

INVESTIGATOR'S ANNUAL REPORT

National Park Service

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Reporting Year: 2002	Park: North Cascades National Park Service Complex
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Permit#: NOCA-2002-SCI-0023	
Park-assigned Study Id. #: NOCA-00045	
Project Title: Exploration for Populations of Rare and Disjunct Hyperoceanic and Oceanic-montane Bryophytes in Periglacial Environments	
Permit Start Date: Jul 01, 2002	Permit Expiration Date Dec 30, 2002
Study Start Date: Jul 01, 2002	Study End Date Dec 30, 2002
Study Status: Continuing	
Activity Type: Research	
Subject/Discipline: Mosses / Bryophytes	
Objectives: This study initiates research on the periglacial bryophyte (liverwort and moss) flora within North Cascades National Park Service Complex. The goals of this research are: 1) to discover and document populations of locally or globally rare species and species not previously known from the park; 2) to improve understanding of habitat requirements and geographic distributions of bryophytes with periglacial distributions; and 3) to understand the historical and ecological processes that shape the geographic distributions of hyperoceanic and oceanic-montane bryophytes in periglacial environments. The major objectives are: 1) to conduct basic inventory and survey of the liverworts and mosses occurring in periglacial habitats within the Park; 2) to document populations of bryophyte species with primarily hyperoceanic and oceanic-montane distributions that occur in periglacial environments within the park at (or near) the limits of their geographic range, and to characterize microhabitats and mesohabitats of those populations; and 3) to begin assembling research materials needed for an empirical test of competing biogeographic hypotheses explaining the occurrence of periglacial populations that are disjunct from the main hyperoceanic body of the species range.	

The "relictual hypothesis" explains disjunct populations in periglacial habitats as the fragmentary vestiges of a much older, geographically more extensive, flora that was prevalent over a wide area during the Pleistocene but now persists in what little remains of the necessary periglacial climatic zone. The competing "dispersal hypothesis" explains those isolated populations as the products of relatively recent long-range dispersal events from the centers of the geographic range into narrow climatically suitable habitats.

The question is a longstanding one with substantial discussion in the literature. Much of the literature tacitly or explicitly endorses the relictual hypothesis, though evidence from studies of dispersal and geographic range analysis strongly suggests that the dispersal hypothesis is equally tenable. An objective test of these competing hypotheses has not been feasible until fairly recently. The increasing availability of automated DNA sequencing instrumentation has expanded the feasibility of using gene sequence data to obtain estimates of the relative recency of population-level evolution within species. The synthesis of population genetic theory and phylogenetic theory in the emergent field of phylogeography has provided the theoretical foundation for use of molecular evidence in rigorous tests of biogeographic hypotheses.

The outcome of tests in the study begun here bears most significantly on the unresolved question of coastal refugia during Pleistocene glacial maxima. A relictual explanation for the fragmented ranges observed in many hyperoceanic and oceanic-montane taxa predicts deep interpopulation genetic divergences among disjunct populations, but relatively shallow divergences under the dispersal hypothesis. Even when populations are morphologically indistinguishable or very close, if they represent vestiges of an ancient split, as suggested by the relictual hypothesis, we expect to find divergence in DNA sequences that are chosen to test the hypothesis. The periglacial bryophyte flora in NOCA provides an excellent natural laboratory for addressing this biogeographic question with modern tools and methods of molecular phylogeography.

This research is also relevant to monitoring the biotic effects of global climate change. Bryophytes in periglacial environments are confined to a narrow intersection of habitat and climatic zone, and those distributions are predicted to be sensitive to global climate change. This study contributes to understanding the occurrence and distribution of this climatically sensitive component of the biota, and thus helps to establish baseline information that may be needed for future climate change research.

Findings and Status:

Field work was initiated in NOCA in August 2002. The bryophyte flora in periglacial habitat was sampled during a 4-day excursion to Nooksack Cirque, centered on approx. 41°50'N, 121°33'W, between Mt. Shuksan and Icy Peak. Nooksack Cirque includes diverse periglacial habitat associated with the East Nooksack Glacier and perennial snow fields below Icy Peak. Samples consisting of 25-100 sq cm patches of substrate with associated bryophytes were collected from various mesohabitat and microhabitat facies in a series of sites from near the floor of the cirque and within a ravine enroute to field fields below Icy Peak. Approximately fifty substrate samples were selected by closely inspecting the substrate and assessing the value of the sample for diversity and abundance of bryophytes. Samples were stored with precise locality and habitat data in plastic boxes and insulated from direct sun and temperature fluctuations for transport to the laboratory.

In the lab samples were stored in the dark at 1-2° C for later microscopic examinations and microphotography. Laboratory procedures were performed Jan-Feb 2003. Whole substrate samples were examined and dissected under 10x-200x dissecting binocular. Plants were cleaned and sorted in distilled water prior to identification. Microdissections on samples of each species revealed relevant features, which were photographed under 10x-200x dissecting magnifications and 100x-1000x compound microscope. Identifications were made using primary literature and standard technical references for the bryophyte flora of North America. Voucher specimens were prepared as dried substrate with attached plants (standard bryophyte protocol) and as specimens fixed and preserved in 70% EtOH, where possible with reproductive structures, and stored in specimen vials for future reference. As of this report approximately 50% of the samples have been thoroughly studied for liverworts. The remaining samples will be processed for liverworts and all samples then studied for mosses. Completion is anticipated by early April 2003.

The following liverwort species have been found to date:

Anastrophyllum minutum (Schreb.)Schust.

Anthelia julacea (L.)Dumort.

Cephalozia bicuspidata (L.)Dumort.

Cephaloziella arctica Bryhn & Douin

Diplophyllum taxifolium (Wahl.)Dumort.

Gymnomitrium concinatum (Lightf.)Corda

Harpanthus flotovianus (Nees)Nees

Jungermannia pumila With.

Lophozia alpestris (Schleich.)Evans

Lophozia bicrenata (Schmid.)Dumort.

Lophozia collaris (Nees)Schust.

Marsupella brevissima (Dumort.)Grolle

Marsupella emarginata (Ehrh.)Dumort.

Marsupella sphacelata (Gies.)Dumort.

Marsupella sprucei (Limpr.)Bernet

Nardia geoscyphus (DeNot.)Lindb.

Nardia scalaris (Schrad.)S.F.Gray

Scapania paludosa (K.Müll.)K.Müll

Scapania undulata (L.)Dumort.

Mosses commonly with the liverworts listed above include:

Kiaeria falcate (Hedw.)Hag.

Oligotrichum hercynicum (Hedw.)Lam.&DC.

Pogonatum dentatum (Menz.)Brid.

The most significant find to date is a liverwort specimen that clearly represents a species in *Lophozia* subgenus *Protolophozia*. *Protolophozia* comprises several species, most of which are only known from the southern hemisphere. The three species known from the northern hemisphere are extremely rare. The specimen most closely matches *Lophozia elongata* (Lindb.)Steph., which has been previously collected in the Pacific Northwest only once, by Godfrey, on the Brooks Peninsula, Vancouver Island. It is rare throughout its range, known only from a few collections ranging from

northern Europe, Greenland, and western North America. The find is significant since the Brooks Peninsula is thought to have been a glacial refugium during the Pleistocene. Other species with disjunct ranges including the Brooks Peninsula are predicted to occur in the North Cascades. Continued research in the periglacial environment within NOCA promises to reveal additional species and populations of rare and disjunct bryophytes.

For this study, were one or more specimens collected and removed from the park but not destroyed during analyses?

Yes

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0

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Fill out the following ONLY IF the National Park Service supported this project in this reporting year by providing money to a university or college

Full name of college or university:

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