

# Living Lab Program for Climate Change and Conservation - Final Report



## Investigations into Determinants of Vegetation Change at Nisga'a Memorial Lava Beds Park

### Research findings

Public perceptions that tree cover has been increasing on the Nass Valley lava plain likely reflect the absence of wildfires in recent memory. Evidence indicates widespread recurrence of such disturbances over the last 90 years, not all of which have been documented by provincial agencies (Figure 1). Fires consume vegetation that had developed to date, leaving bare lava rock that is then slowly colonized by snow lichen and then by hoary rock moss, especially on a'a (rough) lava surfaces. Microclimate monitoring and repeated moisture content monitoring of lichen and moss blanket samples confirmed that these fuels dry out more rapidly than indicated by standard Fire Weather Index reports (Figure 2), making them very susceptible to human ignitions.

Vegetation surveys indicate that trees (particularly paper birch, lodgepole pine, and black cottonwood) tend to establish in pahoehoe (smooth) lava cracks and in low lying areas that are flooded through subsurface water recharge periodically. Overland flow of flood water has also deposited silt in locations currently dominated by well developed woodland. Tree ring analysis indicates that a recent cohort of tree established in 1990 and 1991 (Figure 3), following periods of above-average winter precipitation. Plant community composition across the 25 km<sup>2</sup> lava plain shows distinctive relationships to substrate (a'a or pahoehoe), but also to time since the last fire or flood, and distance from undisturbed mature forest (Figure 4) and roadsides.

A complete floristic survey has updated species lists compiled in the 1970s (Appendix 1). Including habitats throughout the Nisga'a Memorial Lava Beds Provincial Park (not just on the lava plain), a total of 689 taxa were recorded, consisting of 277 vascular plants, 116 mosses, 40 liverworts, and 256 lichens, in contrast to surveys conducted in 1973 and 1976 that collectively itemized 327 taxa (248 vascular species, 34 mosses, 8 liverworts, and 36 lichens). Fifteen species given conservation priority by the BC Conservation Data Centre were identified, consisting of 11 lichens, three mosses, and one vascular plant species (Appendix 2). In addition, two rare and noteworthy lichen discoveries were recorded: *Stereocaulon nanodes* and *Stereocaulon pileatum*, with *S. nanodes* being a new record for North America. A total of 44 exotic species were identified in 2019 (Appendix 2), of which ten species have the potential for invasive behavior; fortunately, their distribution is largely restricted to roadsides and other areas of human activity.

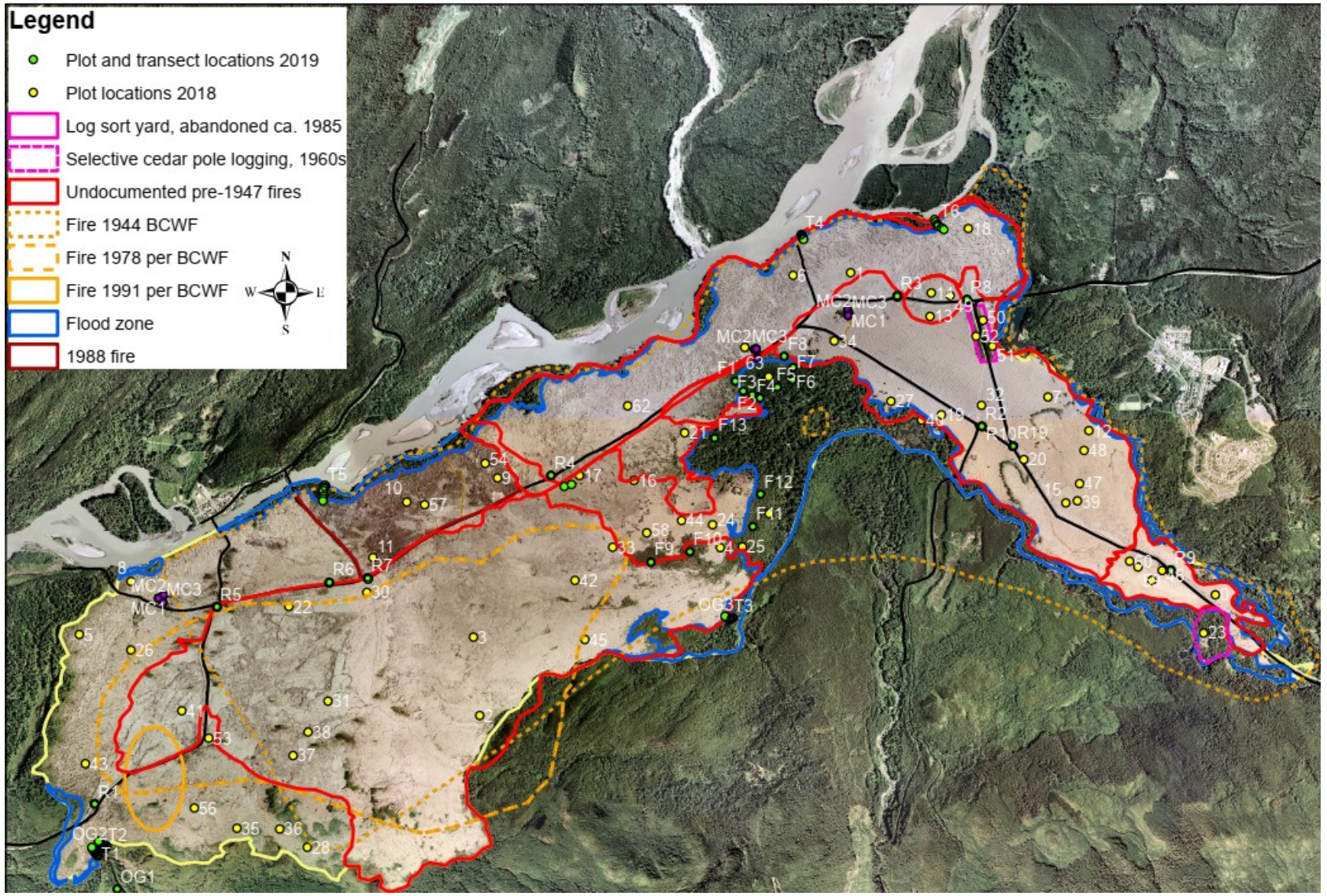


Figure 1 [under revision]. The Nass Valley lava plain, showing the locations of historical wildfires and floods, and 2018 and 2019 vegetation sampling.

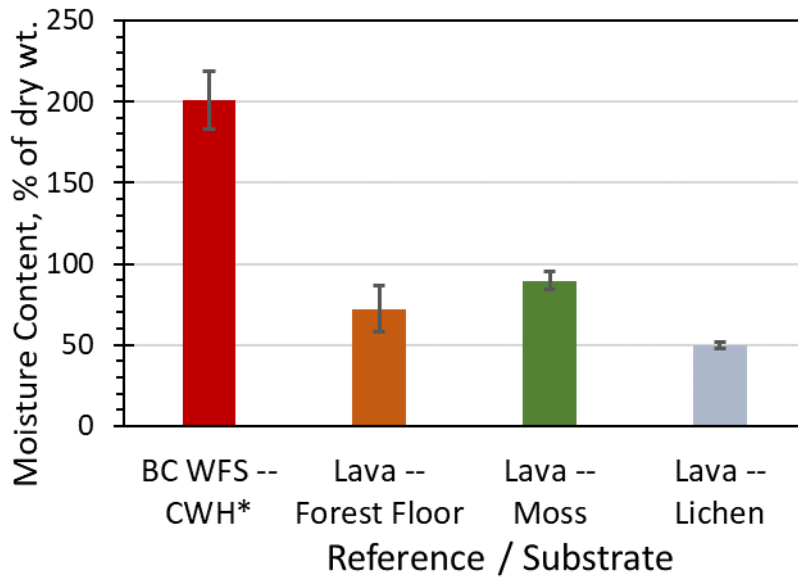


Figure 2. Mean ( $\pm$  S.E.) moisture content of surface fuels on the lava beds, sampled in 78.5 cm<sup>2</sup> pucks 11 times from Aug. 9 to Sept. 26, 2019. \*The reference value for Coastal Western Hemlock (CWH) forests is based on duff moisture codes (DMCs) for the same dates at the nearby Nass Camp weather station, as per the statistical relationship reported by Lawson et al. (1997).

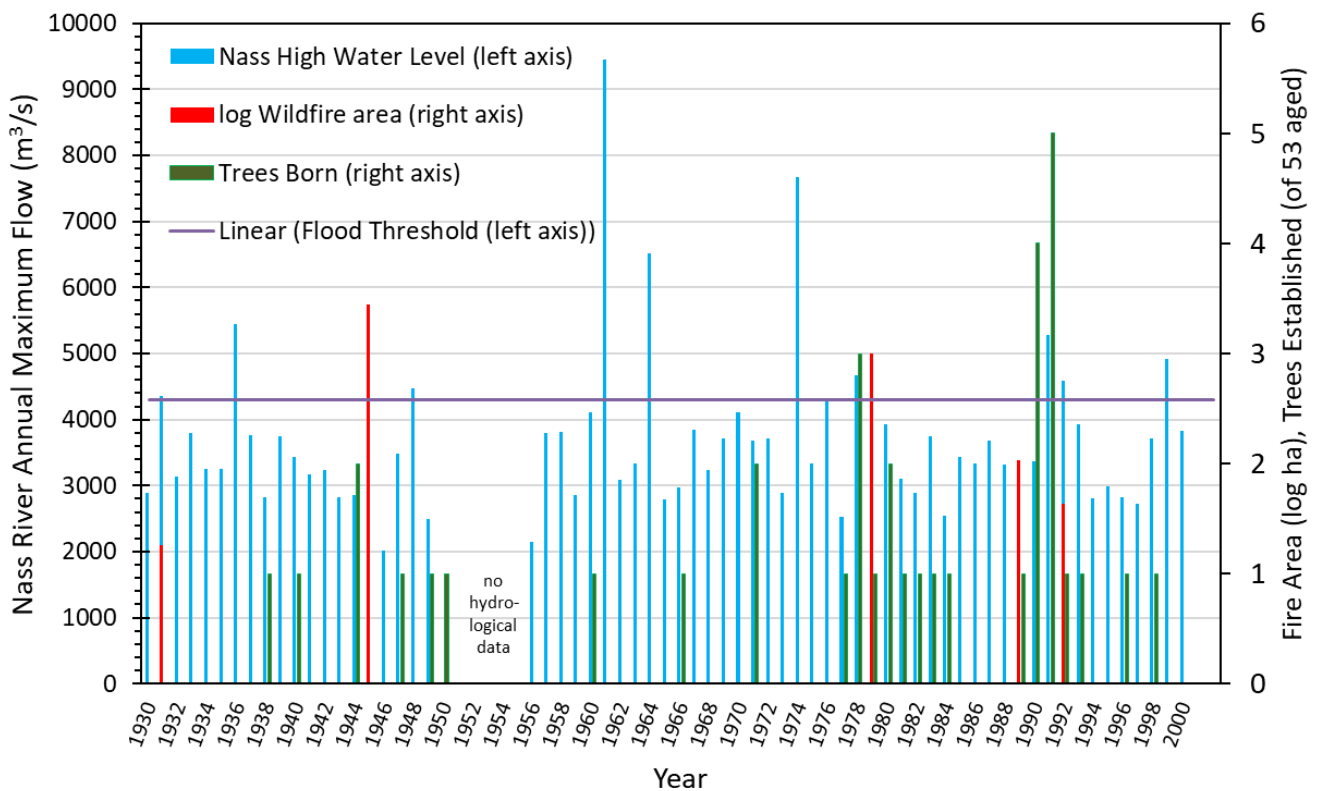


Figure 3. Disturbance and tree recruitment events on the Nass Valley lava plain. Fires were documented by the BC Wildfire Service, inferred from air photos, and dated on the basis of historical documents and local knowledge. Floods were inferred from water levels recorded at the Nass River gauging station, referenced to the 2003 water levels where Vetter Creek was photographically documented as overflowing the east-west portion of Highway 113 at the Vetter Sink. Tree recruitment events are inferred on the basis of tree ring counts derived from increment cores taken from 53 trees in the woodland area around the Vetter Sink.

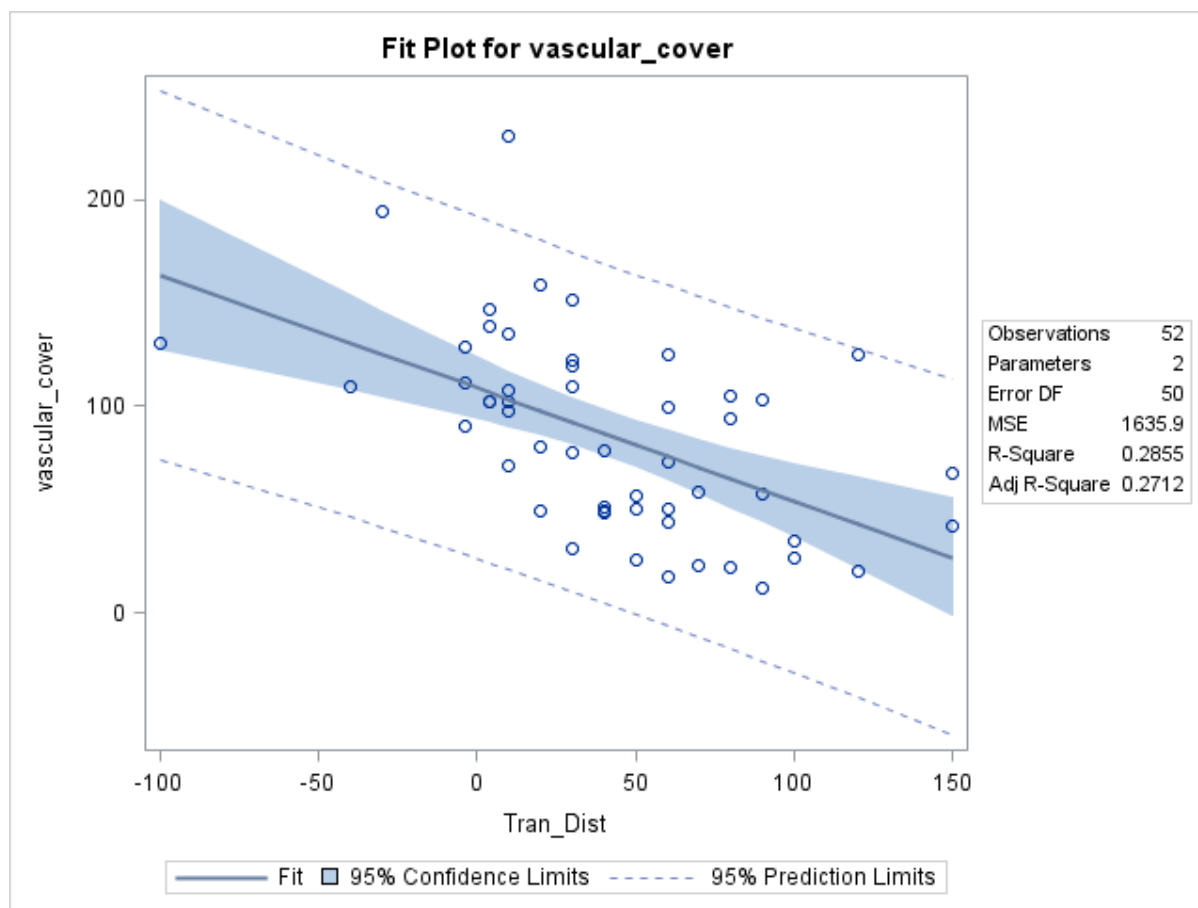


Figure 4 [under revision]. Relationship of total vascular plant cover to distance from the edge of mature forest. Negative values denote distances into undisturbed forest away from the lava beds.

## Methods summary

Information on natural disturbances, infrastructure development and other human activities on the lava beds was compiled from multiple sources, including literature searches, government databases, and local informants. Combined with a recent geological map (Le Moigne et al. 2020), structural differences in the vegetation visible on 1947, 1982 and 2010 aerial photographs, the mappable boundaries of those disturbances were used to define 13 relatively homogenous strata for ground-based inspection and sampling in 2018. The objective of that sampling, consisting of 3 to 7 randomly placed plots per stratum for a total of 66 plots, was to obtain an unbiased, representative description of the vegetation and its variation across the lava plain. Extensive efforts were made to document all plant and lichen species encountered – including many cryptic bryophyte and lichen species – with 406 samples collected and identified by Curtis Björk and Trevor Goward of Enlivened Consulting Ltd. (Clearwater, BC).

Vegetation sampling in 2019 addressed a different set of objectives, although selected plots were also added to the 2018 dataset for representative stratum descriptions. In particular, emphasis was placed on the following components:

- obtaining more vegetation samples in the woodland stratum around the Vetter Sink, with 6 mm increment cores extracted from tree bases in order to estimate the year of establishment for apparent cohorts of trees;
- sampling linear transects from undisturbed or old-growth forest (preferably off the lava beds), to test for the influence of forest edge effects on vegetation development;
- sampling linear transects from edges of the paved Highway 113, which crosses the lava plain, to test for the influence of anthropogenic edge effects reflected in current vegetation;
- expanding the 2018 sampling protocols to include tree density and size measurements, and to check for and measure the depth of silt in order to infer the influence of overland flooding and road dust deposition;
- regular monitoring of moisture content (determined from samples weighed before and after 12 hrs of drying at 180°C) of surface fuels (forest floor, hoary rock moss, snow lichen) from three locations, in conjunction with microclimate monitoring of air temperature and relative humidity, for comparison with data collected at the Nass Camp weather station maintained by the BC Wildfire Service.

For the floristics survey, a lichen and plant species inventory was conducted during six field days (13-18 August, 2019) by Curtis Björk. The species list recorded was augmented by prior collections made by Phil Burton, Trevor Goward, Wilf Schofield, George Otto and others. In the six days of field work, a controlled intuitive wander method was used in order to maximize species capture. By this method, search effort is allocated to all habitats and microhabitats present in the study area. Effort was concentrated in areas where new species could be added to the project checklist. The overall goal of the inventory was to detect all species of lichens and plants (including mosses, liverworts, and vascular plants) present. By the sixth day of work, new additions to the checklist had become difficult to find. Habitats searched include treeless a'a and pahoehoe flows, humid conifer forest on a'a flows, old cottonwood forest, river and lake shores, sloughs, waterfall spray zones, and roadsides and other human-disturbed habitats. Species were identified using a wide variety of floras and original literature. Nomenclature follows the taxonomy used in each case rather than any central database. Results were compared with species lists and habitat descriptions prepared in 1973 by V. Krajina and K. Klinka in support of ecological reserve nominations, and vegetation surveys conducted in 1976 by K. Krumm in preparation for Provincial Park designation (Krumm 1976), as compiled by Inselberg (1977). Taxonomic synonymies and updated nomenclature are provided, with reference to the BC Conservation Data Centre database for identification of taxa recognized as being threatened or endangered.

Analysis to date has been primarily descriptive, with results summarized in terms of means and 95% confidence limits by various categories, and by linear regression analysis to test for significant forest and road edge effects. Data also lend themselves to multivariate ordination and classification, but first require additional cleaning (correction of species names, standardization of habitat descriptors) and reformatting.

## Key Outcomes for BC Parks

Vegetation development on the lava plain does not follow the “textbook” description of primary succession on volcanic substrates. Rather, the plant community composition and distribution seen today reflects a complex history of substrate differences and forest edge effects (through the contribution of plant litter and seeds), altered by a history of repeated wildfires and (in some locations) subsurface flooding and overland flow associated with silt deposition. Although the incidence of fires, floods, and tree recruitment did not show any strong relationships to basic meteorological data, conditions suitable for fires and floods are expected to increase at a regional level under a changing climate. The human impact of greatest concern is the presence of several dozen exotic plant species (Appendix 2), primarily associated with roads and other activity centres.

The conservation and interpretive value of the Nisga’a Memorial Lava Beds Provincial Park has been substantiated by the complex story of ecosystem dynamics revealed by this research, and by documentation of a rich flora of bryophytes and lichens. The product of the second-most recent volcanic eruption in Canada (and certainly the only example of a recent volcanic activity easily accessible by the public) makes this landscape one of national conservation and educational importance.

## Relevance to BC Parks management

This more complex story of ecosystem development and ecological succession could be featured in interpretive signs and pamphlets. The first outreach in this regard has been posted on the BC Parks Blog website (Burton 2019).

Efforts to remove exotic plant species beyond the footprint of road rights of way, parking areas, and campgrounds would be desirable. Susceptibility to wildfire is expected to continue, and offers two management options: 1) continued admonitions to avoid unintentional ignitions, and 2) the potential for using prescribed burns to maintain representative open areas at an early stage of succession. On the other hand, there is no need implement option 2 for the foreseeable future, vegetation types dominated by snow lichen and hoary rock moss remain the most abundant today and are likely to remain so for decades or centuries to come.

## Project’s challenges/opportunities

Two primary challenges emerged during the conduct of the research reported here. First of all, the history of disturbance events is not well documented. While fires and floods are well recognized by residents of the Nass Valley, the timing of most events (other than the 1961 floods that prompted abandonment of Old Aiyansh village) are not well fixed in people’s memories. Wildfire records maintained by the Province of BC are likewise incomplete, and the mapped extent of fires is demonstrably inaccurate. The mapped extent of the 1944 fire, for example, extends to large areas of old-growth forest off the lava plain that clearly haven’t burned for centuries; the mapped extent of the 1978 fire does not match the easily mappable scar visible in 1982 air photos; and the 1991 fire is merely represented by an ellipse.

Secondly, it was disappointing that tree recruitment showed no strong clustering as cohorts in time. We had hypothesized dependence on unusually favourable weather events as favoring tree seed germination and successful seedling establishment, but it appears that tree recruitment is much more random. Further sampling and more sophisticated statistical analysis may yet reveal relationships between tree establishment, flooding, and weather records.

This research has revealed opportunities to employ the unique landscape of the Nisga'a Memorial Lava Beds Provincial Park to increase scientific knowledge on several fronts. For example, as the dominant *Stereocaulon paschale* is a cyanolichen, it would be good to know what annual rates of atmospheric nitrogen fixation it contributes to the ecosystem. Likewise, evidence of free-living cyanobacteria living in forest floor mosses begs the question of whether blankets of *Racomitrium lanuginosum* likewise support significant levels of nitrogen fixation. Our preliminary determination of the extreme drying behavior of surface fuels on the lava beds is evidence of a unique fire weather climate, which could contribute to further refinement of the nationwide Fire Weather Index and Fire Behavior Prediction systems now being undertaken by the Canadian Forest Service.

## References and links

- Burton, P. 2019. Researchers Investigate How Vegetation is Changing at Nisga'a Memorial Lava Bed Park. BC Parks Blog, posted 14 November 2019. Available on-line at <https://engage.gov.bc.ca/bcparksblog/2019/11/14/fires-and-floods-at-nisgaa-memorial-lava-bed-park/> [viewed 22 March 2020]
- Inselberg, A.E. 1977. Summary Analysis of Available Vegetation data: Aiyansh Volcanic Park Proposal Area. Report No. 55, Interpretation Assessment Section, B.C. Parks Branch, B.C. Ministry of Environment. Victoria, B.C. 43 p.
- Kromm, K. 1976. Vegetation Analysis of the Proposed Tseax Park (Aiyansh Volcanic Park). File report, Interpretation Assessment Section, B.C. Parks Branch, B.C. Ministry of Environment. Victoria, B.C. 195 p.
- Lawson, B.D., Dalrymple, G.N., & Hawkes, B.C. 1997. Predicting Forest Floor Moisture Contents from Duff Moisture Code Values. Technology Transfer Note No. 6. Pacific Forestry Centre, Canadian Forest Service, Natural Resources Canada. Victoria, B.C. 6 p.
- Le Moigne, Y., Williams-Jones, G., Russell, J.K., & Quane, S. 2020. Volcanological map of Tseax volcano, British Columbia, Canada. *Journal of Maps*, in press.

## Contact info

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## Checklist

- Have you submitted a blog for BC Parks' website?
  - Yes; see <https://engage.gov.bc.ca/bcparksblog/2019/11/14/fires-and-floods-at-nisgaa-memorial-lava-bed-park/>.
- Have you added any relevant Living Lab project data or reports to the BC Data warehouse and/or EcoCat? Please contact Jen Grant or Stephen Ban for assistance.
  - Year 1 (2018) vegetation data from 66 sample plots were forwarded to Jen Grant on March 26, 2019;
  - Year 2 (2019) vegetation, forest mensuration, tree core, fuel moisture, and microclimate data, as well as annotated floristic checklists, are still undergoing quality control and revised formatting, will be forwarded directly
- As the fiscal year comes to a close, we will need an invoice from you for the final instalment of your Living Lab transfer agreement.
  - The UNBC Finance Department (Kathleen Denis, Research Accounting) indicates that entire amount (\$22,460) has already been received as of March 20, 2020.



# Appendix 1. An Annotated Checklist of Plants and Lichens Found in Nisga'a Memorial Lava Beds Provincial Park

## LICHENS

Microlichen	<i>Acarospora fuscata</i> (Nyl.) Th.Fr.	Saxicolous, on basalt
Macrolichen	<i>Alectoria sarmentosa</i> (Ach.) Ach.	Epiphytic, on twigs
Microlichen	<i>Amygdalaria panaeola</i> (Ach.) Hertel & Brodo	Saxicolous, on basalt
Macrolichen	<i>Arctomia delicatula</i> Th.Fr.	Epiphytic, on twigs
Macrolichen	<i>Arctomia fascicularis</i> (L.) Otálora & Wedin	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Arctoparmelia centrifuga</i> (L.) Hale	Saxicolous, on basalt
Macrolichen	<i>Arctoparmelia incurva</i> (Pers.) Hale	Saxicolous, on basalt
Macrolichen	<i>Arctoparmelia subcentrifuga</i> (Oxner) Hale	Saxicolous, on basalt
Microlichen	<i>Arthonia apatetica</i> (A.Massal.) Th.Fr.	Epiphytic, on stems, acidic bark
Microlichen	<i>Arthrorhaphis alpina</i> (Schaer.) R.Sant.	Terricolous, on thin soil over basalt
Microlichen	<i>Arthrorhaphis citrinella</i> (Ach.) Poelt	Terricolous, on thin soil over basalt
Microlichen	<i>Aspicilia mutabilis</i> (Ach.) Körb.	Epiphytic, on nutrient-rich bark
Microlichen	<i>Bacidina arnoldiana</i> (Körb.) V. Wirth & Vězda	Epiphytic, on twigs
Microlichen	<i>Baeomyces rufus</i> (Huds.) Reben.	Terricolous and saxicolous, various surfaces
Microlichen	<i>Biatora aureolepra</i> T.Sprib. & Tønsberg	Epiphytic, on conifer trunks in old-growth
Microlichen	<i>Biatora chrysantha</i> (Zahlbr.) Printzen	Terricolous and epiphytic, mostly over moss
Microlichen	<i>Biatora hypophaea</i> Printzen & Tønsberg	Epiphytic, on twigs
Microlichen	<i>Biatora rufidula</i> (Graewe) S.Ekman & Printzen	Epiphytic, on twigs
Macrolichen	<i>Bryoria americana</i> (Motyka) Holien	Epiphytic, on twigs
Macrolichen	<i>Bryoria fuscescens</i> (Gyeln.) Brodo & D.Hawksw.	Epiphytic, on twigs, less often saxicolous
Macrolichen	<i>Bryoria glabra</i> (Motyka) Brodo & D.Hawksw.	Epiphytic, on twigs
Macrolichen	<i>Bryoria pikei</i> Brodo & D.Hawksw.	Epiphytic, on twigs
Microlichen	<i>Buellia erubescens</i> Arnold	Epiphytic, on acidic bark
Microlichen	<i>Caloplaca atosanguinea</i> (G.Merr.) I.M.Lamb	Epiphytic, on bark
Microlichen	<i>Caloplaca chrysojeta</i> (Vain.) Dombr.	Saxicolous, on underhangs of basalt
Microlichen	<i>Candelariella vitellina</i> (Ehrh.) Müll.Arg.	Saxicolous and epiphytic, on various surfaces
Macrolichen	<i>Cetraria ericetorum</i> ssp. <i>reticulata</i> (Räsänen) Kärnefelt	Terricolous, over moss on basalt
Microlichen	<i>Chaenotheca cinerea</i> (Pers.) Tibell	Epiphytic, on cottonwood trunks
Microlichen	<i>Chaenothecopsis populicola</i> Björk & Goward ined.	Epiphytic, on cottonwood trunks
Microlichen	<i>Chrysothrix candelaris</i> (L.) J.R.Laundon	Epiphytic, mostly on Thuja
Macrolichen	<i>Cladonia acuminata</i> (Ach.) Norrl.	Terricolous, over moss on basalt

Macrolichen	<i>Cladonia albonigra</i> Brodo & Ahti	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia amaurocraea</i> (Flörke) Schaer.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia arbuscula</i> (Wallr.) Flot.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia bellidiflora</i> (Ach.) Schaer.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia borealis</i> S.Stenroos	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia cenotea</i> (Ach.) Schaer.	Mostly terricolous, sometimes on stumps
Macrolichen	<i>Cladonia cervicornis</i> (Ach.) Flotow	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia chlorophaea</i> (Flörke ex Sommerf.) Spreng.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia ciliata</i> Stirt.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia coccifera</i> (L.) Willd.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia coniocraea</i> (Flörke) Spreng.	Mostly epiphytic on trunks
Macrolichen	<i>Cladonia cornuta</i> (L.) Hoffm. ssp. <i>cornuta</i>	Terricolous and epiphytic, on mossy surfaces
Macrolichen	<i>Cladonia crispata</i> (Ach.) Flotow var. <i>crispata</i>	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia cyanipes</i> (Sommerf.) Nyl.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia deformis</i> (L.) Hoffm.	Terricolous and epiphytic, on mossy surfaces
Macrolichen	<i>Cladonia ecmocyna</i> ssp. <i>intermedia</i> (Robbins) Ahti	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia fimbriata</i> (L.) Fr.	Mostly epiphytic, various mossy surfaces
Macrolichen	<i>Cladonia gracilis</i> ssp. <i>elongata</i> (Wulfen) Vain.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia gracilis</i> ssp. <i>turbinata</i> (Ach.) Ahti	Mostly terricolous, sometimes on stumps
Macrolichen	<i>Cladonia gracilis</i> ssp. <i>vulnerata</i> Ahti	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia macilenta</i> Hoffm.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia macrophyllodes</i> Nyl.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia merochlorophaea</i> Asahina	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia metacorallifera</i> Asahina	Terricolous, over moss on basalt
Macrolichen	<b><i>Cladonia mitis</i> Sandst.</b>	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia multiformis</i> G.Merr.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia norvegica</i> Tønsberg & Holien	Epiphytic, on conifer trunks in old-growth
Macrolichen	<i>Cladonia novochlorophaea</i> (Simpan) Brodo & Ahti	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia ochrochlora</i> Flörke	Epiphytic, on trunks
Macrolichen	<i>Cladonia phyllophora</i> Ehrh. ex Hoffm.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia pleurota</i> (Flörke) Schaer.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia pyxidata</i> (L.) Hoffm.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia rangiferina</i> (L.) Weber ex F.H. Wigg.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia rei</i> Schaer.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia scabriuscula</i> (Delise) Leight.	Terricolous and epiphytic, various surfaces
Macrolichen	<i>Cladonia squamosa</i> (Scop.) Hoffm.	Terricolous and epiphytic, various surfaces
Macrolichen	<i>Cladonia stellaris</i> (Opiz) Pouzar & Vězda	Terricolous, over moss on basalt

Macrolichen	<i>Cladonia stricta</i> (Nyl.) Nyl.	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia stygia</i> (Fr.) Ruoss	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia sulphurina</i> (Michx.) Fr.	Terricolous and epiphytic, various surfaces
Macrolichen	<i>Cladonia symphycarpa</i> (Flörke) Fr.	Terricolous, on thin soil over basalt
Macrolichen	<i>Cladonia uncialis</i> (L.) Weber ex F.H.Wigg. ssp. <i>uncialis</i>	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia verruculosa</i> (Vain.) Ahti	Terricolous, over moss on basalt
Macrolichen	<i>Cladonia verticillata</i> (Hoffm.) Schaer.	Terricolous, over moss on basalt
Macrolichen	<i>Collema auriforme</i> (With.) Coppins & J.R.Laundon	<b>Epiphytic, on spruce in cottonwood dripzone</b>
Macrolichen	<i>Collema furfuraceum</i> Du Rietz	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Collema glebulentum</i> (Nyl. ex Cromb.) Degel.	Saxicolous, on basalt along river shores
Macrolichen	<i>Collema subflaccidum</i> Degel.	Epiphytic, on nutrient-rich bark
Microlichen	<i>Cyphelium inquinans</i> (Sm.) Trevis.	Epiphytic, on wood and bark
Macrolichen	<i>Dendriscoaulon</i> sp.	Epiphytic, n twigs in humid forest
Macrolichen	<i>Dermatocarpon leptophyllodes</i> (Nyl.) Zahlbr.	Saxicolous, on basalt along river shores
Macrolichen	<i>Dermatocarpon reticulatum</i> H.Magn.	Saxicolous, on basalt along river shores
Microlichen	<i>Diploschistes scruposus</i> (Schreb.) Norman	Saxicolous, on basalt
Macrolichen	<i>Evernia prunastri</i> (L.) Ach.	Epiphytic, on bark in open sites
Macrolichen	<i>Flavocetraria cucullata</i> (Bellardi) Kärnefelt & A. Thell	Terricolous, on mosses on basalt in open sites
Macrolichen	<i>Flavocetraria nivalis</i> (L.) Kärnefelt & A. Thell	Terricolous, on mosses on basalt in open sites
Macrolichen	<i>Fuscopannaria ahlneri</i> (P.M. Jørg.) P.M. Jørg.	Epiphytic, on twigs in humid sites
Macrolichen	<i>Fuscopannaria laceratula</i> (Hue) P.M. Jørg.	Epiphytic, on twigs in humid sites
Macrolichen	<i>Fuscopannaria leucostictoides</i> (Ohlsson) P.M.Jørg.	Epiphytic, on twigs in humid sites
Macrolichen	<i>Fuscopannaria mediterranea</i> (Tav.) P.M. Jørg.	<b>Epiphytic, on bark, seldom on basalt</b>
Microlichen	<i>Haematomma ochroleucum</i> (Neck.) J.R.Laundon	Epiphytic and saxicolous, on various surfaces
Macrolichen	<i>Hypogymnia apinnata</i> Goward & McCune	Epiphytic, on twigs
Macrolichen	<i>Hypogymnia canadensis</i> Goward & McCune	Epiphytic, on trunks
Macrolichen	<i>Hypogymnia enteromorpha</i> (Ach.) Nyl.	Epiphytic, on twigs and trunks
Macrolichen	<i>Hypogymnia hultenii</i> (Degel.) Krog	Epiphytic, on twigs
Macrolichen	<i>Hypogymnia inactiva</i> (Krog) Ohlsson	Epiphytic, on twigs
Macrolichen	<i>Hypogymnia lophyrea</i> (Ach.) Krog	Epiphytic, on twigs
Macrolichen	<i>Hypogymnia occidentalis</i> L.H.Pike	Epiphytic, on twigs
Macrolichen	<i>Hypogymnia physodes</i> (L.) Nyl.	Mostly epiphytic, on twigs and trunks
Macrolichen	<i>Hypogymnia rugosa</i> (G.Merr.) L.H.Pike	Epiphytic, on trunks
Macrolichen	<i>Hypogymnia vittata</i> (Ach.) Parrique	Mostly epiphytic, on twigs and trunks
Microlichen	<i>Imshaugia aleurites</i> (Ach.) S.L.F.Mey.	Epiphytic, on bark and wood
Microlichen	<i>Japewia subaurifera</i> Muhr & Tønsberg	Epiphytic, on acidic bark
Microlichen	<i>Japewia tornoensis</i> (Nyl.) Tønsberg	Epiphytic, on acidic bark

Macrolichen	<i>Kaernefeltia californica</i> (Tuck.) A.Thell & Goward	Epiphytic, on twigs
Macrolichen	<i>Kaernefeltia merrillii</i> (Du Rietz) A.Thell & Goward	Epiphytic, on twigs
Microlichen	<i>Lecania dubitans</i> (Nyl.) A.L.Sm.	Epiphytic, on <i>Populus tremuloides</i> trunks
Microlichen	<i>Lecanora achariana</i> A.L.Sm.	Saxicolous, on basalt
Microlichen	<i>Lecanora argopholis</i> (Ach.) Ach.	Saxicolous, on basalt
Microlichen	<i>Lecanora boligera</i> (Th.Fr.) Hedl.	Epiphytic, on acidic bark
Microlichen	<i>Lecanora cadubriae</i> (A.Massal.) Hedl.	Epiphytic, on acidic bark
Microlichen	<i>Lecanora farinaria</i> Borrer	Epiphytic, on bark where sheltered from rain
Microlichen	<i>Lecanora muralis</i> (Schreb.) Rabenh. aggr.	Saxicolous, on basalt
Microlichen	<i>Lecanora pulicaris</i> (Pers.) Ach.	Epiphytic, on acidic bark
Microlichen	<i>Lecanora schizochromatica</i> (Pérez-Ortega, T. Spribille & Printzen) Rodr. Flakus & Printzen	Epiphytic, on acidic bark
Microlichen	<i>Lecidea erythrophaea</i> Flörke ex Sommerf.	Epiphytic, on <i>Populus</i> bark
Microlichen	<i>Lecidea fuscoatra</i> (L.) Ach.	Saxicolous, on basalt
Microlichen	<i>Lecidea atrobrunnea</i> (Ram. ex Lam. & DC.) Schaerer	Saxicolous, on basalt
Microlichen	<i>Lecidea lapicida</i> (Ach.) Ach.	Saxicolous, on basalt
Macrolichen	<i>Lempholemma intricatum</i> (Arnold) Zahlbr.	Saxicolous, on basalt
Microlichen	<i>Lepraria alpina</i> (B. de Lesd.) Tretiach & Baruffo	Terricolous, thin soil over basalt
Microlichen	<i>Lepraria borealis</i> Loht. & Tønsberg	Terricolous, thin soil over basalt
Microlichen	<i>Lepraria diffusa</i> (J.R.Laundon) Kukwa	Epiphytic, and on moss over basalt
Microlichen	<i>Lepraria eburnea</i> J.R.Laundon	Epiphytic, on trunks
Microlichen	<i>Lepraria incana</i> (L.) Ach.	Epiphytic, on trunks
Microlichen	<i>Lepraria membranacea</i> (Dicks.) Vainio	Saxicolous, on underhangs
Microlichen	<i>Lepraria neglecta</i> (Nyl.) Erichsen	Terricolous, thin soil over basalt
Microlichen	<i>Lepraria rigidula</i> (B. de Lesd.) Tønsberg	On mosses over trunks and rock
Macrolichen	<i>Leptogium cellulosum</i> P.M. Jørg. & Tønsberg	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Leptogium compactum</i> D.F.Stone, F.L.Anderson & J.W.Hinds	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Leptogium intermedium</i> (Arnold) Arnold	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Leptogium saturninum</i> (Dicks.) Nyl.	Epiphytic, on nutrient-rich bark
Microlichen	<i>Leptorhaphis epidermidis</i> (Ach.) Th.Fr.	Epiphytic, on birch trunks
Macrolichen	<i>Lichinodium canadense</i> Henssen	Epiphytic, on twigs in humid sites
Macrolichen	<i>Lobaria anomala</i> (Brodo & Ahti) T.Sprib. & McCune	Epiphytic, on twigs in humid sites
Macrolichen	<i>Lobaria hallii</i> (Tuck.) Zahlbr.	Epiphytic, on twigs in humid sites
Macrolichen	<i>Lobaria linita</i> var. <i>tenuior</i> (Hue) Asahina	Epiphytic, on trunks
Macrolichen	<i>Lobaria oregana</i> (Tuck.) Müll. Arg.	Epiphytic, on twigs in humid sites
Macrolichen	<i>Lobaria pulmonaria</i> (L.) Hoffm.	Epiphytic, less often on rock
Macrolichen	<i>Lobaria scrobiculata</i> (Scop.) P.Gaertn.	Epiphytic, on twigs in humid sites

Macrolichen	<i>Lobaria silvae-veteris</i> (Goward & Goffinet) Goward & Goffinet	Epiphytic, on twigs in humid sites
Macrolichen	<i>Melanohalea multispora</i> (A. Schneid.) O. Blanco, et al.	Epiphytic, on bark
Microlichen	<i>Micarea cinerea</i> (Schaer.) Hedl.	Epiphytic, on twigs in humid sites
Microlichen	<i>Micarea prasina</i> Fr. aggr.	Epiphytic, mostly near the ground
Microlichen	<i>Microcalicium ahlneri</i> Tibell	Epiphytic, on wood
Macrolichen	<i>Montanelia panniformis</i> (Nyl.) Divakar, A. Crespo, Wedin & Essl.	Saxicolous, on basalt
Microlichen	<i>Mycoblastus affinis</i> (Schaer.) T.Schauer	Epiphytic, on bark
Microlichen	<i>Mycoblastus sanguinarius</i> (L.) Norman	Epiphytic, on bark
Microlichen	<i>Mycocalicium subtile</i> (Pers.) Szatala	Epiphytic, on wood
Macrolichen	<i>Nephroma arcticum</i> (L.) Torss.	Terricolous over moss, seldom epiphytic
Macrolichen	<i>Nephroma bellum</i> (Spreng.) Tuck.	Epiphytic, on bark
Macrolichen	<i>Nephroma helveticum</i> Ach.	Epiphytic, on twigs
Macrolichen	<i>Nephroma isidiosum</i> (Nyl.) Gyeln.	Epiphytic, on twigs
Macrolichen	<i>Nephroma laevigatum</i> Ach.	Epiphytic, mostly on twigs
Macrolichen	<i>Nephroma occultum</i> Wetmore	Epiphytic, on twigs
Macrolichen	<i>Nephroma parile</i> (Ach.) Ach.	On various surfaces
Macrolichen	<i>Nephroma resupinatum</i> (L.) Ach. (lobulate form)	Epiphytic, on bark
Macrolichen	<i>Nephroma sipeanum</i> Gyeln.	Saxicolous, on basalt
Microlichen	<i>Ochrolechia androgyna</i> (Hoffm.) Arnold	Epiphytic, on bark
Microlichen	<i>Ochrolechia frigida</i> f. <i>lapuensis</i> (Vain.) Coppins	Terricolous on moss over basalt
Microlichen	<i>Ochrolechia juvenalis</i> Brodo	Epiphytic, mostly on twigs
Microlichen	<i>Ochrolechia oregonensis</i> H.Magn.	Epiphytic, mostly on trunks
Microlichen	<i>Ochrolechia szatalaensis</i> Verseghy	Epiphytic, mostly on twigs
Microlichen	<i>Opegrapha herbarum</i> Mont.	Epiphytic, on bark
Microlichen	<i>Opegrapha varia</i> Pers.	Epiphytic, on bark and wood
Microlichen	<i>Ophioparma ventosa</i> (L.) Norman	Saxicolous, on basalt
Macrolichen	<i>Pannaria rubiginella</i> P.M. Jørg.	Epiphytic, on twigs
Macrolichen	<i>Parmelia graduans</i> Goward ined.	Epiphytic, on bark
Macrolichen	<i>Parmelia hygrophila</i> Goward & Ahti	Epiphytic, on bark
Macrolichen	<i>Parmelia saxatilis</i> (L.) Ach.	Mostly saxicolous, sometimes epiphytic
Macrolichen	<i>Parmelia sulcata</i> Taylor	Mostly epiphytic
Macrolichen	<i>Parmelia sulymae</i> Goward, Divakar, M.C.Molina & A.Crespo	Epiphytic, on bark
Macrolichen	<i>Parmeliella triptophylla</i> (Ach.) Müll. Arg.	Mostly epiphytic
Macrolichen	<i>Parmeliopsis ambigua</i> (Wulfen) Nyl.	Epiphytic, on acidic bark
Macrolichen	<i>Parmeliopsis hyperopta</i> (Ach.) Vain.	Epiphytic, on acidic bark
Macrolichen	<i>Peltigera aphthosa</i> (L.) Willd.	Mostly terricolous, on moss
Macrolichen	<i>Peltigera britannica</i> (Gyeln.) Holt.-Hartw. & Tønsberg	Terricolous and epiphytic

Macrolichen	<i>Peltigera canina</i> (L.) Willd.	Terricolous, over moss on basalt
Macrolichen	<i>Peltigera cinnamomea</i> Goward	Terricolous, over moss on basalt
Macrolichen	<i>Peltigera collina</i> (Ach.) Schrad.	Mostly epiphytic, on nutrient-rich bark
Macrolichen	<i>Peltigera conspersa</i> Goward ined.	Mostly terricolous, on moss
Macrolichen	<i>Peltigera extenuata</i> (Nyl.) Vain.	Terricolous, over thin moss on basalt
Macrolichen	<i>Peltigera lepidophora</i> (Vain.) Bitter	Terricolous, over thin moss on basalt
Macrolichen	<i>Peltigera leucophlebia</i> (Nyl.) Gyeln.	Mostly terricolous, on moss
Macrolichen	<i>Peltigera maritima</i> Goward ined.	Terricolous, on moss in forest
Macrolichen	<i>Peltigera membranacea</i> (Ach.) Nyl.	Mostly terricolous, on moss
Macrolichen	<i>Peltigera neckeri</i> Hepp ex Müll. Arg.	Terricolous and epiphytic
Macrolichen	<i>Peltigera pacifica</i> Vitik.	Terricolous, on moss in forest
Macrolichen	<i>Peltigera polydactylon</i> (Neck.) Hoffm.	Mostly terricolous, on moss
Macrolichen	<i>Peltigera rufescens</i> (Weiss) Humb.	Mostly terricolous, on moss
Macrolichen	<i>Peltigera venosa</i> (L.) Hoffm.	Terricolous, on mineral soil
Microlichen	<i>Pertusaria alpina</i> Hepp ex Ahles	Epiphytic, on bark
Microlichen	<i>Pertusaria ophthalmiza</i> (Nyl.) Nyl.	Epiphytic, on bark
Microlichen	<i>Pertusaria subambigans</i> Dibben	Epiphytic, on bark
Microlichen	<i>Pertusaria suboculata</i> Brodo & Dibben	Epiphytic, on bark
Microlichen	<i>Phaeocalicium populneum</i> (Brond. ex Duby) A.F.W.Schmidt	Epiphytic, on Populus trichocarpa twigs
Macrolichen	<i>Physcia alnophila</i> (Vain.) Loht., Moberg, Myllys & Tehler	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Physconia americana</i> Essl.	Epiphytic, on nutrient-rich bark
Microlichen	<i>Placopsis cribellans</i> (Nyl.) Räsänen	Saxicolous, on basalt in open sites
Microlichen	<i>Placopsis gelida</i> (L.) Linds. s. lat.	Saxicolous, on basalt in open sites
Microlichen	<i>Placopsis lambii</i> Hertel & V. Wirth s. lat.	Saxicolous, on basalt in open sites
Microlichen	<i>Placynthiella uliginosa</i> (Schrad.) Coppins & P. James	Terricolous and epiphytic, various surfaces
Macrolichen	<i>Platismatia glauca</i> (L.) W.L.Culb. & C.F.Culb.	Mostly epiphytic, on acidic bark
Macrolichen	<i>Platismatia herrei</i> (Imshaug) W.L. Culb. & C.F. Culb.	Epiphytic, on acidic bark
Macrolichen	<i>Platismatia lacunosa</i> (Ach.) W.L.Culb. & C.F.Culb.	Epiphytic, on acidic bark
Macrolichen	<i>Platismatia norvegica</i> (Lyngé) W.L.Culb. & C.F.Culb.	Epiphytic, on acidic bark
Macrolichen	<i>Protopannaria pezizoides</i> (Weber ex F.H.Wigg.) P.M.Jørg. & S.Ekman	Mostly epiphytic, on nutrient rich bark
Macrolichen	<i>Pseudocyphellaria citrina</i> (Gyeln.) Lücking, Moncada & S. Stenroos	Epiphytic, on twigs in humid sites
Macrolichen	<i>Ramalina dilacerata</i> (Hoffm.) Hoffm.	Epiphytic, on bark
Macrolichen	<i>Ramalina thrausta</i> (Ach.) Nyl.	Epiphytic, mostly on twigs
Microlichen	<i>Ramboldia cinnabarina</i> (Sommerf.) Kalb, Lumbsch & Elix	Epiphytic, on acidic bark
Microlichen	<i>Rhizocarpon atroflavescens</i> Lyngé	Saxicolous, on basalt
Microlichen	<i>Rhizocarpon disporum</i> (Nägeli ex Hepp) Müll. Arg.	Saxicolous, on basalt
Microlichen	<i>Rhizocarpon eupetraeum</i> (Nyl.) Arnold	Saxicolous, on basalt

Microlichen	<i>Rhizocarpon geminatum</i> Körb.	Saxicolous, on basalt
Microlichen	<i>Rhizocarpon grande</i> (Flörke ex Flot.) Arnold	Saxicolous, on basalt
Microlichen	<i>Sclerophora peronella</i> (Ach.) Tibell	Epiphytic, on <i>Populus trichocarpa</i> trunks
Macrolichen	<i>Sphaerophorus tuckermanii</i> Räsänen	Mostly epiphytic, on bark in humid sites
Macrolichen	<i>Sphaerophorus venerabilis</i> Wedin, Högnabba & Goward	Epiphytic, on bark in humid sites
Macrolichen	<i>Spilonema americanum</i> (Henssen & Tønsberg) T.Sprib., Muggia & Tønsberg	Epiphytic, on twigs in humid forest
Macrolichen	<i>Stereocaulon botryosum</i> Ach.	Saxicolous, on basalt
Macrolichen	<i>Stereocaulon grande</i> (H.Magn.) H.Magn.	Saxicolous, on basalt
Macrolichen	<i>Stereocaulon intermedium</i> (Savicz) H.Magn.	Saxicolous, on basalt
Macrolichen	<i>Stereocaulon klondikense</i> T.Sprib	Saxicolous, on basalt
Macrolichen	<i>Stereocaulon myriocarpum</i> Th.Fr.	Saxicolous, on basalt
Macrolichen	<i>Stereocaulon nanodes</i> Tuck.	Saxicolous, on basalt
Macrolichen	<i>Stereocaulon paschale</i> (L.) Hoffm.	Terricolous, over basalt
Macrolichen	<i>Stereocaulon pileatum</i> Ach.	Saxicolous, on basalt
Macrolichen	<i>Stereocaulon sasakii</i> Zahlbr.	Terricolous, over basalt
Macrolichen	<i>Stereocaulon symphycheilum</i> I.M.Lamb	Saxicolous, on basalt
Macrolichen	<i>Stereocaulon tomentosum</i> Fr.	Terricolous, over basalt
Macrolichen	<i>Stereocaulon vesuvianum</i> Pers.	Saxicolous, on basalt
Macrolichen	<i>Sticta fuliginosa</i> (Dicks.) Ach.	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Sticta limbata</i> (Sm.) Ach.	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Sticta sylvatica</i> (Huds.) Ach. cfr.	Epiphytic, on nutrient-rich bark
Macrolichen	<i>Thamnia vermicularis</i> (Sw.) Schaer.	Terricolous, on mosses over basalt
Microlichen	<i>Trapeliopsis granulosa</i> (Hoffm.) Lumbsch	Terricolous, less often on wood and bark
Macrolichen	<i>Tuckermannopsis americana</i> (Spreng.) Hale	Epiphytic, on twigs
Macrolichen	<i>Tuckermannopsis chlorophylla</i> (Willd.) Hale	Epiphytic, on bark
Macrolichen	<i>Umbilicaria angulata</i> Tuck.	Saxicolous, on basalt
Macrolichen	<i>Umbilicaria deusta</i> (L.) Baumg	Saxicolous, on basalt
Macrolichen	<i>Umbilicaria hyperborea</i> (Ach.) Hoffm.	Saxicolous, on basalt
Macrolichen	<i>Umbilicaria muhlenbergii</i> (Ach.) Tuck.	Saxicolous, on basalt
Macrolichen	<i>Umbilicaria polyphylla</i> (L.) Baumg.	Saxicolous, on basalt
Macrolichen	<i>Umbilicaria polyrrhiza</i> (L.) Fr.	Saxicolous, on basalt
Macrolichen	<i>Umbilicaria torrefacta</i> (Lightf.) Schrad.	Saxicolous, on basalt
Macrolichen	<i>Usnea barbata</i> f. <i>scabrata</i> comb. ined.	Epiphytic, on bark
Macrolichen	<i>Usnea dasopoga</i> f. <i>filipendula</i> (Stirt.) comb. ined.	Epiphytic, on bark
Macrolichen	<i>Usnea perplexans</i> Stirt.	Epiphytic, on bark
Macrolichen	<i>Usnea substerilis</i> Motyka	Epiphytic, on bark

Microlichen	<i>Verrucaria aethiobola</i> Wahlenb.	Saxicolous, on basalt along river shores
Macrolichen	<i>Vulpicida canadensis</i> (Räsänen) J.-E. Mattsson & M.J. Lai	Epiphytic, on acidic bark
Macrolichen	<i>Vulpicida pinastri</i> (Scop.) J.-E. Mattsson	Epiphytic, on acidic bark
Macrolichen	<i>Xanthoria sorediata</i> (Vain.) Poelt	Saxicolous, on basalt

## LIVERWORTS

Anastrophyllaceae	<i>Anastrophyllum minutum</i> (Schreb.) R.M.Schust.	On basalt, mostly on vertical surfaces
Anastrophyllaceae	<i>Anastrophyllum saxicola</i> (Schrad.) R.M.Schust.	On basalt
Aneuraceae	<i>Aneura pinguis</i> (L.) Dumort.	Terricolous, on moist soil
Lophoziaceae	<i>Barbilophozia barbata</i> (Schmidel ex Schreb.) Loeske	On basalt in cool sites
Lophoziaceae	<i>Barbilophozia floerkei</i> (F.Weber & D.Mohr) Loeske	On basalt in cool sites
Lophoziaceae	<i>Barbilophozia hatcheri</i> (A.Evans) Loeske	On basalt in cool sites
Lophoziaceae	<i>Barbilophozia kunzeana</i> (Huebener) Müll. Frib.	On basalt in cool sites
Blepharostomataceae	<i>Blepharostoma trichophyllum</i> (L.) Dumort.	Mostly on basalt in cool, humid sites
Cephaloziaceae	<i>Cephalozia macounii</i> (Austin) Austin	Moist, cool sites
Cephaloziaceae	<i>Cephalozia pleniceps</i> (Austin) Lindb.	Moist, cool sites
Cephaloziellaceae	<i>Cephaloziella divaricata</i> (Sm.) Schiffn.	On thin soil over basalt
Lophocoleaceae	<i>Chiloscyphus pallescens</i> (Ehrh. ex Hoffm.) Dumort.	On moist soil where shaded
Lophocoleaceae	<i>Chiloscyphus polyanthos</i> (L.) Corda	On moist soil where shaded
Conocephalaceae	<i>Conocephalum conicum</i> (L.) Dumort.	On soil in wet, cool sites
Scapaniaceae	<i>Diplophyllum albicans</i> (L.) Dumort.	Mostly on basalt underhangs
Jungermanniaceae	<i>Jungermannia borealis</i> Damsh. & Váňa	Over basalt in wet, cool sites
Jungermanniaceae	<i>Jungermannia pumila</i> With.	Over basalt in wet, cool sites
Lophoziaceae	<i>Leiocolea badensis</i> (Gottsche ex Rabenh.) Jørg.	Over basalt in wet, cool sites
Lophoziaceae	<i>Lophozia bantriensis</i> (Hook.) Steph.	Over basalt in wet, cool sites
Lophoziaceae	<i>Lophozia bicrenata</i> (Schmidel) Dumort.	Over basalt in wet, cool sites
Lophoziaceae	<i>Lophozia longidens</i> (Lindb.) Macoun	Over logs in forest
Marchantiaceae	<i>Marchantia polymorpha</i> L.	On soil where moist and cool
Metzgeriaceae	<i>Metzgeria conjugata</i> Lindb.	On basalt, sheltered sites where humid
Blepharostomataceae	<i>Odontoschisma macounii</i> (Austin) Underw.	On soil in moist, cool sites
Pelliaceae	<i>Pellia neesiana</i> (Gottsche) Limpr.	Wet soil
Plagiochilaceae	<i>Plagiochila asplenioides</i> (L.) Dumort	Moist forest understory
Plagiochilaceae	<i>Plagiochila porelloides</i> (Torr. ex Nees) Lindenb.	Moist, cool sites
Plagiochilaceae	<i>Plagiochila satoi</i> S.Hatt.	On vertical basalt faces where humid
Porellaceae	<i>Porella cordaeana</i> (Huebener) Moore	On bark and over basalt



Porellaceae	<i>Porella navicularis</i> (Lehm. & Lindenb.) Pfeiff.	On bark in humid sites
Marchantiaceae	<i>Preissia quadrata</i> (Scop.) Nees	On soil in moist sites
Ptilidiaceae	<i>Ptilidium californicum</i> (Weber) Hampe	On bark of shrubs in forest understory
Ptilidiaceae	<i>Ptilidium ciliare</i> (L.) Hampe	On moss mats over basalt
Ptilidiaceae	<i>Ptilidium pulcherrimum</i> (Weber) Hampe	On bark near the ground
Radulaceae	<i>Radula complanata</i> (L.) Dumort.	On bark and basalt where humid
Scapaniaceae	<i>Scapania bolanderi</i> Austin	On bark of trunks
Jungermanniaceae	<i>Syzygiella autumnalis</i> (DC.) K.Feldberg et al.	On logs in forest
Anastrophyllaceae	<i>Tetralophozia setiformis</i> (Ehrh.) Schljakov	On basalt in open sites
Lophoziaceae	<i>Tritomaria exsectiformis</i> (Breidl.) Schiffn. ex Loeske	On basalt where humid
Lophoziaceae	<i>Tritomaria quinquedentata</i> (Huds.) H.Buch	On rock, wood and bark

## MOSSES

Amblystegiaceae	<i>Amblystegium serpens</i> (Hedw.) Schimp.	Moist soil
Orthotrichaceae	<i>Amphidium lapponicum</i> (Hedw.) Schimp.	On vertical basalt surfaces
Andreaeaceae	<i>Andreaea rupestris</i> Hedw.	On basalt
Leucodontaceae	<i>Antitrichia californica</i> Sull. ex Lesq.	On vertical basalt surfaces
Leucodontaceae	<i>Antitrichia curtispindula</i> (Hedw.) Brid.	On bark and basalt
Aulacomniaceae	<i>Aulacomnium androgynum</i> (Hedw.) Schwägr.	Mostly on bark near the ground
Aulacomniaceae	<i>Aulacomnium palustre</i> (Hedw.) Schwägr.	Among other mosses on moist soil
Pottiaceae	<i>Barbula convoluta</i> Hedw.	On thin soil over basalt
Bartramiaceae	<i>Bartramia ithyphylla</i> Brid.	On basalt underhangs
Seligeriaceae	<i>Blindia acuta</i> (Hedw.) Bruch & Schimp.	On argillite adjacent to waterfall
Brachytheciaceae	<i>Brachythecium acutum</i> (Mitt.) Sull.	On trunks
Brachytheciaceae	<i>Brachythecium asperrimum</i> (Mitt. ex Müll.Hal.) Sull.	Mostly on trunks
Brachytheciaceae	<i>Brachythecium frigidum</i> (Müll.Hal.) Besch.	On bark and basalt
Brachytheciaceae	<i>Brachythecium turgidum</i> (Hartm.) Kindb.	On thin soil over argillite
Hypnaceae	<i>Buckiella undulata</i> (Hedw.) Ireland	Forest understory
Grimmiaceae	<i>Bucklandiella heterosticha</i> (Hedw.) Bedn.-Ochyra & Ochyra	On basalt
Grimmiaceae	<i>Bucklandiella occidentalis</i> (Renauld & Cardot) Bedn.-Ochyra & Ochyra	On basalt
Grimmiaceae	<i>Bucklandiella sudetica</i> (Funck) Bedn.-Ochyra & Ochyra	On basalt
Amblystegiaceae	<i>Calliergonella cuspidata</i> (Hedw.) Loeske	Among other mosses in wet sites
Ditrichaceae	<i>Ceratodon purpureus</i> (Hedw.) Brid.	Various sites, mostly where disturbed
Climaciaceae	<i>Climacium dendroides</i> (Hedw.) F.Weber & D.Mohr	Over basalt and soil near shorelines
Dicranaceae	<i>Cynodontium jeneri</i> (Schimp.) Stirt.	Mostly on vertical surfaces of basalt

Dicranaceae	<i>Cynodontium strumiferum</i> (Hedw.) Lindb.	Mostly on vertical surfaces of basalt
Dicranaceae	<i>Cynodontium tenellum</i> (Schimp.) Limpr.	Mostly on vertical surfaces of basalt
Dicranaceae	<i>Dichodontium pellucidum</i> (Hedw.) Schimp.	On rock along waterways
Dicranaceae	<i>Dicranoweisia cirrata</i> (Hedw.) Lindb. ex Milde	Mostly on bark
Dicranaceae	<i>Dicranum fuscescens</i> Turner	Various rock, bark and wood surfaces
Dicranaceae	<i>Dicranum howellii</i> Renauld & Cardot	Various rock, bark and wood surfaces
Dicranaceae	<i>Dicranum majus</i> Turner	On rock in humid sites
Dicranaceae	<i>Dicranum pallidisetum</i> (J.W.Bailey) Ireland	Various rock, bark and wood surfaces
Dicranaceae	<i>Dicranum polysetum</i> Sw.	Over basalt in cool sites
Dicranaceae	<i>Dicranum scoparium</i> Hedw.	Various rock, bark and wood surfaces
Dicranaceae	<i>Dicranum tauricum</i> Sapjegin	On bark and wood
Ditrichaceae	<i>Distichium capillaceum</i> (Hedw.) Bruch & Schimp.	On basalt underhangs
Ditrichaceae	<i>Ditrichum gracile</i> (Mitt.) Kuntze	On basalt underhangs and on argillite
Brachytheciaceae	<i>Eurhynchiastrum pulchellum</i> (Hedw.) Ignatov & Huttunen	On various surfaces
Fissidentaceae	<i>Fissidens adianthoides</i> Hedw.	On basalt along shores
Fontinalaceae	<i>Fontinalis neomexicana</i> Sull. & Lesq.	Submerged in standing or flowing water
Grimmiaceae	<i>Grimmia torquata</i> Drumm.	Vertical basalt surfaces
Pterigynandraceae	<i>Heterocladium procurrans</i> (Mitt.) A.Jaeger	Mostly on basalt underhangs
Brachytheciaceae	<i>Homalothecium aeneum</i> (Mitt.) E.Lawton	On basalt, mostly vertical surfaces
Brachytheciaceae	<i>Homalothecium fulgescens</i> (Mitt. ex Müll.Hal.) A.Jaeger	On trunks
Hylocomiaceae	<i>Hylocomium splendens</i> (Hedw.) Schimp.	On various surfaces
Hypnaceae	<i>Hypnum callichroum</i> Brid.	Mostly on bark
Hypnaceae	<i>Hypnum circinale</i> Hook.	Mostly on trunks
Hypnaceae	<i>Hypnum cupressiforme</i> Hedw.	On various surfaces
Hypnaceae	<i>Hypnum dieckeii</i> Renauld & Cardot	On bark and basalt
Hypnaceae	<i>Hypnum subimponens</i> Lesq.	On trunks
Lembophyllaceae	<i>Isothecium stoloniferum</i> Brid.	Mostly on bark
Meesiaceae	<i>Leptobryum pyriforme</i> (Hedw.) Wilson	On mineral soil
Mniaceae	<i>Leucolepis acanthoneuron</i> (Schwägr.) Lindb.	On soil among other mosses where moist
Mniaceae	<i>Mnium blyttii</i> Bruch & Schimp.	On soil where sheltered and cool
Mniaceae	<i>Mnium spinulosum</i> Bruch & Schimp.	On soil where sheltered and cool
Neckeraceae	<i>Neckera menziesii</i> Drumm..	On vertical surfaces of bark and basalt
Grimmiaceae	<i>Niphotrichum canescens</i> (Hedw.) Bedn.-Ochyra & Ochyra	On basalt
Grimmiaceae	<i>Niphotrichum elongatum</i> (Ehrh. ex Frisvoll) Bedn.-Ochyra & Ochyra	On basalt
Grimmiaceae	<i>Niphotrichum ericoides</i> (Brid.) Bedn.-Ochyra & Ochyra	On basalt
Dicranaceae	<i>Oncophorus wahlenbergii</i> Brid.	Mostly on basalt and logs
Orthotrichaceae	<i>Orthotrichum lyellii</i> Hook. & Taylor	On nutrient-rich bark in humid sites

Orthotrichaceae	<i>Orthotrichum obtusifolium</i> Brid.	On Populus bark
Orthotrichaceae	<i>Orthotrichum pylaisii</i> Brid.	On basalt underhangs
Orthotrichaceae	<i>Orthotrichum speciosum</i> Nees	On nutrient-rich bark in humid sites
Bartramiaceae	<i>Philonotis capillaris</i> Lindb.	On moist soil
Bartramiaceae	<i>Philonotis fontana</i> var. <i>pumila</i> (Turner) Brid.	On moist soil
Mniaceae	<i>Plagiomnium ciliare</i> (Müll.Hal.) T.J.Kop.	Forest understory
Mniaceae	<i>Plagiomnium ellipticum</i> (Brid.) T.J.Kop.	Moist soil in shaded sites
Mniaceae	<i>Plagiomnium insigne</i> (Mitt.) T.J.Kop.	Forest understory
Mniaceae	<i>Plagiomnium medium</i> (Bruch & Schimp.) T.J.Kop.	Forest understory
Bartramiaceae	<i>Plagiopus oederianus</i> (Sw.) H.A.Crum & L.E.Anderson	On vertical basalt surfaces
Plagiotheciaceae	<i>Plagiothecium denticulatum</i> (Hedw.) Schimp.	On basalt in cool sites
Plagiotheciaceae	<i>Plagiothecium laetum</i> Schimp.	Mostly on basalt in cool sites
Plagiotheciaceae	<i>Plagiothecium piliferum</i> (Sw.) Schimp.	Mostly on basalt in cool sites
Amblystegiaceae	<i>Platydictya jungermannioides</i> (Brid.) H.A.Crum	On underhangs where humid
Hylocomiaceae	<i>Pleurozium schreberi</i> (Brid.) Mitt.	On various surface at or near ground level
Polytrichaceae	<i>Pogonatum urnigerum</i> (Hedw.) P.Beauv.	On thin soil over basalt
Mielichhoferiaceae	<i>Pohlia cruda</i> (Hedw.) Lindb.	On basalt underhangs
Mielichhoferiaceae	<i>Pohlia nutans</i> (Hedw.) Lindb.	Moist soil
Polytrichaceae	<i>Polytrichastrum alpinum</i> (Hedw.) G.L.Sm.	On thin soil over basalt
Polytrichaceae	<i>Polytrichum commune</i> Hedw.	On thin soil over basalt
Polytrichaceae	<i>Polytrichum juniperinum</i> Hedw.	On thin soil over basalt
Polytrichaceae	<i>Polytrichum piliferum</i> Hedw.	On thin soil over basalt, where dry
Polytrichaceae	<i>Polytrichum strictum</i> Menzies ex Brid.	Among mosses where moist
Pterigynandraceae	<i>Pterigynandrum filiforme</i> Hedw.	On vertical surfaces
Hypnaceae	<i>Ptilium crista-castrense</i> (Hedw.) De Not.	On various surfaces where cool
Bryaceae	<i>Ptychostomum pallescens</i> (Schleich. ex Schwägr.) J.R.Spence	On thin soil where humid
Bryaceae	<i>Ptychostomum pseudotriquetrum</i> (Hedw.) J.R.Spence & H.P.Ramsay ex Holyoak & N.Pedersen	On thin soil where humid
Bryaceae	<i>Ptychostomum weigeli</i> (Biehler) J.R.Spence	On moist soil
Hypnaceae	<i>Pylaisia polyantha</i> (Hedw.) Schimp.	Lower trunks, mostly on Populus
Grimmiaceae	<i>Racomitrium lanuginosum</i> (Hedw.) Brid.	On basalt where dry
Mniaceae	<i>Rhizomnium glabrescens</i> (Kindb.) T.J.Kop.	On soil in forest understory
Mniaceae	<i>Rhizomnium pseudopunctatum</i> (Bruch & Schimp.) T.J.Kop.	On soil in forest understory
Brachytheciaceae	<i>Rhynchostegium aquaticum</i> A.Jaeger	Wet soil
Hylocomiaceae	<i>Rhytidiadelphus loreus</i> (Hedw.) Warnst.	On various surfaces where humid
Hylocomiaceae	<i>Rhytidiadelphus squarrosus</i> (Hedw.) Warnst.	On soil in wet sites
Hylocomiaceae	<i>Rhytidiadelphus subpinnatus</i> (Lindb.) T.J.Kop.	On soil in wet sites

Hylocomiaceae	<i>Rhytidiadelphus triquetrus</i> (Hedw.) Warnst.	On various surfaces where cool
Hylocomiaceae	<i>Rhytidiopsis robusta</i> (Hook.) Broth.	Forest understory
Rhytidiaceae	<i>Rhytidium rugosum</i> (Hedw.) Kindb.	Among other mosses on basalt
Amblystegiaceae	<i>Sanionia symmetrica</i> (Renauld & Cardot) Wheld.	Moist, cool sites
Amblystegiaceae	<i>Sanionia uncinata</i> (Hedw.) Loeske	Moist, cool sites
Calliergonaceae	<i>Sarmentypnum exannulatum</i> (Schimp.) Hedenäs	Wet sites where periodically flooded
Grimmiaceae	<i>Schistidium frigidum</i> H.H.Blom	On basalt
Grimmiaceae	<i>Schistidium papillosum</i> Culm.	On basalt
Grimmiaceae	<i>Schistidium pulchrum</i> H.H.Blom	On basalt
Grimmiaceae	<i>Schistidium robustum</i> (Nees & Hornsch.) H.H.Blom	On basalt
Brachytheciaceae	<i>Sciurohypnum latifolium</i> (Kindb.) Ignatov & Huttunen	Moist, cool understory
Scouleriaceae	<i>Scouleria aquatica</i> Hook.	On basalt along river shores
Sphagnaceae	<i>Sphagnum girgensohnii</i> Russow	Moist forest understory
Sphagnaceae	<i>Sphagnum squarrosum</i> Crome	Moist forest understory
Pottiaceae	<i>Syntrichia norvegica</i> F.Weber	On basalt where cool
Splachnaceae	<i>Tetraplodon mnioides</i> (Hedw.) Bruch & Schimp.	On bone in a'a field
Timmiaceae	<i>Timmia austriaca</i> Hedw.	On basalt in shaded sites
Orthotrichaceae	<i>Ulota obtusiuscula</i> Müll. Hal. & Kindb.	On nutrient-rich bark
Calliergonaceae	<i>Warnstorfia fluitans</i> (Hedw.) Loeske	On wet soil where periodically flooded
Pottiaceae	<i>Weissia controversa</i> Hedw.	On thin soil over basalt

## VASCULAR PLANTS

Pinaceae	<i>Abies lasiocarpa</i> (Hook.) Nutt.	A dominant forest tree, sometimes in open sites
Sapindaceae	<i>Acer glabrum</i> var. <i>douglasii</i> (Hook.) Dippel	Sparsely treed sites and sinkholes
Asteraceae	<i>Achillea borealis</i> Bong. s. lat.	Various open sites
Asteraceae	<i>Achillea millefolium</i> L. s. lat.	River shores and disturbed sites
Ranunculaceae	<i>Actaea rubra</i> (Ait.) Willd.	Forest understory, on rich soil
Adiantaceae	<i>Adiantum aleuticum</i> (Rupr.) C.A.Paris	Basalt underhangs
Rosaceae	<i>Agrimonia striata</i> Michx.	Forest edge at river shores
Poaceae	<i>Agrostis exarata</i> Trin.	River shores
Poaceae	<i>Agrostis gigantea</i> Roth	Disturbed sites
Poaceae	<i>Agrostis scabra</i> Willd.	Open sites over basalt
Poaceae	<i>Agrostis stolonifera</i> L.	Moist soil in disturbed sites
Betulaceae	<i>Alnus alnobetula</i> var. <i>fruticosa</i> (Rupr.) H.Winkl.	Cool sites, especially in gullies
Betulaceae	<i>Alnus rubra</i> Bong.	Mostly along river and creek shores

Poaceae	<i>Alopecurus aequalis</i> Sobol.	River shores
Rosaceae	<i>Amelanchier florida</i> Lindl.	Various open or lightly shaded sites
Asteraceae	<i>Anaphalis margaritacea</i> (L.) Benth. & Hook.f.	Various open or lightly shaded sites
Apiaceae	<i>Angelica genuflexa</i> Nutt.	Rich soil in moist sites
Asteraceae	<i>Antennaria howellii</i> Greene	Over moss on basalt
Ranunculaceae	<i>Aquilegia formosa</i> Fisch. ex DC.	Shores and other moist sites
Brassicaceae	<i>Arabidopsis lyrata</i> ssp. <i>kamchatica</i> (Fisch. ex DC.) O'Kane & Al-Shehbaz	River and creek shores
Araliaceae	<i>Aralia nudicaulis</i> L.	Forest understory
Asteraceae	<i>Arctium minus</i> (Hill) Bernh.	Disturbed site
Ericaceae	<i>Arctostaphylos uva-ursi</i> (L.) Spreng.	Various open or lightly shaded sites
Asteraceae	<i>Arnica cordifolia</i> Hook.	Forest understory
Rosaceae	<i>Aruncus dioicus</i> var. <i>acuminatus</i> (Rydb.) H.Hara	Moist sites
Aristolochiaceae	<i>Asarum caudatum</i> Lindl.	Cool, humid forest understory
Aspleniaceae	<i>Asplenium trichomanes</i> L.	Basalt underhangs
Athyriaceae	<i>Athyrium americanum</i> (Butters) Maxon	Rocky, open, cool sites
Athyriaceae	<i>Athyrium filix-femina</i> var. <i>cyclosorum</i> Rupr.	Moist or cool sites
Brassicaceae	<i>Barbarea vulgaris</i> W.T.Aiton	River and creek shores
Betulaceae	<i>Betula papyrifera</i> Marshall var. <i>papyrifera</i>	Various open or lightly shaded sites
Brassicaceae	<i>Boechnera divaricarpa</i> (A.Nelson) Á.Löve & D.Löve	Open site on the Tseax Cone
Botrychiaceae	<i>Botrypus virginianus</i> (L.) Michx.	Forest understory
Poaceae	<i>Bromus inermis</i> Leyss.	Disturbed sites
Poaceae	<i>Calamagrostis canadensis</i> (Michx.) P.Beauv.	Mostly on moist cool sites
Plantaginaceae	<i>Callitriche palustris</i> L.	Wet soil where periodically flooded
Campanulaceae	<i>Campanula rotundifolia</i> L.	Open or lightly shaded sites
Asteraceae	<i>Canadanthus modestus</i> (Lindl.) G.L.Nesom	Moist sites along shores
Papaveraceae	<i>Capnodes sempervirens</i> (L.) Borkh.	Moss mats over basalt in cool sites
Brassicaceae	<i>Cardamine breweri</i> var. <i>orbicularis</i> (Greene) Detling aff.	Muddy sites
Brassicaceae	<i>Cardamine pensylvanica</i> Muhl. ex Willd. aff.	Muddy sites
Cyperaceae	<i>Carex arcta</i> Boott	Moist, silty soil
Cyperaceae	<i>Carex brunnescens</i> (Pers.) Poir.	Among mosses over soil or basalt
Cyperaceae	<i>Carex crawfordii</i> Fernald	Shores
Cyperaceae	<i>Carex kelloggii</i> W.Boott	Shores
Cyperaceae	<i>Carex macloviana</i> d'Urv.	Moist soil, open or lightly shaded
Cyperaceae	<i>Carex mertensii</i> J.D.Prescott ex Bong.	Moist, cool sites
Cyperaceae	<i>Carex praticola</i> Rydb.	Dry soil, open site
Cyperaceae	<i>Carex sitchensis</i> J.D.Prescott ex Bong.	Shores

Cyperaceae	<i>Carex stipata</i> Muhl. ex Willd.	Shores and silty soil in forest understory
Cyperaceae	<i>Carex utriculata</i> Boott	Various wet sites
Caryophyllaceae	<i>Cerastium fontanum</i> Baumg.	Disturbed sites
Amaranthaceae	<i>Chenopodium album</i> L.	Disturbed sites
Ericaceae	<i>Chimaphila umbellata</i> (L.) W.P.C. Barton	Forest understory
Apiaceae	<i>Cicuta douglasii</i> (DC.) J.M.Coult. & Rose	Wet sites
Poaceae	<i>Cinna latifolia</i> (Trevir. ex Göpp.) Griseb.	Moist forest understory
Onagraceae	<i>Circaea alpina</i> L. ssp. <i>alpina</i>	Moist forest understory
Liliaceae	<i>Clintonia uniflora</i> (Menzies ex Schult.) Kunth	Forest understory
Rosaceae	<i>Comarum palustre</i> L.	Wet sites where periodically flooded
Cornaceae	<i>Cornus sericea</i> L.	Moist soil and sinkholes
Cornaceae	<i>Cornus unalaschkensis</i> Ledeb.	Moist forest understory
Betulaceae	<i>Corylus cornuta</i> Marshall var. <i>cornuta</i>	Rich soil, forest understory or lightly shaded sites
Rosaceae	<i>Crataegus douglasii</i> Lindl.	Open or lightly shaded sites
Asteraceae	<i>Crepis tectorum</i> L.	Disturbed sites
Pteridaceae	<i>Cryptogramma acrostichoides</i> R.Br.	Moss mats over basalt
Pteridaceae	<i>Cryptogramma sitchensis</i> (Rupr.) T.Moore	Moss mats over basalt
Cystopteridaceae	<i>Cystopteris fragilis</i> (L.) Bernh.	Mostly on basalt underhangs
Poaceae	<i>Danthonia spicata</i> (L.) P.Beauv. ex Roem. & Schult.	Open, dry sites
Lycopodiaceae	<i>Dendrolycopodium dendroideum</i> (Michx.) A.Haines	Among mosses in open forest understory
Poaceae	<i>Deschampsia caespitosa</i> (L.) P.Beauv.	Shores, less often on basalt
Lycopodiaceae	<i>Diphasiastrum complanatum</i> (L.) Holub	Among mosses in open forest understory
Rosaceae	<i>Dryas drummondii</i> Richardson ex Hook.	River cobble bars and disturbed sites on basalt
Dryopteridaceae	<i>Dryopteris carthusiana</i> (Vill.) H.P.Fuchs	Mostly in crevices in basalt flows
Dryopteridaceae	<i>Dryopteris expansa</i> (C.Presl) Fraser-Jenk. & Jermy	Forest understory and crevices
Dryopteridaceae	<i>Dryopteris filix-mas</i> (L.) Schott	Mostly in crevices in basalt flows
Poaceae	<i>Elymus glaucus</i> Buckley ssp. <i>glaucus</i>	Open and lightly shaded sites
Ericaceae	<i>Empetrum nigrum</i> L.	Mossy sites on basalt
Onagraceae	<i>Epilobium angustifolium</i> L.	Various sites, mostly where disturbed
Onagraceae	<i>Epilobium glandulosum</i> Lehm.	Moist sites
Onagraceae	<i>Epilobium hornemannii</i> Rchb. subsp. <i>hornemannii</i>	Creek shores
Onagraceae	<i>Epilobium lactiflorum</i> Hausskn.	Moist, cool sites
Onagraceae	<i>Epilobium latifolium</i> L.	River shores
Onagraceae	<i>Epilobium leptocarpum</i> Hausskn.	Moist sites along creeks and near waterfalls
Equisetaceae	<i>Equisetum arvense</i> L.	Various sites
Equisetaceae	<i>Equisetum fluviatile</i> L.	Wet sites, where periodically flooded
Equisetaceae	<i>Equisetum laevigatum</i> A.Braun	More or less open sites

Equisetaceae	<i>Equisetum sylvaticum</i> L.	Forest understory
Equisetaceae	<i>Equisetum variegatum</i> ssp. <i>alaskanum</i> (A.A.Eaton ) Hultén	River shores
Asteraceae	<i>Erigeron acris</i> var. <i>kamtschaticus</i> (DC.) Herder	Open, cool site
Asteraceae	<i>Erigeron philadelphicus</i> L.	River and creek shores
Phrymaceae	<i>Erythranthe guttata</i> (DC.) G.L.Nesom	River and creek shores
Orobanchaceae	<i>Euphrasia stricta</i> Kunth	Disturbed sites
Poaceae	<i>Festuca occidentalis</i> Hook.	Open and lightly shaded sites
Poaceae	<i>Festuca rubra</i> L. ssp. <i>rubra</i>	Disturbed sites
Poaceae	<i>Festuca saximontana</i> Rydb. subsp. <i>saximontana</i>	Thin soil over basalt, open sites
Rosaceae	<i>Fragaria cascadiensis</i> Hummer cfr.	Forest margins
Rosaceae	<i>Fragaria vesca</i> L.	Lightly shaded, moist sites
Rosaceae	<i>Fragaria virginiana</i> Mill.	Various open or lightly shaded sites
Lamiaceae	<i>Galeopsis bifida</i> Boenn.	River shores and disturbed sites
Rubiaceae	<i>Galium boreale</i> L.	More or less open sites
Rubiaceae	<i>Galium trifidum</i> L.	Wet soil
Rubiaceae	<i>Galium triflorum</i> Michx.	Forest understory
Santalaceae	<i>Geocaulon lividum</i> (Richardson) Fernald	Forest understory and open, cool sites
Geraniaceae	<i>Geranium bicknellii</i> Britton	River shores
Geraniaceae	<i>Geranium robertianum</i> L.	Disturbed sites
Rosaceae	<i>Geum macrophyllum</i> Willd.	Moist soil in lightly shaded sites
Poaceae	<i>Glyceria borealis</i> (Nash) Batch.	Wet sites, where periodically flooded
Poaceae	<i>Glyceria elata</i> (Nash) M.E.Jones	Wet, muddy sites
Orchidaceae	<i>Goodyera oblongifolia</i> Raf.	On mosses in understory and cool, open sites
Cystopteridaceae	<i>Gymnocarpium dryopteris</i> (L.) Newman	Forest understory
Cystopteridaceae	<i>Gymnocarpium jessoense</i> (Koidz.) Koidz.	Cold-air pockets on basalt
Cystopteridaceae	<i>Gymnocarpium x intermedium</i> Sarvela	Forest understory
Apiaceae	<i>Heracleum lanatum</i> Michx.	Moist, more or less open sites
Saxifragaceae	<i>Heuchera glabra</i> Willd. ex Roem. & Schult.	On moss over basalt
Saxifragaceae	<i>Heuchera glabra x micrantha</i>	On moss over basalt
Saxifragaceae	<i>Heuchera micrantha</i> var. <i>diversifolia</i> (Rydb.) Rosend. et al.	On moss over basalt
Asteraceae	<i>Hieracium albiflorum</i> Hook.	Mostly on moss over basalt
Asteraceae	<i>Hieracium caespitosum</i> Dumort.	Mostly where disturbed
Asteraceae	<i>Hieracium laevigatum</i> Willd.	Mostly where disturbed
Asteraceae	<i>Hieracium piloselloides</i> Vill.	Mostly where disturbed
Asteraceae	<i>Hieracium praealtum</i> Vill. ex Gochnat	Mostly where disturbed
Poaceae	<i>Hordeum brachyantherum</i> Nevski ssp. <i>brachyantherum</i>	Seasonally moist soil on basalt
Lycopodiaceae	<i>Huperzia miyoshiana</i> (Makino) Ching	Mossy, open site on the Tseax cone

Hypericaceae	<i>Hypericum perforatum</i> L.	Disturbed sites
Balsaminaceae	<i>Impatiens noli-tangere</i> L.	Moist, rich soil
Juncaceae	<i>Juncus ensifolius</i> Wikstr.	River shores
Juncaceae	<i>Juncus filiformis</i> L.	River shores
Juncaceae	<i>Juncus nodosus</i> L.	River shores
Cupressaceae	<i>Juniperus communis</i> var. <i>depressa</i> (Steven) Boiss.	Open, dry sites on basalt
Asteraceae	<i>Leucanthemum vulgare</i> Lam.	Mostly where disturbed
Plantaginaceae	<i>Linaria vulgaris</i> Mill.	Disturbed sites
Caprifoliaceae	<i>Linnaea borealis</i> L.	Cool, open or lightly shaded sites
Caprifoliaceae	<i>Lonicera involucrata</i> (Richardson) Banks ex Spreng.	Moist sites on rich soil
Juncaceae	<i>Luzula parviflora</i> (Ehrh.) Desv.	Moist forest understory
Lycopodiaceae	<i>Lycopodium clavatum</i> L.	Over moss on basalt, open or lightly shaded sites
Lamiaceae	<i>Lycopus uniflorus</i> Michx.	Shores
Araceae	<i>Lysichiton americanus</i> Hultén & H. St. John	Wet, rich soil
Asteraceae	<i>Madia glomerata</i> Hook.	Mostly in disturbed sites
Asparagaceae	<i>Maianthemum racemosum</i> (L.) Link	Various open or lightly shaded sites
Rosaceae	<i>Malus fusca</i> (Raf.) Schneid.	Open forest understory, moist soil
Asteraceae	<i>Matricaria discoidea</i> DC.	Disturbed sites
Asteraceae	<i>Matricaria inodora</i> L.	Disturbed sites
Fabaceae	<i>Melilotus albus</i> Medik.	Disturbed sites
Lamiaceae	<i>Mentha canadensis</i> L.	Shores
Menyanthaceae	<i>Menyanthes trifoliata</i> L.	Wet sites, where at least periodically flooded
Saxifragaceae	<i>Micranthes pacifica</i> (Hultén) Björk comb. ined.	Cobbly creek shore near waterfall
Saxifragaceae	<i>Mitella nuda</i> L.	Moist forest understory
Ericaceae	<i>Moneses uniflora</i> (L.) A.Gray	Mossy forest understory
Ericaceae	<i>Monotropa uniflora</i> L.	Cool forest understory
Montiaceae	<i>Montia parvifolia</i> (Moc. ex DC.) Greene	River and creek shores
Asteraceae	<i>Mycelis muralis</i> (L.) Dumort.	Various sites, mostly where shaded
Boraginaceae	<i>Myosotis laxa</i> Lehm.	Wet soil
Boraginaceae	<i>Myosotis scorpioides</i> L.	River and creek shores
Asteraceae	<i>Nabalus alatus</i> Hook.	Moist, cool sites near shores and waterfalls
Orchidaceae	<i>Neottia nephrophylla</i> (Rydb.) Szlach.	Mossy, cool forest understory
Nymphaeaceae	<i>Nuphar polysepala</i> Engelm.	In standing-water pools
Apiaceae	<i>Oenanthe sarmentosa</i> C.Presl ex DC.	Wet soil where periodically flooded
Araliaceae	<i>Oplopanax horridus</i> (Sm.) Miq.	Moist, cool forest understory, rich soil
Ericaceae	<i>Orthilia secunda</i> (L.) House	Forest understory and moss mats over basalt
Apiaceae	<i>Osmorhiza berteroi</i> DC.	Open forest understory



Asteraceae	<i>Packera indecora</i> (Greene) Á.Löve & D.Löve	Moist, lightly shaded sites, rich soil
Asteraceae	<i>Packera pauciflora</i> (Pursh) Á.Löve & D.Löve	Moist, lightly shaded sites, rich soil
Celastraceae	<i>Parnassia fimbriata</i> K.D.Koenig	River and creek shores
Celastraceae	<i>Paxistima myrsinites</i> (Pursh) Raf.	Forest understory and mossy, open sites
Poaceae	<i>Phalaris arundinacea</i> L.	Moist, open sites
Thelypteridaceae	<i>Phegopteris connectilis</i> (Michx.) Watt	Basalt crevices, underhangs, and near waterfall
Poaceae	<i>Phleum pratense</i> L.	Mostly in disturbed sites
Polemoniaceae	<i>Phlox gracilis</i> (Douglas ex Hook.) Greene	Disturbed sites
Ericaceae	<i>Phyllodoce glanduliflora</i> (Hook.) Coville	On moss mats over basalt around the Tseax cone
Pinaceae	<i>Picea glauca</i> (Moench) Voss	A dominant forest tree, also in open sites
Pinaceae	<i>Picea sitchensis</i> (Bong.) Carrière	Forest in gullies
Pinaceae	<i>Picea x lutzii</i> Little	Forest in gullies
Pinaceae	<i>Pinus contorta</i> var. <i>latifolia</i> Engelm.	Various open or forested sites
Plantaginaceae	<i>Plantago major</i> L.	Disturbed sites
Orchidaceae	<i>Platanthera dilatata</i> (Pursh) Lindl. ex L.C.Beck var. <i>dilatata</i>	Moist sites
Orchidaceae	<i>Platanthera orbiculata</i> (Pursh) Lindl.	Mossy forest understory
Poaceae	<i>Poa annua</i> L.	Disturbed sites
Poaceae	<i>Poa compressa</i> L.	Mostly in disturbed sites
Poaceae	<i>Poa glauca</i> Vahl	Open sites on basalt
Poaceae	<i>Poa interior</i> Rydb.	Open sites on basalt
Poaceae	<i>Poa palustris</i> L.	Open sites, seasonally wet
Poaceae	<i>Poa pratensis</i> L.	Mostly disturbed sites
Poaceae	<i>Podagrostis humilis</i> (Vasey) Björkman	Cool, open sites at upper elevations
Polygonaceae	<i>Polygonum douglasii</i> Greene	On thin soil over basalt
Polypodiaceae	<i>Polypodium glycyrrhiza</i> D.C.Eaton	On basalt, mostly on underhangs
Polypodiaceae	<i>Polypodium hesperium</i> Maxon	On basalt, mostly on underhangs
Dryopteridaceae	<i>Polystichum andersonii</i> Hopkins	Basalt crevices
Dryopteridaceae	<i>Polystichum lonchitis</i> (L.) Roth	Basalt crevices and a'a flows
Salicaceae	<i>Populus tremuloides</i> Michx.	Various open or lightly shaded sites
Salicaceae	<i>Populus trichocarpa</i> Torr. & A.Gray	Shores, forests, gullies, and sinkholes
Potamogetonaceae	<i>Potamogeton gramineus</i> L.	Lake shores
Rosaceae	<i>Potentilla biennis</i> Greene	On disturbed soil
Rosaceae	<i>Potentilla norvegica</i> L.	Various open or lightly shaded sites
Lamiaceae	<i>Prunella vulgaris</i> var. <i>lanceolata</i> (W.P.C.Barton) Hultén	River shores and other moist sites
Rosaceae	<i>Prunus pensylvanica</i> L.f.	Open or lightly shaded sites
Ericaceae	<i>Pyrola asarifolia</i> Michx.	Mossy ground where lightly shaded
Ericaceae	<i>Pyrola chlorantha</i> Sw.	Mossy ground where lightly shaded

Ericaceae	<i>Pyrola minor</i> L.	Mossy ground where lightly shaded
Ranunculaceae	<i>Ranunculus abortivus</i> L.	Moist, rich soil in light shade
Ranunculaceae	<i>Ranunculus aquatilis</i> L. sensu lato	Wet soil where periodically flooded
Ranunculaceae	<i>Ranunculus flammula</i> L. aggr.	Shores
Ranunculaceae	<i>Ranunculus gmelinii</i> DC.	Wet soil where periodically flooded
Ranunculaceae	<i>Ranunculus macounii</i> Britton	Moist, rich soil in light shade
Ranunculaceae	<i>Ranunculus uncinatus</i> D. Don	Moist forest understory, shores
Ericaceae	<i>Rhododendron menziesii</i> Craven	Forest understory and in basalt crevices
Grossulariaceae	<b><i>Ribes glandulosum</i></b> Grauer	Moist, lightly shaded sites
Grossulariaceae	<i>Ribes hudsonianum</i> Richardson var. <i>hudsonianum</i>	Wet, rich soil
Grossulariaceae	<i>Ribes lacustre</i> (Pers.) Poir.	Mostly where moist and lightly shaded
Grossulariaceae	<i>Ribes laxiflorum</i> Pursh	Moist, rich soil where shaded
Grossulariaceae	<i>Ribes oxycanthoides</i> L. ssp. <i>oxycanthoides</i>	On mossy basalts
Brassicaceae	<i>Rorippa palustris</i> (L.) Besser ssp. <i>palustris</i>	Wet sites, rich soil
Rosaceae	<i>Rosa nutkana</i> C. Presl subsp. <i>nutkana</i>	Various open or lightly shaded sites
Rosaceae	<i>Rosa x engelmannii</i> nothosubsp. <i>britannicae-columbiae</i> W.H. Lewis	Wet soil, cottonwood forest understory
Rosaceae	<i>Rubus idaeus</i> L. aggr.	Various open or lightly shaded sites
Rosaceae	<i>Rubus leucodermis</i> Douglas ex Torr. & A. Gray	Basalt crevices and sinkholes
Rosaceae	<b><i>Rubus nutkanus</i></b> Moc. ex Ser.	Various open or shaded sites
Rosaceae	<i>Rubus pedatus</i> Sm.	Mossy ground, mostly in forest understory
Rosaceae	<i>Rubus pubescens</i> Raf.	Moist, rich soil in light shade
Rosaceae	<i>Rubus spectabilis</i> Pursh	Mostly in moist, shaded sites
Polygonaceae	<b><i>Rumex acetosella</i></b> L.	On thin soil over basalt and moss mats
Polygonaceae	<i>Rumex triangulivalvis</i> (Danser) Rech.f.	Shores
Salicaceae	<i>Salix drummondiana</i> Barratt ex Hook.	Various moist sites
Salicaceae	<i>Salix lasiandra</i> Benth. var. <i>lasiandra</i>	Various moist sites
Salicaceae	<i>Salix niphoclada</i> Rydb.	Rocky ground in gullies
Salicaceae	<i>Salix petrophila</i> Rydb.	Apex of the Tseax cone
Salicaceae	<i>Salix scouleriana</i> Barratt ex Hook.	Various, mostly open upland sites
Salicaceae	<i>Salix sitchensis</i> Sanson ex Bong.	Various moist sites
Adoxaceae	<b><i>Sambucus callicarpa</i></b> Greene	Various moist sites
Rosaceae	<i>Sanguisorba sitchensis</i> C.A. Mey.	Forest edge at river shores
Saxifragaceae	<i>Saxifraga tricuspidata</i> Rottb.	Over mosses on basalt
Cyperaceae	<i>Scirpus microcarpus</i> J. Presl & C. Presl	Wet sites where open or lightly shaded
Crassulaceae	<i>Sedum divergens</i> S. Watson	On thin soil and moss mats over basalt
Asteraceae	<i>Senecio viscosus</i> L.	Disturbed sites
Elaeagnaceae	<i>Shepherdia canadensis</i> (L.) Nutt.	Various open or lightly shaded sites

Asteraceae	<i>Solidago lepida</i> DC.	Moist sites, crevices, and trailsides
Rosaceae	<i>Sorbus scopulina</i> Greene	Shaded sites, crevices and sinkholes
Typhaceae	<i>Sparganium fluctuans</i> (Morong) B.L.Rob.	River shore sloughs
Lycopodiaceae	<i>Spinulum canadense</i> (Nessel) A.Haines	Over moss in open or lightly shaded sites
Rosaceae	<i>Spiraea douglasii</i> Hook.	Moist sites, crevices, sinkholes
Caryophyllaceae	<i>Stellaria calycantha</i> (Ledeb.) Bong.	Moist sites near shores
Caryophyllaceae	<i>Stellaria crispa</i> Cham. & Schldtl.	Moist soil in forest understory
Caryophyllaceae	<i>Stellaria media</i> (L.) Vill.	Disturbed, shaded sites
Liliaceae	<i>Streptopus amplexifolius</i> (L.) DC.	Moist, rich soil in understory
Brassicaceae	<i>Subularia aquatica</i> L.	River shore sloughs
Caprifoliaceae	<i>Symphoricarpos albus</i> var. <i>laevigatus</i> (Fernald) S.F.Blake	Various open or lightly shaded sites
Asteraceae	<i>Symphyotrichum foliaceum</i> (Lindl. ex DC.) G.L.Nesom var. <i>foliaceum</i>	River shores
Asteraceae	<i>Symphyotrichum maccallae</i> (Rydb.) comb. ined.	River and creek shores
Asteraceae	<i>Tanacetum vulgare</i> L.	Disturbed sites
Asteraceae	<i>Taraxacum</i> spp.	Mostly in disturbed sites
Saxifragaceae	<i>Tellima grandiflora</i> (Pursh) Douglas ex Lindl.	Forest understory
Ranunculaceae	<i>Thalictrum sparsiflorum</i> Turcz. ex Fissch. & C.A.Mey.	River shores
Cupressaceae	<i>Thuja plicata</i> Donn ex D.Don	A forest dominant, less often in open sites
Saxifragaceae	<i>Tiarella trifoliata</i> L. var. <i>trifoliata</i>	Forest understory
Poaceae	<i>Torreyochloa pauciflora</i> (J.Presl) G.L.Church	Wet soil along shores
Fabaceae	<i>Trifolium aureum</i> Pollich	Disturbed sites
Fabaceae	<i>Trifolium hybridum</i> L.	Disturbed sites
Fabaceae	<i>Trifolium pratense</i> L.	Disturbed sites
Fabaceae	<i>Trifolium repens</i> L.	Disturbed sites
Poaceae	<i>Trisetum cernuum</i> Trin.	Mostly in open forest understory
Poaceae	<i>Trisetum spicatum</i> (L.) K.Richt.	Open sites on basalt
Pinaceae	<i>Tsuga heterophylla</i> (Raf.) Sarg.	A forest dominant, less often in open sites
Brassicaceae	<i>Turritis glabra</i> L.	Disturbed sites
Typhaceae	<i>Typha latifolia</i> L.	Muddy sites
Urticaceae	<i>Urtica gracilis</i> Aiton	Mostly moist, lightly shaded sites, rich soil
Ericaceae	<i>Vaccinium alaskaense</i> Howell	Cool, moist, mostly shaded sites
Ericaceae	<i>Vaccinium cespitosum</i> Michx.	Open sites on basalt
Ericaceae	<i>Vaccinium membranaceum</i> Douglas ex Torr.	Forest understory, crevices, sinkholes
Ericaceae	<i>Vaccinium ovalifolium</i> Sm.	Forest understory, crevices, sinkholes
Ericaceae	<i>Vaccinium parvifolium</i> Sm.	Forest understory, crevices, sinkholes
Caprifoliaceae	<i>Valeriana sitchensis</i> Bong.	Moist, cool, lightly shaded sites
Plantaginaceae	<i>Veronica americana</i> Schwein. ex Benth.	Moist soil

Plantaginaceae	<i>Veronica serpyllifolia</i> L.	Moist soil, mostly where disturbed
Adoxaceae	<i>Viburnum edule</i> (Michx.) Raf.	Forest understory, shores, crevices, sinkholes
Fabaceae	<i>Vicia americana</i> Muhl. ex Willd.	Lightly shaded sites, rich soil
Fabaceae	<i>Vicia cracca</i> L.	Disturbed sites
Violaceae	<i>Viola adunca</i> Sm. var. <i>adunca</i>	Moss mats and small crevices on basalt
Violaceae	<i>Viola palustris</i> L.	Moist, more or less rich soil
Woodsiaceae	<i>Woodsia scopulina</i> D.C.Eaton	Basalt crevices and underhangs

## Appendix 2. Plant and Lichen Taxa of Conservation Concern in Nisga’a Memorial Lava Beds Provincial Park

Fifteen species were recorded that are given conservation-priority status by the British Columbia Conservation Data Centre, including 11 lichens, 3 mosses, and 1 vascular plant (Table 1). Two of the mosses (*Ptychostomum pallens* and *Schistidium pulchrum*) are more common than previously thought and should not retain their conservation status. Two additional lichens were found that appear to merit conservation status in British Columbia: *Stereocaulon nanodes* and *Stereocaulon pileatum*. *Stereocaulon nanodes* has not previously been recorded from North America. In addition, 44 exotic vascular plant species were encountered (Table 2), and could be considered for removal when found away from roadsides or centres of human activity.

Table 1. Conservation listed species found in the Nisga’a Lava Flows study area in 2019 (or documented by earlier observers).

<i>Arctoparmelia subcentrifuga</i>	S3
<i>Cladonia cyanipes</i>	S2S3
<i>Collema glebulentum</i>	S3
<i>Fuscopannaria ahlneri</i>	S3
<i>Lichinodium canadense</i>	S3
<i>Lobaria silvae-veteris</i>	S1
<i>Micranthes pacifica</i>	S2
<i>Nephroma helveticum</i>	S3
<i>Nephroma isidiosum</i>	S3
<i>Nephroma occultum</i>	S3, SARA Schedule 1 Species of Concern
<i>Pannaria rubiginella</i>	S3
<i>Ptychostomum pallescens</i>	S3 (should not have conservation status)
<i>Schistidium pulchrum</i>	S3 (should not have conservation status)
<i>Schistidium robustum</i>	S3
<i>Sclerophora peronella</i>	S1
<i>Stereocaulon nanode</i>	No status, should be S1
<i>Stereocaulon pileatum</i>	No status, should be S1

Table 2. Exotic vascular plant species found in the Nisga'a Lava Flows study area in 2019.

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<i>Agrostis gigantea</i> Roth	<i>Matricaria discoidea</i> DC.
<i>Agrostis stolonifera</i> L.	<i>Matricaria inodora</i> L.
<i>Arctium minus</i> (Hill) Bernh.	<i>Melilotus albus</i> Medik.
<i>Barbarea vulgaris</i> W.T.Aiton	<i>Mycelis muralis</i> (L.) Dumort.
<i>Brassica napus</i> L.	<i>Myosotis scorpioides</i> L.
<i>Bromus inermis</i> Leyss.	<i>Phalaris arundinacea</i> L.
<i>Capsella bursa-pastoris</i> (L.) Medik.	<i>Phleum pratense</i> L.
<i>Cerastium fontanum</i> Baumg.	<i>Plantago major</i> L.
<i>Chenopodium album</i> L.	<i>Poa annua</i> L.
<i>Crepis tectorum</i> L.	<i>Poa compressa</i> L.
<i>Euphrasia stricta</i> Kunth	<i>Poa pratensis</i> L.
<i>Festuca rubra</i> L. ssp. <i>rubra</i>	<i>Rumex acetosella</i> L.
<i>Galeopsis bifida</i> Boenn.	<i>Senecio viscosus</i> L.
<i>Geranium robertianum</i> L.	<i>Stellaria media</i> (L.) Vill.
<i>Hieracium caespitosum</i> Dumort.	<i>Tanacetum vulgare</i> L.
<i>Hieracium laevigatum</i> Willd.	<i>Taraxacum</i> spp.
<i>Hieracium piloselloides</i> Vill.	<i>Thlaspi arvense</i> L.
<i>Hieracium praealtum</i> Vill. ex Gochnat	<i>Trifolium aureum</i> Pollich
<i>Hypericum perforatum</i> L.	<i>Trifolium hybridum</i> L.
<i>Leucanthemum vulgare</i> Lam.	<i>Trifolium pratense</i> L.
<i>Linaria vulgaris</i> Mill.	<i>Trifolium repens</i> L.
<i>Madia glomerata</i> Hook.	<i>Vicia cracca</i> L.

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