken from Brodo et al. (2001), Gowan and Brodo (1988) and Selva (1999); nomenclature follows Esslinger (1997).

RESULTS AND DISCUSSION

Sixty-one species of lichen were found (Table 1). Of these, 29 were fruticose, 25 were foliose and 7 were crustose growth forms. Forty-two species (69%) were forest dwellers living on the dominant balsam fir which is interspersed with white and black spruce (Cameron 2004). About 25% (13 species) were found in barrens or barren/bog complexes. Six species were found on rocky shores.

Substrate

The greatest number of lichens (48% or 29) were corticolous (living on cortex or bark-like substances). Most species occurred on balsam fir (*Abies balsamea*) followed by white spruce (*Picea glauca*) and black spruce (*Picea mariana*). Few species occurred on birch (*Betula cordifolia*) or mountain ash (*Sorbus americana*) possibly because of the low abundance of these trees on the island.

Six species were found on well rotted deadwood on the forest floor. Of these, only one species, (*Cladonia digitata*), occurs almost exclusively on deadwood (Brodo et al. 2001). The other lignicolous species (inhabitants of wood) occurred on deadwood, but were not restricted to this substrate. All lignicolous species found were in the genus *Cladonia*.

Saxicolous species (inhabitants of rocks) included six species collected from rocky shores and four from inland cliffs and rocky outcrops in barrens.

Fourteen (23%) of the species found were terricolous (living on or in the ground). This community is dominated by species of the genus *Cladonia,* but also includes several species of *Peltigera*. *Peltigera* species grew in forested habitats on damp moss, soil or tree bases while *Cladonia* species tended to be found in barrens, forest openings or disturbed areas along trails. Fruticose *Cladonia* species dominated barrens and hummocks in bogs along with *Cetraria islandica. Cladonia boryi* and *C. terrae-novae* were common on barrens on the island and are probably indicators of these unique coastal barren communities. Although these species can be found in inland barrens they are never abundant.

Biogeography

Phytogeographic affinities of lichens found in this study largely reflect the coastal position of the island. Over half (51%) of the species identified in this study have a boreal/arctic distribution and, in Nova Scotia, are at the southern portion of their range. The number of arctic/alpine vascular plants and high proportion of arctic lichens found here attest to the harsh environmental conditions on the island, which allow these species to survive where the more

Table 1 Lichen species identified on Scatarie Island as well as substrate, abundance and habitat where they were found. Growth form and phyto-geography are summarized from the literature. Phytogeography is for North American distribution.

Species	Growth Form[1]	Substrate	Abundance	Habitat	Phytogeography
Alectoria sarmentosa (Ach.) Ach.	frut.	bark	common	forest	east & west coast
Bryoria trichodes ssp. *trichodes* (Mot.) Brodo & D.Hawksw.	frut.	bark	common	forest	east & west
Bryoria capillaris (Ach.) Brodo & D.Hawksw.	frut.	bark	occasional	forest	east & west
Bryoria fuscescens (Gyelnik) Brodo & D.Hawksw.	frut.	bark	occasional	forest	boreal
Caloplaca sorediata (Vainio) Du Rietz	frut.	rock	occasional	shore	NA
*Cetraria islandica** (L.) Ach.	frut.	soil	locally abundant	barren	boreal/arctic
*Cetraria muricata** (Ach.) Eckfeldt	frut.	soil	rare	barren	boreal/arctic
Cladonia stellaris (Opiz) Brodo	frut.	soil	common	barren, bog forest	temperate, s. boreal
*Cladonia terrae-novae** (Ahti) Hale & Culb.	frut.	soil	common	barren	east coast
Cladonia rangiferina (L.) Nyl.	frut.	soil	common	barren, bog	NA
*Cladonia squamosa** Hoffm.	frut.	soil	occasional	forest	temperate, boreal
Cladonia boryi Tuck.	frut.	soil	common	barren	NE coast
*Cladonia pleurota** (Flörke) Schaerer	frut.	deadwood	occasional		temperate, boreal
*Cladonia maxima** (Asah.) Ahti	frut.	soil	common	forest	east & west coast
*Cladonia cenotea** (Ach.) Schaerer	frut.	deadwood	common	forest	temperate, boreal
*Cladonia scabriuscula** (Delise) Nyl.	frut.	soil	common	forest	temperate, boreal
*Cladonia chlorophaea** (Flörke ex Sommerf.) Sprendel	frut.	deadwood	occasional	forest	NA
Cladonia cristatella Tuck.	frut.	soil	occasional	forest	east
Cladonia strepsilis (Ach.) Grognot.	frut.	soil	occasional	forest	east
*Cladonia digitata** (L.) Hoffm.	frut.	deadwood	occasional	forest	east & west coast
*Cladonia subulata** (L.) F.H. Wigg.	frut.	deadwood	occasional	barren	boreal
Cladonia spp.	frut.	deadwood	occasional	forest	east & west coast
Dibaes baeomyces (L.f.) Rambold & Hertel	frut.	soil	common	barren	east

Table 1 Continued

Species	Growth Form[1]	Substrate	Abundance	Habitat	Phytogeography
Evernia mesomorpha Nyl.	frut.	bark	common	forest	temperate, boreal
Hypogymnia physodes (L.) Nyl.	fol.	bark	abundant	forest	temperate, boreal
*Hypogymnia tubulosa** (Schaerer) Hav.	fol.	bark	common	forest	east & west coast
*Lasallia papulosa** (Ach.) Llano.	fol.	rock	common	barren	east
Lepraria lobificans Nyl.	crust.	bark	common	forest	east & west
Lobaria pulmonaria (L.) Hoffm.	fol.	bark	rare	forest	temperate
Lobaria scrobiculata (Scop.) DC.	fol.	bark	rare	forest	east & west coast
Lopadium disciforme (Flotow) Kullh.	crust.	bark	common	forest	east & west coast
Loxospora elatina (Ach.) A.Massal.	crust.	bark	abundant	forest	boreal
Loxospora ochrophaea (Tuck.) R.C. Harris	crust.	bark	abundant	forest	east
Mycoblastus sanguinarius (L.) Norman	crust.	bark	occasional	forest	boreal
Mycoblastus caesius (Coppins & P. James) Tønsberg	crust.	bark	common	forest	northern
Parmelia sulcata Taylor	fol.	bark	common	forest	northern
Parmelia squarrosa Hale	fol.	bark	abundant	forest	east & west
Peltigera horizontalis (Hudson) Baumg.	fol.	soil	occasional	forest	temperate
Peltigera aphthosa (L.) Willd.	fol.	soil	occasional	forest	temperate, boreal
Pertusaria amara (Ach.) Nyl.	crust.	bark	common	forest	east
Platismatia tuckermanii (Oakes) Culb. & C. Culb.	fol.	bark	common	forest	east
Physcia adscendens (Fr.) H. Olivier	fol.	rock	occasional	shore	NA
Physcia phaea (Tuck.) J. W. Thomson	fol.	rock	occasional	shore	NA
Physcia tenella (Scop.) DC.	fol.	rock	occasional	shore	east & west coast
Platismatia glauca (L.) Culb. & C. Culb.	fol.	bark	abundant	forest	boreal, arctic
*Ramalina roesleri** (Hochst. ex Schaerer) Hue	fol.	bark	common	forest	boreal, arctic coast
*Ramalina farinacea** (L.) Ach.	fol.	bark	occasional	forest	boreal, arctic coast
*Ramalina americana** Hale	fol.	bark	occasional	forest	east
Ramalina thrausta (Ach.) Nyl.	fol.	bark	occasional	forest	boreal coast

Table 1 Continued

Species	Growth Form[1]	Substrate	Abundance	Habitat	Phytogeography
*Ramalina dilacerata** (Hoffm.) Hoffm.	fol.	bark	occasional	forest	boreal
Sphaerophorus fragilis (L.) Pers.	frut.	rock	occasional	barren	arctic
Stereocaulon intermedium (Savicz) H. Magn	frut.	rock	occasional	barren	northeast
*Tuckermannopsis orbata** (Nyl.) M.J. Lai	fol.	bark	occasional	forest	east & west coast
*Tuckermannopsis americana** (Sprengel) Hale	fol.	bark	occasional	forest	boreal
*Umbilicaria muehlenbergii** (Ach.) Tuck.	fol.	rock	occasional	barren	boreal
*Umbilicaria hyperborea** (Ach.) Hoffm.	fol.	rock	common	barren	arctic
*Usnea subfloridana** Stirton	frut.	bark	common	forest	boreal
*Usnea filipendula** Stirton	frut.	bark	abundant	forest	temperate, boreal
Usnea longissima Ach.	frut.	bark	occasional	forest	east & west coast
*Xanthoria parietina** (L.) Th. Fr.	fol.	rock	common	shore	east & west
Xanthoria elegans (Link) Th. Fr.	fol.	rock	common	shore	NA

[1] frut. = fruticose; fol. = foliose; crust. = crustose

* indicates specimen was collected and deposited at the Nova Scotia Museum of Natural History.

temperate species cannot. The Arctic lichen species that tended to occupy barren and bog habitats, often on rocky outcrops, included *Cetraria islandica, Sphaerophorus fragilis* and *Umbilicaria hyperborea.* Boreal distributions were characterized by epiphytes of the genus *Ramalina* and also included epiphytes of the genera *Lopadium, Loxospora* and *Mycoblastus*.

The next most common phytogeographic affinity was represented by those species with a coastal distribution (28 species, 46%). Of these 28 species with coastal distribution, 16 are restricted to eastern North America while the other 12 species have general coastal affinities and can be found on either the west or east coast of North America.

Only 10 species (16%) have a temperate distribution. This group is made up largely of those in the genus *Cladonia*, all of which are terricolous. A few common epiphytes, such as *Evernia mesomorpha* and *Hypogymnia physodes*, are also in this group. Many of the more common temperate species found on the Nova Scotian mainland, such as *Hypogymnia krogiae,* were absent from Scatarie Island. Thirty-three percent of species have a wide Northern American distribution often covering one or more of arctic, boreal, temperate or even subtropical or mountain biomes.

Rarity

Three species, *Cetraria muricata, Cladonia subulata* and *Mycoblastus caesius*, may be new published records for Nova Scotia. *Cetraria muricata* is a terricolous or saxicolous, fruticose species found on the arctic tundra (Brodo et al. 2001). *Cladonia subulata* is a fruticose species found on dead wood on the forest floor. *Cladonia subulata* was rare in Fundy National Park, New Brunswick (Gowan & Brodo 1988). *Mycoblastus caesius* is an inconspicuous epiphytic crustose species and is often overlooked.

Five species may be new published records for Cape Breton. These include those species mentioned above as well as *Bryoria capillaris* and *Lepraria lobificans. Bryoria capillaris* is an epiphytic fruticose species found to be most abundant in old growth forests on the mainland of Nova Scotia (Cameron 2002). This species may require the high humidity found in old growth forests, but appears to find the humid forests of Scatarie Island also suitable. Although this is the first published finding of *Leparia lobificans* in Cape Breton, it has been found previously on the Island (Sneddon 1997) and is considered common on mainland Nova Scotia (Cameron 2002).

Several of the species found are considered “ancient forest” species and are relatively uncommon in Nova Scotia (Cameron 2002, Rose 1976, Selva 1994,1999). Included in this group are *Bryoria*

capillaris, Ramalina thrausta, and *Usnea longissima.* Forests of Scatarie Island are unlikely to be old growth now, but previously there may have been a long continuity of forest cover on the island

Cyanolichens

Cyanolichens (lichens in which a cyanobacterium is one of the symbiotic partners) are excellent bio-indicators as they are sensitive to acid rain, sulphur and nitrous oxide pollution (Richardson 1992). Some cyanolichens are indicators of old growth forests (Rose 1976, Selva 1994) and many are rare in Canada (Goward et al. 1998). Only four species of cyanolichens were found on Scatarie Island, two *Peltigera* and two *Lobaria*. Among the cyanolichen group the genus *Peltigera* is not an old growth forest species and is one of the least sensitive to air pollution. Only one small specimen of *Lobaria pulmonaria* and one of *L. scrobiculata* was found and these had formed only small thalli on a fallen tree.

The low number of epiphytic cyanolichen species on Scatarie Island is remarkable as there are many common epiphytic cyanolichens in Nova Scotia (Cameron & Richardson 2006, Selva 1999, Casselman & Hill 1995). Although Cameron and Richardson (2006) found that epiphytic cyanolichen species richness greatly decreased on coastal headlands, at least a few species were always found including several species in the Gabarus Wilderness Area about 27 km southwest of Scatarie Island. One possible reason for the absence of epiphytic cyanolichens on Scatarie Island may be pollution from the nearby industrial area of Cape Breton.

Isle Haute

The only other small island study of lichens undertaken in Nova Scotia was of Isle Haute (an area of less than 100 ha) in the Bay of Fundy. It is almost 1 degree of latitude south and 5 degrees of longitude west of Scatarie Island. Isle Haute, like Scatarie Island, has mild winters, cool summers, high rainfall and frequent fog. In 1997 the Nova Scotia Museum of Natural History undertook a multi-disciplinary study of Isle Haute in which Karen Casselman collected and identified lichens (Grantham et al. 2000).

The number of lichen species documented for Isle Haute (56) was approximately equal to the number for Scatarie (61) although neither study produced an exhaustive list. Only twelve species overlap both study areas. These include common coastal species of *Ramalina* and *Xanthoria* and very common ubiquitous species such as *Hypogymnia physodes, Parmelia sulcata* and *Parmelia squarrosa*. Isle Haute had a much richer saxicolous lichen flora which may be a result of the basalt bedrock there. However, in our study we made only a few collections from rocks on Scatarie Island.

Absent from Scatarie Island are epiphytes typical of the deciduous trees found on Isle Haute. While Isle Haute had several of the coastal species found on Scatarie Island, Isle Haute did not have the arctic and boreal species common on Scatarie Island.

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