Nonvascular Plants of Sitka National Historical Park
By Kitty LaBounty

Bryophyte Inventory: Summer 2004-2005

Introduction

Bryophytes are an abundant component of the cool rain forests of southeastern Alaska. Bryophytes have a diverse role in the forest ecosystem; providing habitat for a variety of invertebrates, nesting material for birds and squirrels, carbon fixation, and buffering the effects of increased or decreased precipitation.

The humid cool temperate climate and the diversity of habitats available in southeastern Alaska provides for great diversity of bryophytes. There have been 572 species of bryophytes (159 hepatics and 413 mosses) reported in southeastern Alaska (Worley 1972). Approximately 150 of these species have been found in forests. No bryophytes are on the endangered or sensitive species lists for the state of Alaska. In British Columbia, bryophyte diversity in the humid coastal forests has been related to stand age and habitat heterogeneity (Newmaster 2003). Forest stands greater in age than 250 years had significantly higher bryophyte diversity than those 80 to 90 years since establishment. Old growth forests provide greater constancy of environmental conditions and a greater diversity of microhabitats. There is a greater variety of microhabitats on both living trees and on trees in varying stages of decay. The variety of mesohabitats (cliffs, streams, etc) also has a positive impact on bryophyte diversity.

The vegetation of Sitka National Historical Park (SITK) is typical of the temperate rain forest of southeastern Alaska. The overstory is dominated by *Tsuga heterophylla* and *Picea sitchensis* with *Alnus rubra* occurring in the floodplain and stream terraces. *Malus fusca* occurs sporadically along the lower reaches of Indian River, beach fringe and uplifted beach forest. *Sorbus aucuparia* (European Mountain Ash) occurs throughout most of the park, only absent from the least disturbed portions of the forest. The park contains a mixture of early seral stages and more highly developed forest plant communities. Several disturbances in the past, both natural and human caused (flooding, wind storms, logging, grazing, gravel extraction and possibly fire) have removed most of the old growth vegetation. The oldest trees with documented ages are 160 years old. A few isolated trees on the east side of the park are estimated to be 400-500 years of age (USDA 1994).

A vegetation and ecological inventory of the park was conducted in 1993. Landforms, soils, and vegetation of eight ecological units were described. The units were Indian River, estuary, uplifted beach meadow, uplifted beach, floodplain, stream terrace, moraine (later determined to be alluvial) and lowlands. Landforms, soils, and overstory plant associations were inventoried in each ecological unit. Plant associations are defined as the potential natural vegetative community typically a designation is not assigned to

early seral stages. A plant association inventory can be used as an indicator of bryophyte diversity as it reflects the diversity of topography and soil types occurring in the park. The majority of the park vegetation can be classified as Western Hemlock/Blueberry with smaller areas of Western Hemlock/Devil's Club and Sitka Spruce/Devil's Club. Large areas currently dominated by *Alnus rubra* may develop over time to Sitka Spruce/ Devil's Club associations if disturbance from flooding is relatively infrequent.

There is not a study available on the relationship between plant associations and bryophyte communities. The scale of the 1993 study may be too large to accurately reflect the diversity of bryophyte microhabitats in the park. Within each ecological unit there are a variety of abiotic and biotic substrates that are not mapped. Rock outcrops, decaying wood, roots of windthrow trees, eroding banks, river rock, trunks of deciduous and coniferous trees, lawns, and beach logs support different and often unique suites of species. Physical structure of the river bank is a strong determinant of the species of bryophytes able to colonize a site. The northwestern banks of Indian River above the footbridge have steeper rock and boulders and are inhabited by *Marsupella alpina*, *Scapania undulata* and *Chiloscyphyus polyanthos*. Whereas the eroding soil banks of the northeast bank is inhabited by *Oligotrichum aligerum*. Disturbance can create new microsites by tree fall, flooding, or by the uplift of land by isostatic rebound. Indian River or tidal flooding associated with storms and windthrow continue to create new habitat in the park.

Methods

Survey methods were devised for maximum species capture instead of quantitative information about each species' abundance in the park. The park was divided into seven sections delineated by easily discernible boundaries, walking paths and Indian River. Each section was traversed by several transects (approximately 5 to 6 meters apart) stopping every meter to observe the bryophytes. Field surveys were conducted both by unaided eye and with a hand lens to ensure a likelihood of locating smaller species. Each section was visited a minimum of four different times to facilitate complete coverage. Care was taken to look at different microsites with a hand lens in each section. Microsites of potential interest were rocks, swales, aquatic habitat, upturned trees, decaying logs and stumps as well as stems and trunks of shrubs and trees.
An attempt was made to relocate the permanent vegetation plots established in 1993. When a plot was relocated each bryophyte in the plot was recorded and assigned an abundance class using an index system (1=less than 3%, 2= 4-10%, 3 = 11-75%, 4 = 75-99%.

Identification followed the *Bryophyte Flora of North America* (in progress) when a genus treatment was available. For genera not covered by the *Bryophyte Flora of North America*, nomenclature followed the *Moss Flora of the Pacific Northwest* by Elva Lawton or *Some Common Mosses of British Columbia* by W. B. Schofield. For liverworts not covered by the Bryophyte flora, nomenclature followed the *Field Guide to Liverwort Genera of Pacific North America* by W. B. Scholfield and individual treatments of genera by W. S. Hong published in the Bryologist (see references). *The*

Liverwort Flora of the British Isles by Jean A. Paton was also consulted. Dr. Judy Harpel, Regional Interagency Bryologist, USFS, verified identification of selected species.

Collections of each bryophyte species encountered were deposited in the herbarium at Sitka National Historical Park. Standard curatorial techniques were followed. A duplicate collection will be sent to the herbarium at the University of Alaska, Fairbanks. Latitude and longitude data for each collection used the 1927 North American Datum.

A survey of ferns and fern allies was conducted simultaneously. Selected specimens were collected and will be deposited in the SITK Herbarium. Nomenclature followed the Flora of North America. Mary Stensvold, Tongass National Forest Regional Botanist, verified selected specimens.

Results

The homogeneity of SITK's vascular plant associations parallels the relative homogeneity of the park's bryophyte communities. The bryophyte communities did reflect the distinct vegetation types and microhabitats found on either side of Indian River. Bryophytes dominate the forest floor, decaying logs and the lowest portions of the trunk of both conifers and deciduous trees. Bryophytes also are common on the tops of larger horizontal branches, fissures and crevices in the trunks and on any trees leaning enough to create a somewhat horizontal surface. Lichens were more common on the trunk and on the smaller branches as the height of the tree increased. Due to the homogenous nature of the plant associations, vegetation type (e.g. riparian, forest, beach) and ecological unit were more useful predictors of bryophyte communities. The differences in the bryophyte communities were greater between different vegetation types than between different types of Western hemlock plant associations.

Approximately 114 species of bryophytes, 86 mosses and 27 species of liverworts were collected in the park. Despite all attempts to be quite thorough in this survey, more species are likely to be found in the park. Especially useful would be to survey the upper trunks and branches of windfall trees. Several species were observed in less than five locations due to limited amount of preferred habitat in the park. These species include *Schistostega pennata, Sphagnum girgensohnii, S. cuspidatum, Pleurozium schreberi, Drepanocladus uncinatus,Marsupella alpina, Racomitrium sudeticum, Oligotrichum aligerum, O. parallelum, Bryum capillare*, and *Schistidium apocarpum* and *S. maritimum*. Nine species of ferns and one club moss were collected. The most unusual species collected was *Schistostega pennata*. *S. pennata* is a circumboreal species confined to damp, acidic rock or soil in caves or crevices (in this park created by upturned tree roots). *Schistostega* can survive in lower light levels than other bryophytes, but tends to disappear as other bryophytes colonize a site. It seems to act as a pioneer species on low light, disturbed sites. *Schistostega pennata* has a very narrow environmental specificity and is on the sensitive plant lists of Oregon, Idaho, Wisconsin, Montana, Oregon, Alberta, and New Brunswick.

Oligotrichum aligerum was collected from one site, a cut bank on the east side of Indian River. This species is common to disturbed site throughout southeastern Alaska. *Sphagnum girgensohnii* occurred in two sites in the park, *S. cuspidatum* in one site. The site with the largest population is adjacent to the upper parking lot in an inclusion of Western Hemlock/Blueberry/Skunk Cabbage association. The second collection came from a small swale in the stream terrace unit on the northeast side of the park. Both species of Sphagnum are common in the temperate rain forest.

Three species, *Bryum capillare, Oligotrichum parallelum* and *Marsupella alpina* were found in riparian areas. In the park *O. parallelum* occurs only on crevices in large boulders and cliffs adjacent to Indian River. *Bryum capillare* was only found on the rocky bar upriver from the riprap site on the west side of Indian River. *O. parallelum* occurs throughout southeastern Alaska. *Bryum capillare* has been reported from Sitka and Glacier Bay. *Marsupella alpina*, a circumboreal species, was found on the steep rocky banks of the western bank of Indian River.

Racomitrium sudeticum was collected from rocks adjacent to Lincoln Street, west of Merrill Rock. It is most often found at higher elevations, only occasionally occurring at lower elevations. This well-drained, sunny site most likely mimics the preferred alpine habitat of *R. sudeticum*.

Drepandocladus uncinatus was collected from two sites in the park, one from rocks on a tiny island near the bridge at Sawmill Creek Rd. and the other from a decaying log near Merrill Rock.

Although *Pleurozium schreberi* is a very common moss in southeastern Alaska, it was only collected from one site in the park. It is associated with well drained successionally young forests of uplifted beaches and recently deglaciated areas (Worley 1972). *P. schreberi* was collected from under *Picea sitchensis* approximately three meters above the beach.

Both species of *Schistidium* were collected from large beach rocks west of the Visitor Center and from the rocks adjacent to Lincoln Street. Both are common in our area.

Species Encountered by Ecological Unit

Most species encountered occur in several different ecological units and could be considered ubiquitous in the park. Foremost on this list is *Rhizomnium glabresens* which occurs in all units except Indian River. *Kindbergia praelonga, K. oregana, Rhytidiadelphus loreus, Hookeria lucens, Hylocomium splendens, Buckiella undulata, Plagiomnium insigne, Pellia neesiana, Scapania bolanderi* and *Plagiochila satoi* var. *magnum* were encountered in all of the forested ecological units. *Hookeria lucens* usually formed very small colonies in more deeply shaded parts of the forest. *Pellia neesiana* was often dominant on exposed soil banks, but was also common in forest soils in the park.

Indian River

There are four aquatic and two subaquatic species occurring in Indian River, *Hygrohypnum ochraceum, Fontinalis neomexicana, Souleria aquatica and Scapania undulata*. These species were especially abundant above the main footbridge. *Souleria aquatica* was collected approximately 200 meters down river from the bridge. *Scapania undulata, Hygrohypnum ocrhaceum,* and *Scapania undulata* were exposed to the air by the low water level during the summer. *Marsupella alpina* and *Chiloscyphus polyanthus* was found growing on rocks above the water in summer, but are likely to be seasonally irrigated.

Floodplain

The most frequently encountered species on rocks adjacent to Indian river included *Brachythecium asperrimum, Racomitrium aciculare*, and *Hypnum dieckii*. *Heterocladium macounii, Oligotrichum parallelum, Radula bolanderi,* and *Plagiochila satoi* occured on larger boulders and cliff faces adjacent to the river.
Epiphytes of the deciduous trees in the floodplains were abundant and diverse. *Metzgeria species, Radula bolanderi,* and *Porella cordeana*, were found on deciduous trees almost exclusively in the floodplain. *Isothecium stoloniferum*, *Plagiothecium* spp, and *Kingbergia oregana* were frequently encountered on the lower stems of *Rubus spectabilis* and *Sambucus racemosa*. *Orthotrichum pulchellum* was most frequent in the floodplain units on *Sambucus racemosa*. Seventeen species of epiphytic bryophytes were found on deciduous trees in flooplains.

Stream Terrace

Leucolepis acanthoneuron was found almost exclusively in forest on the first terrace above the river on the west side of the park. *Conocephalum conicum* was also common in these sites. *Pellia neesiana* and *Hookeria lucens* are also encountered on exposed soils on the terraces. Stream terrace units more than 5 to 6 meters from the river had bryophyte communities typical of the upland forests of uplifted beaches and moraines. *Pleuroziopsis ruthenica* was common only on the east side of Indian River north of the main trail to Sawmill Creek Rd. Elsewhere in the park this species is rarely encountered.

Moraine (Alluvial Uplands) and Successionally Older Uplifted Beaches

The most common species on the forest floor were *Rhizominium glabrescens, Rhytidiadelphus loreus, Hylocomium splendens, Kindbergia praelonga, K. oregana, Plagiomnium insigne, Plagiochila satoi var. magnum, Dicranum scoparium* and *Polytrichastrum alpinum*. Decaying logs and stumps in the upland forested ecological units had a suite of species that usually grew intermingled, occasionally forming single species colonies. The most common mix included *Tetraphis geniculata, T. pellucida, Pseudotaxophyllum elegans, Cephalozia bicupidata, Bazzania denudata, Scapania bolanderi,*and *Calypogea*.

Common epiphytes of conifers in the upland forest were *Hypnum circinale, Dicranum fuscescens, Isothecium stoloniferum, Antitrichia curtipendula, Scapania bolanderi, Rhytidiadelphus loreus Buckiella undulata, Ptilidium californicum, Douinia ovata,*and *Frullania nisquallensis*

Exposed mineral soil on upturned roots of trees was most commonly inhabited by *Pogonatum contortum, Bartramiopsis lescurri, Dicranella heteromalla*, and *Diplophyllum albicans. Schistostega pennata* was also collected sporadically from similar sites.

Uplifted Beaches with Successionally Young Forest

Rhytidiadelphus triquetrus, Rhytidiadelphus loreus, Hylocomium splendens, Plagiochila satoi var. magnum, Plagiomnium insigne, Kindbergia oregana, and *K. praelonga* were typical species growing on the ground on these sites. The most luxuriant growth of *Dicranum scoparium* occurred on a decaying log near a gun emplacement in this unit. *Rhytidiadelphus triquetrus* was limited to uplifted beach sites of young forest near the Battleground trail. *Pleurozium schreberi* was found in only one uplifted beach site. Typical epiphytes on *Alnus sitchensis, Sorbus aucuparia* and *Sambucus racemosa* included *Ulota obtusiuscula, U. megalospora*, and *U. barclayii*.

Uplifted Beach Meadow and Estuary

Beach logs and stumps were surveyed in the rip rap meadow, estuary meadow and along the actual beach. Mosses were not found on the ground in the tidal influenced meadows. Beach logs were colonized by a unique group of species not encountered on decaying logs in the low light conditions of the forest. *Aulacomium androgynnum, Dicranum tauricum, Ceratodon purpureus, Brachythecium albicans and Oncophorus wahlenbergii* were only found on these sites. *Ptilidium californicum* and *Lophocolea* spp.were also found on decaying trees in high light conditions. *Ulota phyllantha* was a common epiphyte on *Picea sitchensis* and *Alnus sitchensis* along the beach fringe. This species was also found growing on *P. sitchensis* on the rip-rap along Indian River.

Species Encountered By Micro- And Mesohabitat

Species Encountered On Forest Floor

- Conocephalum conicum
- Dicranum majus
- Hookeria lucens
- Hylocomium splendens
- Kinbergia oregana
- Kindbergia praelonga
- Pellia neesiana
- Plagiochila satoi var magnum
- Plagiomnium insigne
- Pleuroziopsis ruthenica
- Polytrichastrum alpinum
- Rhizomnium glabrescens
- Rhytidiadelphus loreus
- Sphagnum girgensohnii

Species Of Upturned Trees (Windthrow)

- Bartramia pomiformis
- Bartramiopsis lescurri
- Dicranella heteromalla
- Diplophyllum albicans
- Pogonatum contortum
- Schistostega pennata

Decaying Logs And Stumps

- Bazzania denudata
- Cephalozia bicuspidata
- Cephalozia lunulifolia
- Dicranum scoparium
- Lepidozia reptans
- Lophozoia incisa
- Polytrichum formosum
- Pseudotaxophyllum elegans
- Riccardia palmata
- Tetraphis geniculata
- Tetraphis pellucida

Epiphytes Of Coniferous Trees

- Antitrichia curtipendula
- Buckiella undulata
- Dicranum fuscescens
- Dicranum scoparium
- Douinia ovata
- Hypnum circinale
- Isothecium cardotti
- Isothecium stoloniferum
- Ptilidium californicum
- Scapania bolanderi
- Ulota phyllantha

Epiphytes Of Deciduous Trees And Shrubs

- Antitrichia curtipendula
- Frullania nisquallensis
- Hypnum callichroum
- Isothecium cardottii
- Isothecium stoloniferum
- Metzgeria conjugata
- Metzgeria temperata
- Orthotrichum pulchellum
- Plagiothecium laetum
- Plagiothecium piliferum
- Porella cordeana
- Radula bolanderi
- Ulota barclayii
- Ulota megalospora
- Ulota obtusiuscula

Indian River

- Fontinalis neomexicana
- Hygrohypnum ochraceum
- Scapania undulata
- Scouleria aquatica

River Banks

- Brachythecium asperrimum
- Bryum capillare
- Chiloscyphus polyanthos
- Dichodontium pellucidum
- Heterocladiuim macounii
- Hypnum dieckii
- Marsupella alpina
- Oligotrichum parallelum
- Racomitrium aciculare
- Rhytidiadelphus squarrosus

Swales

- Chiloscyphus pallescens
- Sphagnum cuspidatum
- Sphagnum girgensohnii

Lawns

- Kindbergia praelonga
- Pleurozium schreberi
- Rhizomnium glabrescens
- Rhytidiadelphus loreus
- Rhytidiadelphus squarrosus
- Tritomaria exsecta

Beach Logs

- Aulacomium androgynum
- Brachythecium albicans
- Ceratodon purpureus
- Dicranum tauricum
- Drepanocladus uncinatus
- Lophocolea incisa
- Oncophoruswahlenbergii
- Polytrichum formosum
- Ptilidium californicum
- Ulota phyllantha

Beach Rock

- Antitrichia curtipendula
- Racomitrium heterstichum
- Schistidium apocarpum
- Schistidium maritmium
- Ulota phyllantha

Rock Outcrops

- Bartramia pomiformis
- Heterocladium macounii
- Metzgeria temperata
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Ferns and Fern Allies:

Ten species of ferns and one club moss were found in the park; *Athyrium filix-femina, Dryopteris expansa, Gymnocarpium dryopteris, G. disjunctum, Blechnum spicant, Phegopteris connectilis, Polypodium glycerrhiza, Cystopteris fragilis, Polystichum setigerum, P. lonchitis, and Huperzia miyoshiana*. *Athyrium filix-femina, Dryopteris expansa, Polypodium glycerrhiza*, and *G. disjunctum* are the most frequently encountered ferns in the park. *Athyrium filix-femina* has the broadest habitat range, occurring in all ecological units except the river. *Dryopteris expansa* is most abundant in well drained forest, but does occur in other forest sites. *Polypodium glycerrhiza* is most often an epiphyte on trees and rocks, but also occurs in the rocky soil of the uplifted beach dominated by *Alnus sitchensis*. *Blechnum spicant, Phegopteris connectilis, Cystopteris fragilis* occur less frequently than the previous three species, but small populations are scattered through the forested areas of the park. *Cystopteris fragilis* is largely confined to rocky areas near Indian River. *Phegopteris* is more commonly encountered on the east side of the park. *Polystichum setigerum* was found in three isolated populations. The largest population (approximately 15 individuals) was growing in a *Picea sitchensis-Rubus spectabilis-Oplopanax horridum* seral community on the northeast side of the park. A smaller population was in the *Alnus sitchensis* dominated uplifted beach near the battleground trail. The third site is limited to one individual growing adjacent to the small trail along the west side of the river.

Only four individual *Polystichum lonchitis* were found. All were growing in the floodplain of Indian River. Three of the four were in the rocks or on a log on the river bank. The fourth *P. lonchitis* is located near the footing of the northernmost foot bridge in the park. This species is in the most danger of being extirpated from the park. The individual ferns could easily be removed by flooding or by construction projects. *Huperzia miyoshiana* is the only club moss identified in the park. There are several groups of 1-5 plants in the park. These are most common on the west side of Indian River growing in shallow soil over rock or directly on rock.

Potential Threats to Species Diversity

Construction of new trails, bridges and buildings could destroy existing populations of bryophytes. Especially vulnerable to this threat are the species that grow in limited types of mesohabitats, eg. *Polystichum lonchitus, P. setigerum, Huperzia miyoshiana* and *Oligotrichum parallelum*.

Reduction in the wild character of the park vegetation could also reduce the species diversity. Excessive trimming of branches, and removal of stumps and logs adjacent to the trails reduce microhabitat. Natural processes such as blowdown of large trees creates habitat for *Schistostega pennata* and for a variety of species that colonize decaying logs.

Displacement of bryophytes by shade tolerant invasive weeds, especially *Ranunculus repens*, on the forest floor. *Ranunculus repens* dominates the herbaceous understory in

the area east of the foot bridge and is invading other areas along the trails. This weed could potentially displace bryophytes because of its fast growth rate and shade tolerance.

Lack of suitable habitat due to natural processes could reduce diversity. Beach log recruitment has most likely decreased with the closure of the Pulp mill. Lack of this habitat will eliminate a unique suite of species in the park. Recruitment of new beach logs could prevent loss of these species. The bryoflora of recently uplifted beach meadow and forest will continue to change as the community changes. This could result in the elimination of species restricted to these habitats, e.g. *Rhytidiadelphus triquetrus*.

Diminished air quality could potentially limit the diversity of bryophytes in the park. Bryophytes are used as bioindicators of air pollution in Europe because of their sensitivity to air quality.

Species Lists

Ferns and Fern Allies

• Athyrium filix-femina	• Huperzia miyoshiana
• Blechnum spicant	• Phegopteris connectilis
• Cystopteris fragilis	• Polypodium glycerrhiza
• Dryopteris expansa	• Polystichuum lonchitus
• Equisetum	• Polystichum setigerum
• Gymnocarpium disjunctum	• Gymnocarpium dryopteris

Liverworts

- Bazzania denudata
- Blepharostoma trichophyllum
- Calypogeia integristipula
- Cephalozia bicuspidata
- Cephalozia lunulifolia
- Chiloscyphus pallescens
- Chiloscyphus polyanthos
- Conocephalum conicum
- Diplophyllum albicans
- Douina ovata
- Frullania nisquallensis
- Lepidozia reptans
- Lophocolea cuspidata
- Lophocolea heterophylla
- Lophozia incisa
- Lophozia ventricosa
- Marsupella alpina
- Metzgeria conjugata
- Metzgeria temperata
- Pellia neesiana
- Plagiochila asplenioides
- Plagiochila satoi
- Plagiochila satoi var magnum
- Porella cordeana
- Ptilidium californicum
- Radula bolanderi
- Riccardia palmata
- Scapania bolanderi
- Scapania cuspiduligera
- Scapania umbrosa
- Scapania undulata
- Tritomaria exsecta

Mosses

- Antitrichia curtipendula
- Aulacomnium androgynum
- Bartramia pomiformis
- Bartramiopsis lescurii
- Brachythecium albicans
- Brachythecium asperrimum
- Brachythecium velutinum var. velutinum
- Bryum capillare
- Buckiella undulata
- Ceratodon purpureus
- Dichodontium pellucidum
- Dicranella heteromalla
- Dicranum fuscescens
- Dicranum majus
- Dicranum scoparium
- Dicranum tauricum
- Drepanocladus uncinatus
- Fontinalis neomexicana
- Heterocladium macounii
- Hookeria lucens
- Hygrohypnum ochraceum
- Hylocomium splendens
- Hypnum callichroum
- Hypnum circinale
- Hypnum dieckii
- Isothecium cardotii
- Isothecium stoloniferum
- Kindbergia oregana
- Kindbergia praelonga
- Leucolepis acanthoneuron
- Oligotrichum aligerum
- Oligotrichum parallelum
- Oncophorus wahlenbergii
- Orthotrichum consimile
- Orthotrichum pulchellum
- Plagiomnium insigne
- Plagiothecium denticulatum
- Plagiothecium laetum
- Plagiothecium piliferum
- Pleuroziopsis ruthenica
- Pleurozium schreberi
- Pogonatum contortum
- Polytrichastrum alpinum
- Polytrichum formosum
- Pseudotaxophyllum elegans
- Racomitrium aciculare
- Racomitrium heterostichum
- Racomitrium heterostichum var heterostichum
- Racomitrium sudeticum
- Rhizomnium glabrescens
- Rhytidiadelphus loreus
- Rhytidiadelphus squarrosus
- Rhytidiadelphus triquetrus
- Schistidium apocarpum
- Schistidium maritimum
- Schistidium strictum
- Schistostega pennata
- Scouleria aquatica
- Sphagnum cuspidatum
- Sphagnum girgensohnii
- Tetraphis geniculata
- Tetraphis pellucida
- Ulota barclayi
- Ulota megalospora
- Ulota obtusiuscula
- Ulota phyllantha

Lichen Inventory: Summer 2005

Introduction

Lichens are an integral part of the temperate rain forest ecosystem of southeastern Alaska. Lichens can be separated into ecological functional groups. (McCune 1993) Cyanolichens (e.g. *Peltigera, Lobaria*) contribute to pool of available nutrients by both nitrogen fixation and photosynthesis. Alectoroid (e.g. *Alectoria, Usnea, Bryoria*) lichens provide forage for deer, mountain goats, and flying squirrels. Other lichens (*Platismatia, Hypogymnia* have a green algal phycobiont contribute to the pool of available nutrients by photosynthesis, but have a less well documented relationship with animals.

Lichen diversity is positively correlated with stand age and diversity of ecosystems. Frequency and severity of disturbance affects the species composition of a site. Colonization of forest canopy by lichens is somewhat slow after substantial disturbance and is dependent on proximity of remnant trees as sources of propagules (Benson 2002). Although lichen colonization can be affected by humidity and temperature, fluctuations are minimized by the maritime climate. Availability of light may be a limiting factor of lichen growth in forests of southeastern Alaska. (Geiser 1994b). Epiphyte biomass is greater in old growth stands and is also higher on larger trees within an old growth stand (McCune, 1993)

The most comprehensive lichen inventory of southeastern Alaska reported 453 lichen species from 112 genera and 15 subspecies (Geiser et al. 1994a). One hundred seven of these species are considered to be rare in the area. A species list for forest dependent lichens was not given.

The Lichen air quality monitoring project of Geiser et al. (1994b) also analyzed the relationship between lichen communities and vegetation type, elevation and canopy cover. In forested areas, the plant association of each plot was also recorded. They found that elevation and vegetation type (muskeg, forest, riparian, beach etc) were the best indicators of lichen communities. Plant associations were not a useful predictor of lichen communities when the plots were of similar canopy cover and elevation. For example the lichen species list for the Western Hemlock and Sitka Spruce series were quite similar as these associations occur at similar elevations and have similar canopy cover. The lichen species list for the Shore Pine series (a low canopy cover series) is more distinctive from that of the Western Hemlock series. Constancy values for lichen species in these series were also highly variable. This survey did not attempt to look at the relationship between microhabitat diversity and lichen species diversity.

There are 20 species of lichens listed for Sitka National Historical Park in the National Park Service database of Lichens, maintained by James Bennett. There are no lichens on the endangered or sensitive species lists for the state of Alaska.

Methods

Survey methods were devised for maximum species capture instead of quantitative information about each species' abundance in the park. The park was divided into seven sections delineated by easily discernible boundaries, walking paths and Indian River. Each section was traversed by several transects (approximately 5 to 6 meters apart) stopping every meter to observe the lichens. Field surveys were conducted both by unaided eye and with a hand lens to ensure a likelihood of locating smaller species. Each section was visited a minimum of four different times to facilitate complete coverage. Care was taken to survey different micro- and mesohabitats in each section in the park. Sites of potential interest were rock outcrops, beach logs and rocks, the rip rap barrier, upturned trees, decaying logs and stumps as well as stems and trunks of shrubs and trees. Upper canopy epiphytes were studied using fallen branches and trees. A binocular survey for trunk and branch epiphytes was also conducted. Trunk epiphytes of *Alnus sinuata* and *Picea sitchensis* were examined from trimmed shrubs. Due to the somewhat limited time available and the difficulty of accurate identification of microlichens, it was considered expedient to emphasize the macrolichens in this survey. The wooden roof of the Visitor Center was also examined.

Identification followed the *Macrolichens of the Pacific Northwest* by Bruce McCune and Linda Geiser, *Lichens of North America* by I. Brodo, S.D. Sharnoff and S. Sharnoff, and *Keys to Lichens of British Columbia* by Trevor Goward. Individual treatments for *Usnea, Phaeocalicium,* and the Calicioid Lichens are listed in the references. The following chemical tests were used to test for lichen substances: potassium hydroxide, chlorine, paraphenyldiamine, and iodine. Thin layer chromatography was not available. As species of *Cladonia* were identified without the use of chromatography, identification should be considered tentative. James Bennett, USGS, kindly identified selected species of *Lecanora, Rinodina, Xylographa,* and *Leptogium polycarpum*. Lichens names were verified for taxonomic status by checking T. L. Esslingers 1997 checklist of lichens. Collections of most lichen species encountered were deposited in the herbarium at Sitka National Historical Park. Species were not collected in the following circumstances; damage of habitat and if the lichen was limited to one or two sites. Species that were not collected were photographed and location data was recorded (GPS). Standard curatorial techniques were followed for species collected. Latitude and longitude data for each collection used the 1927 North American Datum.

Results

Eighty five species of lichen were collected and identified. This number will probably increase as more microlichens are identified. Despite all attempts to conduct a thorough survey, it is highly likely that more species of lichens will be found in the park. Sitka National Historical Park has 12 of the 17 most common macrolichens listed by Geiser et al 1994b. *Alectoria sarmentosa ssp sarmentosa, Bryoria trichodes ssp americana, Cavernularia hultenii, Cladonia squamosa, Hypogymnia entermorpha, Lobaria linita, Parmelia sulcata, Peltigera britannica, Platismatia glauca, P. herreri, P.lacunosa, P. norvegica,* and *Sphaerophorus globosus*. These common species were found in all

forested vegetation types in the park. Six additional species were found in most forested communities; *Hypogymnia physodes, Hypotrichyna sinuosa, Tuckermanniopsis chlorophylla, Usnea filipendula, Parmelia sulcata*, and *P. squarrosus*. Notable by their absence were *Lobaria oregana* and *Cladonia bellidiflora*.

The majority of the forest lichens are trunk and branch epiphytes. The forest floor is dominated by bryophytes and vascular plants. The lowermost portion of the trunks of conifers was typically dominated by bryophytes. In some areas with greater light exposure (e.g. beach ecotone or river), the lower portions of the trunk were colonized by lichens. Sterile lichens (*Cladonia* squamules and *Lepraria*) were more common in forested areas with low to moderate amounts of light. Mid and upper levels of the trunks and branches were colonized by a mixture of Alectoroid species and other lichens. Alectoroid lichens were much less abundant than other lichens. Total lichen cover of conifer trunks in the forest was relatively low. As light exposure increased, the number of lichen epiphytes on the trunk also increased. Lichens ecologically classified as other lichens were more common than other types of lichens even when light levels increased. Bryophytes were also common on fissures of the trunk or the tops of branches that seem to retain moisture.

Cyanolichens (*Peltigera* spp) were found only on the forest floor. Vertical stratification of forest epiphytes by functional group has been studied in a variety of ecosystems in the Pacific Northwest. (McCune 1993, 1997) The general pattern in trunk ascending order is bryophytes, cyanolichens, alectoroid, and other lichens. When epiphyte biomass in forest stands of different ages were compared, cyanolichens were absent from younger stands, which were dominated by the other lichen group. Cyanolichens are slower to colonize a site after disturbance (Benson 2002). Alectoroid lichens were less abundant in younger stands than in the older stands studied (McCune 1993). The absence of epiphytic cyanolichens in the park is probably related to the relatively young age (160 yrs) of the forest stand. The lower amount of alectoroid species compared with other lichen group also seems to be consistent with McCune's study. Interestingly there is a *Populus trichocarpa* at 835 Lincoln Street within a short distance of the park with abundant growth of Lobaria.

The biggest difference in lichen species composition in forested ecosystems was found between the deciduous and the coniferous forest types. Some species were common in both forest types, e.g. *Platismatia glauca*, others eg, *Graphis scripta*, were largely confined to one type. All epiphytes were more abundant on the trunks of deciduous trees. Bryophytes dominate the trunks of *Alnus rubra* to a height of approximately 2 meters in the stream terraces. Lichens, especially crustose species were abundant above the bryophyte zone.

Vegetation type and light availability seemed to be the best predictor of lichen abundance and diversity in the park. Arboreal epiphytes are particularly abundant on the *Alnus rubra* growing in the floodplain and stream terraces and on *Tsuga heterophylla* and *Picea sitchensis* growing at the forest beach ecotone. The *Alnus rubra* growing adjacent to the bicycle path and Sawmill Creek Road had fewer epiphytes than those growing elsewhere

in the park. These alders would presumably be receiving an adequate amount of light for lichen growth. The air pollution from car exhaust on the road could be limiting lichen growth on the Sawmill Creek Road. side of the park. Another explanation could be a change in microclimate because of the road.

Sites with the most unique lichen communities included the beach rock near Merrill Point, the rip-rap barrier on the west side of Indian River, and drift wood in the estuary meadow and on the beach. Merrill rock is particularly rich in crustose lichens. Lichens growing on Merrill rock were particularly difficult to identify because removal of the lichens was not possible without damaging the site.

Pilophorus acicularis, Lobaria linita, Menegazza tenebrata, Graphis scripta, and *Leptogium polycarpum* were each collected from one to four sites in the park. All but Leptogium are common in southeastern Alaska. *Menegazza, Lobaria and Graphis* could be overlooked because of inaccessible growing sites. *Lobaria linita* and *Pilophorus acicularis* both were found on the rip rap barrier on the west side of Indian River. *Graphis scripta* grows on Alnus rubra in the floodplain on the east bank of Indian River *Menegazza* was found once from a collection from *Alnus sinuata* from the beach fringe adjacent to the visitor center. Sensitivity to air pollution or slow colonization could explain this species rarity in the park.

Leptogium polycarpum was collected from a beach log west of the visitor center. This *Leptogium* has not been previously reported from southeastern Alaska. Another unusual species from this habitat, *Rinodina conradii* was collected and identified by Jim Bennett.

Vulpicida pinastri was collected once from *Alnus sinuata* growing adjacent to the visitor center. This represents a range extension for this species, but as the collection was extremely small and further specimens have not been located.
Stereocaulon intermedium was confined to the rip rap barrier on the west bank of Indian River, Merrill Rock and from the rock between Lincoln St. and the beach west of Merrill Point.

Another species of interest because of its sensitivity to air pollution is Usnea longissima. U. longissima was found sporadically through out the park. It is more common in the Northern (north of the Indian River footbridge) sections of the park, with highest frequency in the northeastern section of the park.

Species Found by Ecological Unit

Floodplain and Stream Terraces:

Epiphytes were abundant in these ecological units. Although occasionally found in other units, *Hypogymnia vittata, Thelotrema lepadinum, Ochrolechia* spp. were most abundant on trunks of *Alnus rubra* in these areas. *Cetrelia cetariodes* was collected only from *Alnus rubra* and *Malus fusca* in this habitat. *Xanthoria candelaria* is common on small twigs of Picea sitchensis both along the river and at the beach ecotone. *Usnea*

subfloridana was abundant on the trunks of *Alnus rubra*. The boulders adjacent to Indian River and in the floodplain is habitat for somewhat shade tolerant rock dwelling species, *Porpidia carlottiana*, *Pilophorus acicularis*, and *Peltigera britanica*. *Placopsis gelida* and *Lobaria linita* were also collected from these units. Three small individual *Stereocaulon tomentosum* were found on more exposed rocks adjacent to Indian River.

Uplifted Beach Ecotones and Beaches

The branches and trunks of both deciduous and coniferous trees are abundantly covered with lichens in the forest- beach ecotone. *Ramalina farinacea* and *R. roesleri* were found exclusively in this habitat. *Hypogymnia tubulosa* was more common in this vegetation type.

Parmelia saxatilis, Physcia caesia, Stereocaulon, Caloplaca, Rhizocarpon geographicum, R. hochstetteri , Porpidia carlottiana, Lecidea lapicida, Buellia, were found on bedrock above the mean high tide line. *Verrucaria maura* was the only lichen encountered below the high tide line.

Lecanora xylophila was particularly abundant on the drift logs and stumps. A rare black form of this species was also identified by J. Bennett. *Xylographa parallela, Parmelia saxatilis, Peltigera ponoj ensis*. *Cladonia* spp, and *Leptogium corniculatum* were common on drift logs above the high tide line. *Cladonia* spp are especially abundant on the stumps in the tidal meadow.

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Moraine (alluvial uplands) and successionally older uplifted beaches

These units had fewer visible and accessible lichens than other units. Epiphytes could be examined only on fallen trees and branches, so the study of this area was somewhat limited. Based on three fallen conifers in mature forest, lichen species richness increases above 12 to 15 meters on the trunk. *Alectoria sarmentosa, Usnea filipendula, Bryoria* spp. and *Sphaerophorus globosus* were most abundant at trunk mid levels and above in the more mature forests. Closer to the beach ecotone, *Bryoria* was more abundant at lower levels on the conifer trunks.

Lichens are uncommon on the forest floor probably because of the low light conditions and competition from bryophytes. *Peltigera neopolydactyla, P. membranacea, P. pacifica* were most the frequently encountered species. *Cladonia squamosa, Icmadophila ericetorum*, and *Omphalina umbellifera* were the most common species found on decaying wood in the forest.

Sterile lichens, *Leparia* and *Cladonia* were seen frequently in low to medium light conditions on coniferous tree trunks. Other common trunk epiphytes were *Mycoblastus sanguinarius* and Pertussaria spp.

Lawn

Peltigera membranacea was the only lichen growing in the lawns of the park.

Potential threats to diversity

Reduction in the wild character of the park vegetation could also reduce lichen species diversity. Excessive trimming of branches, removal of stumps and logs adjacent to the trails reduce microhabitat. Lack of suitable habitat due to natural processes could reduce diversity. Beach log recruitment has most likely decreased with the closure of the Pulp mill. Lack of this habitat will eliminate a unique suite of species in the park. Recruitment of new beach logs could prevent loss of these species. Diminished air quality could potentially limit the diversity of lichens in the park. Lichens are useful as bioindicators of because of their sensitivity to air pollution. Air quality studies using lichens in Sitka predate the closure of the APC pulp mill and the city incinerator. Current sources of air pollution are automobile exhaust and cruise ships.

Species List Lichens

- Alectoria sarmentosa
- Amandinea punctata
- Bryoria bicolor
- Bryoria pseudofuscesens
- Bryoria tenuis
- Bryoria trichodes ssp americana
- Buellia
- Caloplaca
- Cavernularia hultenii
- Cavernularia lophyrea
- Cetrelia cetrarioides
- Cladonia chlorophaea
- Cladonia ecmocyna
- Cladonia furcata
- Cladonia macilenta
- Cladonia squamosa
- Cladonia umbricola
- Hypogymnia apinnata
- Hypogymnia enteromorpha
- Hypogymnia physodes
- Hypogymnia tubulosa
- Hypogymnia vittata
- Hypotrachyna sinuosa
- Icmadophila ericetorum
- Lecanora xylophila
- Peltigera britannica
- Peltigera membranacea
- Peltigera neopolydactyla
- Peltigera pacifica
- Peltigera polydactylon
- Peltigera ponojensis
- Pertussaria sp 1
- Pertussaria sp 2
- Phaeocalicium flabelliforme
- Physcia caesia
- Placopsis gelida
- Platismatia glauca
- Platismatia herrei
- Platismatia lacunose
- Platismatia norvegica
- Porpidia carlottiana
- Porpida sp
- Pyrrhospora cinnabarina
- Ramalina farinacea
- Ramalina roesleri
- Ramalina thrausta
- Rhizocarpon geographicum
- Rhizocarpon
- Rinodina conradii
- Rinodina sp

- Lecanora xylophila (black form)
- Lecidea lapicida
- Lecidea sp
- Lepraria lobificans
- Leptogium corniculatum
- Leptogium polycarpum
- Lobaria linita
- Menegazzia terebrata
- Mycoblastus affinus
- Mycoblastus sanguinarius
- Ochrolechia juvenalis
- Ochrolecia subpallescens
- Omphalina umbellifera
- Parmelia hygrophila
- Parmelia saxatilis
- Parmelia squarrosa
- Parmelia saxatilis
- Parmelia sulcata
- Sphaerophorus globosus
- Stereocaulon tomentosum
- Stereocaulon
- Thelotrema lepadinum
- Tuckermannopsis chlorophylla
- Usnea fibrillosa
- Usnea filipendula
- Usnea glabrata
- Usnea glabrescens
- Usnea lapponica
- Usnea longissims
- Usnea scabrata
- Usnea scabriosa
- Usnea subfloridana
- Verrucaria maura
- Xanthoria candelaria
- Xylographa parallela
- Xylographa sp.

Future Work

- Survey of live trees with climbing equipment or a man-lift would greatly enhance understanding of the upper canopy lichen communities.
- Quantitative evaluation of lichen communities in order to measure changes in the flora over time.
- Quantitative survey of the bryophyte communities in order to measure changes in the flora over time.
- Evaluation of effects of air pollution on lichens in the park.
- Production of a guidebook for identification of the common bryophytes and lichens of Sitka National Historical Park.

Works Cited

Benson, Shelly, Darwyn S. Coxson. 2002. Lichen Colonization and Gap Structure in Wet-temperate Rainforests of Northern Interior British Columbia. Bryologist 105(4) 673-692.

McCune, Bruce. 1993. Gradients in Epiphyte biomas in three Pseudotsuga-Tsuga forests of different ages in Western Oregon and Washington. Bryologist 96:405-411

McCune, Bruce, KA Amsberry, FJ Camacho, S. Clery, C. Cole. 1997. Vertical Profile of Epiphytes in a Pacific Northwest Old Growth Forest. Northwest Science 71(2) 145-152.

Geiser, Linda H. , Karen L. Dillman, Chiska C. Derr and Mary C. Stensvold. Lichens of Southeastern Alaska: An Inventory. 1994. USDA-Forest Service. R10-TB-45.

Geiser, Linda H., Chiska C. Derr, and Karen L. Dillman. 1994. Air Quality Monitoring on the Tongass National Forest. Methods and Baselines Using Lichens. USDA-Forest Service. R10-TB-46

Newmaster, Steven G., Rene J. Bellard, Andre Arsenault and Dale H. Vitt. 2003. Patterns of Bryophyte Diversity in humid coastal and inland cedar-hemlock forests of British Columbia. Environ. Rev 11 (S1) S159-S185.

U.S.D.A. Forest Service. March 1994. Vegetation Inventory and Forest Health Assessment Sitka National Historical Park.

Worley, I. A. 1972. The Bryo-geography of Southeastern Alaska. Doctoral dissertation University of British Columbia, Vancouver. 715pp.

Selected References

Brodo, Irwin M., Sylvia Duran Sharnoff, and Stephen Sharnoff.2001. Lichens of North America. New Haven and London, Yale University Press.

Davison, Paul Gregory. 1993. Floristic and Phytogeographic studies of the hepatic flora of the Aleutian islands, Alaska. Doctoral dissertation, University of Tennessee, Knoxville.

T. L Esslinger's checklist.. 1997. A cumulative checklist for the lichen-forming,lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm (First Posted 1 December 1997, Most Recent Update 14 June 2005), Fargo, North Dakota

Goward, T. 1999. The Lichens of British Columbia- Illustrated Keys. Part II- Fruticose Species. British Columbia Ministry of Forests.

Goward, T., B. McCune and D. Meidinger. 1994. The Lichens of British Columbia-Illustrated Keys. Part I: Foliose and Squamulose Species. British Columbia Ministry of Forests.

Halonen,Pekka, P. Clerc, T. Goward, I Brodo and K. Wulff. Synopsis of the Genus Usnea (Lichenized Ascomycetes) in British Columbia. Bryologist: 101:36-60.

Hong, W.S. 1990. The Family Calypogeiaceae in North America West of the Hundredth Meridian. Bryrologist 93(3) 313-318.

Hong, W.S. 1990. The Family Radulaceae in North America West of the Hundredth Meridian. Lindbergia 16: 37-43. 37-43

Lawton, Elva. 1971. Moss Flora of the Pacific Northwest. Nichinan, Miyazaki, Japan. Hattori Botanical Laboratory

McCune,Bruce and Linda Geiser. 1997. Macrolichens of the Pacific Northwest. Corvallis, Oregon State University Press.

Peterson, Eric. 2002. A Preliminary Key to Calicioid Lichens and Fungi in the Pacific Northwest. Permanently stored at the Lichen Key Archive. http://www.toyen.uio.no/botanisk/lav/LichenKey/index.htm

Schofield, W. B. 1992. Some Common Mosses of British Columbia. Victoria, B.C. Royal British Columbia Museum.

Schofield, W. B. 2002. Field Guide to Liverwort Genera of Pacific North America. Seattle, WA, University of Washington Press.

Tibell, Leif. 1996. Phaeocalicium (Mycocaliciaceae, Ascomycetes) in Northern Europe. Ann. Bot. Fennici 33:205-221.