Survey of Rare Alpine Lichens
&
General Inventory for Camp Muir

Report for Mount Rainier

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Project Summary

The purpose of this research project was to generate a list of rare lichens from Camp Muir for Mount Rainier National Park, Washington State. This work was a continuation of research already established in Washington State (Glew 2001, 1998ab, 1997, 1994; Fryday & Glew 2003, Riley 1995, Riley et al. 1995). The lichens found from Camp Muir contribute additional information to the work previously published by the Principal Investigator (PI). This report includes a list and collection of lichens from Camp Muir. Collections were analyzed microscopically and for chemical substances.

Purposes

This research generates supplemental information regarding species of lichens in Washington State, particularly from alpine regions. The study has several purposes:

To provide Mount Rainier National Park with a list of lichens commonly found from the rock substrate at Camp Muir.

The list of lichens from Camp Muir generates baseline information regarding lichen populations in alpine regions of the Pacific Northwest. Mount Rainier is the highest peak in this region. Its climate is unique compared with other high elevation sights in Alaska and California.

The data can be used to predict the breakdown or increase of ozone in the atmosphere. Lichen presence/absence can confirm increased levels of ultraviolet light reaching earth due to reduced ozone in the atmosphere (Galloway 1993, Fahselt 1993). This is done by comparing established inventories of lichens from high elevations over time. Alpine areas will be the first to be affected by increased ultraviolet light penetrating the atmosphere. Yet, insufficient inventories of lichens exist for meaningful use in comparisons.

The information provided by this report will facilitate in the assessment of further development of base camp facilities by Rainier Mountaineering Incorporated at Camp Muir and the Mount Rainier National Park . The data is necessary to make decisions for the protection of lichen communities at this location.

The United States Geological Survey (USGS-BRD, Lichens, 2003), Biological Resources Division has developed lists of lichens, bryophytes (mosses and liverworts), and vascular plants for botanical inventory purposes. Lichens lists are fairly complete for national parks in the Midwest and eastern United States. But, comprehensive lists for the parks in the western states remain to be developed. The Camp Muir list will contribute to the completion of a full list of lichens for the park.

Background

Lichens are a symbiotic relationship between two or more organisms. A fungal member is always present with a photobiont, a green alga and/or a blue-green bacterium (cyanobacteria). Approximately 90% of all lichens have a green algal partner, but 10% incorporate a cyanobacteria photobiont. In alpine ecosystems, lichens can make up over 50% of the vegetation. Work initiated in 1993 (Glew 1997, 1998ab) developed an inventory of lichens in alpine regions of Washington State. Little information exists on lichens from these ecosystems (Douglas 1973; Ryan 1985; Glew 1994, 1998b) and much of it is based on literature lists rather than actual collections (Douglas 1974). The previous work done by Glew (1998b) provides information regarding alpine lichens from two other national parks, Olympic and North Cascades. Currently Glew et al. 2003, Miller (2002), and Berry (2003) collected and inventoried lichens from Burroughs Mountain and Spray Park (2002, 2003). This report adds a third location of alpine lichens inventoried on Mount Rainier.

Lichens in alpine/arctic ecosystems have been well documented in northern Europe and Russia (Ahti & Oksanen 1990, Akatov 1995, Haapasaari 1988). Several studies have included the affects of trampling in these sensitive areas (Grabherr 1982, Pentecost & Rose 1985, Lund et. al. 2000). In North America, few studies have directly documented the effects of disturbance on lichens (Pegau 1970, St. Clair 1984, Harper & Kershaw 1996). To fully understand the impact of hikers and climbers on the lichen communities of Mount Rainier, inventories must be developed at such locations as Camp Muir, to stand as a basis of comparison for human activity. Camp Muir provides a unique and accessible location to study these impacts. This report provides a list of known and recognizable lichens from the 10,000 foot elevation. This site could be preserved with minimal or no further development. The purpose of a national park is to act as a preserve for organisms and communities that might otherwise be threatened if not protected (http://www. nps.gov). Alpine lichen communities should be cared for as any other organism or group would.

Procedure:

Site description: Camp Muir is located at 3105.3m (10,188ft) to the southeast of Mount Rainier's summit. The GPS reading for the west side collecting site was 46º50'08"N, 121º43'58"W. The collection area consisted of rocks and boulders found to the west of the current ranger hut known as "Butler Shelter". Collections were also made in the rocky area to the east of the Quonset hut, referred to as "temporary shelter". Rock in the area was reported as andesite. Rocks by the ranger hut were more stable than those found to the east of camp. The lichen community in the stable area (west side) was more developed than the community found to the east. Aspect of the rocks was south, providing a much longer exposure to sun and warming in the summer months.

Lichens were collected at Camp Muir on September 4 and 5, 2001 by the PI and student assistant, Corinne L. Miller. An attempt was made to collect all lichens found on the west

side of the ranger station hut and the Rainier Mountaineering Incorporated (RMI) facility and to the east of camp. The list of lichens provided in this report is by location around the base camp. All lichens were found on rock.

Collections were taken to the University of Puget Sound and University of Washington for microscopic analysis. In some cases, chemical tests were performed to determine species.
Representative voucher specimens will be deposited in the herbariums at the University of Washington (WTU) and Mount Rainier National Park. Taxonomic determinations were made following standard methods (Brodo et al. 2001, McCune & Goward (1995). Keys used were those of Brodo et al. (2001), Dobson (1992, 2000), Goward et al. (1994), McCune & Goward (1995), McCune & Geiser (1997), Nash et al. (2002), and Purvis et al. (1992), Thomson (1984, 1997), and White & James (1985). Nomenclature follows that of Esslinger & Egan (2002).

The lichen community found at Camp Muir, provides a rare opportunity to view high alpine lichens in Washington State and in the United States. Even though alpine environments begin at 5500 feet in the Olympics and 6500 feet in the Cascades, this is a relatively low elevation compared to the Rocky Mountains, where alpine may begin at 10,000 feet. All the more reason that this site is unique, occurring approximately 3500 feet above timberline. Because of the glaciers and permanent snow fields on Mount Rainier, there are few open areas for lichens to become established. Even fewer of these sites are accessible to the lichenologist. Only when avalanches create newly exposed rock, would there be potential for lichens to grow. But Camp Muir has one of few observable high alpine locations in the state and certainly the highest. The route from Paradise to Camp Muir allows for monitoring of lichens.

Previous studies by principle investigator (PI) indicate that there is no other location on Mount Rainier that is similar. Studies of lichen communities at Burroughs Mountain and Spray Park have very different conditions and vascular plants. Each alpine/subalpine area is **unique**. Camp Muir is almost exclusively lichens with one known vascular plant, *Draba aureola* S. Watson and scanty collections of mosses. This makes the location uncommon. There may be other similar habitats, but at this elevation, most are covered with snow year-round or are not similar in microhabitats. Although Camp Muir is limited in area, it is probably the most extensive alpine site at that elevation or higher on the mountain.

The following observations were made regarding lichens found at Camp Muir.
Early successionals and rapid growers:

Caloplaca arenaria (Pers.) Müll. Arg.
Caloplaca sp.
Candelariella aurella (Hoffm.) Zahlbr.
Candelariella vitellina (Hoffm.) Müll. Arg.
Lecanora polytropa (Hoffm.) Rabenh.

Lecanora intricata (Ach.) Ach.
Rhizoplaca melanophthalma (DC.) Leuckert & Poelt

Noticeable absences:
Allantoparmelia alpicola (Th. Fr.) Essl.
Arctoparmelia incurva (Pers.) Hale
Aspicilia caesiocinerea (Nyl. ex Malbr.) Arnold
Aspicilia cinerea (L.) Körber
Rhizocarpon geographicum (L.) DC.
Rhizocarpon grande (Flörke ex Flotow) Arnold
Rhizocarpon geminitum Körber
Umbilicaria hyperborea (Ach.) Hoffm
Umbilicaria proboscidea (L.) Schrader
Umbilicaria torrefacta (Lightf.) Schrader
Usnea spacelata R. Br.

These lichens can be typically found in arid alpine areas such as Camp Muir. Their absence may indicate climate restrictions, elevation, or inadequate set of environmental conditions. The genus *Rhizocarpon* does take time to become established (It can grow as little as 10mm in a century.).

Rare lichens for Washington, not well documented for the state:
Buellia *notabilis* Lynge
Lecidella *carpathica* Körber
Tephromela armeniaca (DC.) Hertel & Rambold (I+ strain)
Umbilicaria decussata (Vill.) Zahlbr.
Umbilicaria havaasii Llano

Unique development of lichens:
Several lichen species were in an unusual abundance at Camp Muir. The lichen *Pseudephebe minuscula* was quite well developed on many of the larger rocks at Camp Muir, with colonies covering large areas (10-20cm) . I have not see this elsewhere in the Cascade Mountains. *Umbilicaria decussata*, a typical alpine/arctic lichen, was frequently found at this site. From my observations in the Olympic and North Cascade Mountains, this lichen is infrequent with a small thallus (less than 1cm). In this community it was doing well with the thallus size greater than 1cm. *Umbilicara havaasii*, another infrequent alpine/arctic species, was frequently found on the rocks to the west of the ranger hut. *Lecidella carpathica* may be a more common alpine lichens, but is not well documented for the state, with only a few records. This report provides another location for its known distribution.

These rare lichens are an indication of a unique habitat in which they can thrive. Care should be made in protecting this area and preserving an uncommon habitat in the Cascade Mountains. The assemblage of lichens found on the

rocks at Camp Muir is unique and most likely exists only at this elevation. Camp Muir is the only accessible location on Mount Rainier at this elevation. The accessibility allows for monitoring the lichens for pollution and exposure to increased UV radiation.

It is likely there more species of lichens than this report lists for Camp Muir. These species may be rare or poorly documented for state. The present list is considered to be a "working list". Due to the small size and limited collections of some crustose lichens, determinations could not be made for all collections by the time of this report. I will continue to work on these, updating the list, as they are sent to "experts" to confirm or identify.

What does the presence of these lichens indicate about habitat (and microhabitat)?
Lichens are important to ecosystems because they provide stability and nutrients to the habitat (Gold et al. 2001). They aid in soil development, and may provide shelter for other organisms, mainly insects and arachnids in alpine environments (Brodo et al. 2001). As soil develops the lichens aid in conditioning and some may contribute nitrogen to the ecosystem (St. Clair & Johansen 1993). Knowing the distribution of lichens in the alpine and arctic ecosystems can provide us with information about abiotic environmental gradients found around Camp Muir (Robinson et al. 1989a,b). Lichens, as well as bryophytes and plants, respond to environmental factors that determine their distribution. We can potentially learn a great deal about substrate contents, soil pH, and climatic conditions by studying these organisms in alpine areas (Glew 1997, 2001). As we learn more about the lichens that are found in the park and state, we are able to learn about the environment and important interactions between species and groups of organisms.

Recommendations:
1. The area between Paradise and Camp Muir does not have well developed lichen communities.
This is a highly impacted area due to the changing ice flow, snow, water drainage and hikers/climbers. It is recommended that climbers keep off the rocks and restrict the climbing route.

2. It is recommended that the area to the west of the ranger hut be left undeveloped. It seems to be a stable site where lichens have established themselves and will continue to develop a community. Any construction would disrupt the community. Lichens grow slowly and are poor dispersers. A construction site and new building would disrupt more than the immediate area. It would take many years, if not decades, for the lichens to re-establish themselves on newly exposed rock.

3. The area to the east of camp has many of the same species as the west. It appears to be less stable and more recently disturbed. Many of the lichens are common, early successionals, and "rapid" growers, as far as lichens go. Several lichens: *Xanthoria elegans, Candelariella aurella, C. vitellina, Caloplaca arenaria, Rhizoplaca melanophthalma, Lecidea atrobrunnea* are common and can be found elsewhere in park. If any new construction is done, this would be a low impact area for the lichen communities.

4. I have not been to Camp Muir during peak season, but when I was there the last two years in September, not too many people seem to be climbing the rocks on west section. Most individuals stay in huts around the cooking facility or set up camp in the snow fields. Walking seems restricted to immediate camp or snow fields.
For this reason, I would recommend that the RMI (Rainier Mountaineering Incorporated) facility could expand out to the south, over the snow field, rather than disturbing either lichen community. When at Camp Muir, on September 7, 2002 of this year, I noticed the snow distributions were quite different. While last year (2001) there was deep snow to south of RMI, this year it was snow free. An extension of RMI housing could be built in the southern direction, while snow may be absent. With today's technology, this should be no problem to expand another facility, rather than disrupt the lichen community.

5. Proposed ranger hut to the north of the present Butler Shelter could be built/expanded on to the snow field or to the east of camp avoiding any disruption to the lichen community NW above the NPS hut. In addition to the lichen communities, the infrequent occurrence of *Draba aurea* S. Watson on boulder fields should be protected and allowed to thrive.

LIST - LICHENS OF CAMP MUIR
MOUNT RAINIER NATIONAL PARK

Washington State

Katherine Glew©

Macrolichens:

West Side

Pseudephebe *minuscula (*Nyl. ex Arnold) Brodo & D. Hawksw.
Rhizoplaca melanophthalma (DC.) Leuckert & Poelt
Umbilicaria cylindrica (L.) Delise ex Duby
****Umbilicaria decussata*** (Vill.) Zahlbr.
Umbilicaria havaasii Llano
Umbilicaria krascheninnikovii (Savicz) Zahlbr.
Umbilicaria virginis Schaerer

East Side.

Physcia sp.

Pseudephebe *minuscula (*Nyl. ex Arnold) Brodo & D. Hawksw.
Rhizoplaca melanophthalma (DC.) Leuckert & Poelt
****Umbilicaria decussata*** (Vill.) Zahlbr.
Umbilicaria krascheninnikovii (Savicz) Zahlbr.
Umbilicaria virginis Schaerer
Xanthoria elegans (Link) Th. Fr.

Microlichens:

West Side

Acarospora fuscata (Schrader) Arnold
Acarospora smaragdula (Wahlenb.) A. Massal.
Acarospora veronensis A. Massal.
†***Buellia*** *notabilis* Lynge
Caloplaca *arenaria* (Pers.) Müll. Arg.
Caloplaca sp.
Candelariella *aurella* (Pers.) Müll. Arg.
Candelariella *vitellina* (Hoffm.) Müll. Arg.
Lecanora intricata (Ach.) Ach.
Lecanora *polytropa* (Hoffm.) Rabenh.
Lecidea atrobrunnea (Ramond ex Lam. & DC.) Schaerer
†***Lecidella carpathica*** Körber
Pleopsidium chlorophanum (Wahlenb.)
Pleopsidium *flavum* (Bellardi) Körber
Sporastatia testudinea (Ach.) A. Massal.
Tephromela armeniaca (DC.) Hertel & Rambold (I + strain)

East Side

Acarospora fuscata (Schrader) Arnold
Acarospora smaragdula (Wahlenb.) A. Massal.
Acarospora veronensis A. Massal.
Bellemerea subsorediza (Lynge) R. Sant.
Candelariella *aurella* (Pers.) Müll. Arg.
Candelariella *vitellina* (Hoffm.) Müll. Arg.
Lecanora *polytropa* (Hoffm.) Rabenh.
Lecidea atrobrunnea (Ramond ex Lam. & DC.) Schaerer
Pleopsidium *flavum* (Bellardi) Kroger
Psora *globifera* (Ach.) Mass.
Sporastatia testudinea (Ach.) A. Massal.
Tephromela armeniaca (DC.) Hertel & Rambold (I+ strain)

*rare in Washington
†not well documented in Washington, may be rare

I = Iodine spot test on medulla

LICHENS from CAMP MUIR, MOUNT RAINIER
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