

A baseline plant, lichen and ecosystem survey of Lakelse Lake Wetlands Park



Paula Bartemucci, MSc, RPBio
March 19, 2023

Executive Summary

Lakelse Lake Wetlands Park harboured a diversity of habitats such as a large intact bog woodland, western redcedar swamp forests, productive old growth forests of Sitka spruce, riparian and lakeshore habitats, islands of floating vegetation, reed beds, fens, marshes, small ponds, slow-moving water channels, and groundwater-fed creeks.

The baseline plant survey documented new occurrences of Tacoma jellyskin lichen (*Leptogium tacomae*), and yellow specklebelly lichen (*Pseudocyphellaria citrina*). These rare lichens were found at two locations: the riparian forest at the northeastern corner and in the bog woodland at the centre of the park. No rare vascular plants were detected.

Four types of at-risk ecological communities were found in the park: red-listed Sitka sedge – Pacific water-parsley marshes and Sitka spruce – salmonberry alluvial forests and blue-listed sweet gale – Sitka sedge fens and western redcedar – western hemlock – Sitka spruce – skunk cabbage swamp forests. There was also a riparian forest that seemed analogous to the blue-listed black cottonwood – red-osier dogwood forests that develop on middle benches of fluvial systems. The park also harboured regionally-significant Pacific crab apple ecosystems, Lodgepole pine - *Sphagnum* bog woodlands and diverse foreshore vegetation communities. Bio-geoclimatic ecosystem classification and mapping of the ecosystems is suggested.

The large complex of wetlands, bog woodlands and lake shore habitats may support other significant and rare species and plant communities that were not detected during this baseline study. Access to parts of the park was a challenge – further search effort in the un-surveyed areas of the park is recommended, particularly in old forests and unusual wetlands (e.g. open peatland sites with low shrub cover). Further study of the groundwater-fed creeks and springs in the park that remain ice-free over winter is also recommended – these systems are understudied, globally rare and likely support unusual aquatic ecosystems.

Acknowledgements

Many thanks to the Lakelse Watershed Stewardship Society (LWSS) and Westland Resources for their kind and generous support of this project. I am grateful for their collective local expertise, guidance and logistical support.

A special thanks to Cath McRae (LWSS) for spear-heading this project and for providing meals and a guest suite as well as maps, background reports and a ton of knowledge about Lakelse Lake. Many thanks to Eileen Lefrancois (LWSS) for lending me a kayak and kindly accompanying me in the field for an afternoon of lakeshore surveying by kayak.

Many thanks also to Cheryl Brown, Darren Fillier, Marten Geertsema, and Fred Heikkinen for generously providing invaluable information and reports about the Lakelse Lake area.

Thank you to BC Parks for funding this work and to Shane Kirwin for authorizing this survey.

Introduction

Lakelse Lake Wetlands Park was established in 2004 to conserve an exceptional warm-water wetland complex. Groundwater springs feed the into Clearwater and Andalus Creeks, keeping them ice-free and open all winter. Lakelse Lake is believed to be the largest warm-water lake in northwestern B.C. Groundwater springs, geothermal activity, such as Mount Layton hot springs, and shallow depths (mean depth is 8 m, majority of the lake < 5m, and maximum depth is 34 m) likely contribute to its warm temperatures.

The park occurs at the southern end of Lakelse Lake, approximately 18 km south of Terrace, B.C. (Figure 1). It lies in the Kitimat - Kitsumkalum trough within the Kitimat Ranges of the Coast Mountains. Uplifted glaciomarine sediments (marine clay deposits) from an ancient sea floor and glacio-fluvial outwash deposits of sands and gravels underlie the site (Geertsema 1996). Organic layers have developed over time in low-lying wet areas. Several major creeks occur in the park including large portions of Clearwater, Andalus Creeks, and shorter portions of Ena and Schulbuckhand Creeks.

The park is located within the traditional territories of the Allied Tsimshian First Nations (Front Counter BC 2022). The park occupies approximately 1214 ha on level terrain. Elevation ranges from 72 to 95 m.

The park lies within the sub-montane variant of the wet, sub-maritime Coastal Western Hemlock Zone (CWHws1; Banner *et al.* 1993).

There have been no plant surveys previously done in the park. De Groot and Bartemucci (2003) ranked this park as medium to high priority for needing vegetation inventories owing to the lack of survey effort in the park and the potential influence of warm springs on the wetland species.

Williston (2020) established a research project to assess the effects of air pollution on epiphytic lichens in the Kitimat Valley airshed. Nearby lichen research sites included Williams Creek, Sockeye Creek, and Clearwater Lakes, Kitimat River, with the closest site being 1.5 km southeast of Lakelse Lake Wetlands Park. Numerous red- and blue-listed lichens were encountered: cryptic paw lichen (*Nephroma occultum*), oldgrowth lung lichen (*Lobaria silvae-veteris*), smoker's lung lichen (*Lobaria retigera*), pebbled paw lichen (*Nephroma isidiosum*), corrugated shingles lichen (*Fuscopannaria ahlneri*), and yellow specklebelly lichen (*Pseudocyphellaria citrina*).

Several inventories have occurred in Lakelse Lake Provincial Park to the northeast: red-listed Sitka spruce – Salmonberry (CWHws1/07) forests on alluvial fans were identified by Hans Roemer in 2002 (in de Groot and Bartemucci 2003); and white adder's mouth orchid (*Malaxis brachypoda*) was found in Lakelse Lake Provincial Park by Gisela Mendel in 1975 but has not been re-visited since 1979 (de Groot and Bartemucci 2003). This orchid is no longer blue-listed, or considered at risk in B.C. *Hammarbya paludosa* (bog adder's mouth orchid) also formerly blue-listed was found approximately 2 km south of the park in a bog (July 2016, iNaturalist 2023). Smoker's lung lichen (*Lobaria retigera*) was found in oldgrowth forest in 1970 near Furlong Bay in Lakelse Lake Park, and was re-located in 2015. It is blue-listed in B.C., ranked as vulnerable in Canada (COSEWIC 2018), and is listed as Special Concern on Schedule 1 of the *Species at Risk Act* (SARA).

Field surveys were concurrently completed at the Muller’s Bay Nature Trust of BC property at the north end of the lake in August 2022. The surveys reported new occurrences of *Pseudocyphellaria citrina* and *Lobaria silvae-veteris* as well as three blue-listed ecological communities (Sweet gale – Sitka sedge fens [wf52], Sitka sedge – Pacific water-parsley marshes [wm50], and western redcedar – Sitka spruce – skunk cabbage swamp forests [CWHws1/11]).

Field surveys were initiated by the Lakelse Watershed Stewardship Society and BC Parks to gain a better understanding of the diversity of plants, lichens, and ecosystems in the Lakelse Lake Wetlands Park. One of the objectives of the survey was to determine if there were unusual species or plant communities associated with the wetlands and warm-water springs. Species and ecosystems considered to be at-risk in BC (red or blue listed) were the primary target species during the field survey.

Baseline plant inventories were undertaken in August 2022 with the following objectives:

- to document occurrences of rare plant species and ecosystems when found;
- to describe the dominant habitats, species and ecosystems found within the Lakelse Lake Wetlands Park;
- to create a baseline list of plants and lichen species encountered;
- to discuss potentially occurring species not detected during the 2022 surveys; and
- to make recommendations about conservation priority and management.

Methods

Fieldwork preparation

Prior to starting fieldwork, a list of potentially-occurring at-risk plants, lichens and ecological communities was created using on-line information provided by the BC Conservation Data Centre (2022). Blue and red-listed species and communities previously reported within a relatively large region surrounding Lakelse Lake were included on the target list. This list included eleven ecological communities, nine lichens, one moss and two vascular plant species (23 elements; **Appendix 1**; BC Conservation Data Centre 2022). When the entire Coast Mountain Natural Resource District was queried for at-risk elements, approximately 118 were listed but many of these were restricted to alpine and outer coast habitats or other habitats that do not occur in the Lakelse Lake Wetlands Park. The habitats and life-history characteristics of all potentially-occurring at-risk species were researched prior to field surveys and their potential for occurrence in the park was assessed.

See **Appendix 1** for the list of target species, conservation status and a pre-field work assessment of their potential to occur in the park.

Field surveys

Field surveys were completed by Paula Bartemucci on August 26 and 30, 2022. During this time, a total search effort of approximately 12.6 km of survey transects and over 17.5 hours of active surveying were completed (Figure 1).

Following the rare plant and lichen survey protocol (Resource Information Standards Committee 2018), targeted surveys sought out high-potential habitats and microsites, while also attempting to cover all habitat types located in the prescribed area. This approach is referred to as the “intuitive wander method” and is believed to capture more rare species than systematic linear transect methods (Resource Information Standards Committee 2018). Pockets of old-growth forest experiencing high humidity and stable microclimate conditions and pristine air quality are considered to be high potential areas for many of the epiphytic target lichen species.

The survey was primarily a targeted survey of at-risk plant and lichen species but was also a baseline ecosystem and floristic inventory of the park. Full biogeoclimatic ecosystem classification and mapping was not completed but detailed field notes were taken. Most vascular plants and macrolichens (and some of the microlichens, mosses and liverworts) encountered during the field survey were recorded and identified. The survey transect was recorded on a geo-referenced PDF map of the park using Avenza Maps on an iPad with a Garmin Glo Portable GPS and Glonass Receiver to provide a measure of search effort and to document where surveys occurred in the park.

For this relatively large area (~1200 ha) adequate search effort was achieved in several discrete areas, but further search effort will likely locate more populations and ecological communities at the site (see Figure 1 for survey coverage). Four separate locations were surveyed in the Lakelse Lake Wetlands Park (Figure 1):

- (1) Southeastern corner to Lakelse Lake foreshore – north-south transect (Day 1)
- (2) Northeast corner site 1 - riparian forest and foreshore wetlands (Day 2)
- (3) Northeast corner site 2 - oldgrowth Sitka spruce forests (Day 2)
- (4) Southwestern corner – Shoreline habitats, Andalus and Clearwater Creeks and lake (kayak transect) (Day 2)

Sections of the park were difficult to access owing to high water levels and inability to cross larger creeks. Dense thickets of shrubs often made it difficult to see any distances from the survey transect and species could have been overlooked. However, few at-risk species grow under dense shrub canopies.

When a potential rare species was detected, the following information was recorded: number of individuals (plants, colonies or thalli), habitat description, host tree species for epiphytic lichens, assessment of threats, GPS coordinates, and associated species. Photographs were taken of species and habitats of interest. Specimens or fragments of species were collected to confirm identification when necessary. Reference specimens of listed or unusual lichen species were also collected. No

specimens were collected if there were fewer than 20 individuals in a population. In the event that there were fewer than 20 individuals, photographs were taken as records of occurrence.

Lab work

Bryophyte and lichen specimens were dried in paper collecting bags, vascular plant specimens were dried in plant presses. Important specimens were curated and prepared for future deposit at the UBC herbarium (Beaty Biodiversity Museum, UBC). Specimen identification was confirmed by microscope examination and chemical reagent spot tests (lichens). Occurrence data will be submitted to the BC Conservation Data Centre. Nomenclature follows the BC Conservation Data Centre (2022).

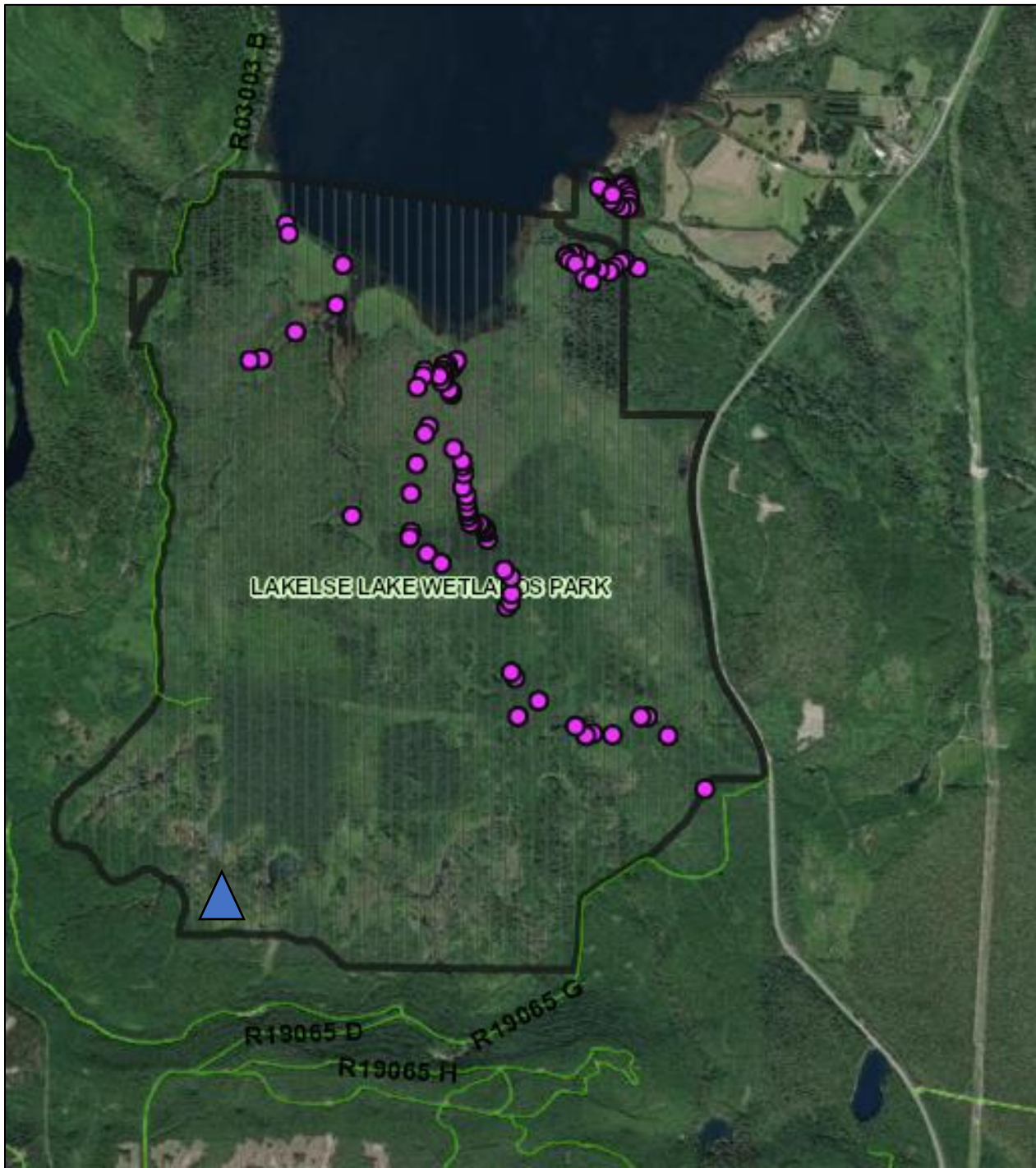


Figure 1. Recent satellite imagery of Lakelse Lake Wetlands (iMap BC 2023). Pink dots represent survey plot locations of August 2022 survey. Blue triangle shows where the location of the groundwater spring. Sentinel real-time satellite imagery shows this area open in winter

Results and Discussion

Background and Disturbance history

By the early 1990s, Lakelse Lake Wetlands Park had already been classified as a Goal 2 protected area through the Regional Protected Areas Strategy (1996). At the time, the area was originally protected as a wildlife management area with two other adjoining parcels of land to protect critical fish and wildlife habitats. The park was formally established in 2004 as part of the Kalum Land Resource Management Plan to conserve pockets of old forests, as well as the large wetland complex and lakeshore habitats at the southern end of Lakelse Lake (Figure 1).

Prior to the park's establishment, over one-half of the park was logged. By 1985, most of the productive old growth forests were clearcut (see Figures 2 and 3). Only a few pockets of this type of old forest remain in the park, with the largest one being at the northeast corner of the park (Figures 1-3). The extensive logging and associated resource roads may have altered hydrology of the wetland complex.



Figure 2. Air photo of Lakelse Lake Wetlands Park in 1947, prior to development in the area (from Kerby et al. 2010).



Figure 3. Air photo of Lakelse Lake Wetlands Park in 1985, showing extensive clearcutting in the southern, northwestern and western parts of the park (Digital Air Photos of BC 2023. Blue triangle points to big-treed oldgrowth forests.

A large part of the park is underlain by glaciomarine clay sediments – sea floor from an inland sea that formed (sea level ~ 200 m asl) in the Kitimat - Kitsumkalum trough during deglaciation (Geertsema *et al.* 2017a,b). As the glaciers retreated fully, the sea floor was uplifted. Marine clays have a different structure than freshwater clays. They generally contain more pores and hold more water than freshwater clays because they form aggregates of clay and silt particles that settle randomly. High salt content from sea water creates strong bonds between the particles. *Sensitive* marine clays develop when salts are leached from the clays, bonds weaken, and particles begin to repulse each other. These glaciomarine clays are common near Lakelse Lake where numerous historic and pre-historic earthflows have occurred (*e.g.* Geertsema *et al.* 2017a, Geertsema *et al.* 2017b, Geertsema and Schwab 1997). When Geertsema *et al.* (2017b) mapped landslide depressions (scarps) between Kitimat and Terrace, several prehistoric slides were found in or near Lakelse Lake Wetlands Park (Figure 4). Three small landslide scarps were marked in the southern part of the park (near Clearwater Creek) and one near Schulbuckhand Creek to the east of Highway 37 and the park boundary. More earthflows may have occurred but have been covered (and masked) by alluvium and organic deposits over time, especially in low-lying areas that are prone to flooding (Geertsema *et al.* 2017b). The biological legacy of these landslides on the landscape is increased biophysical diversity (site, soil, vegetation and habitats; Geertsema and Pojar 2007) including soil mixing, soil movement, formation of scarps and scallops, development of wetlands, and the creation of landslide-dammed lakes.

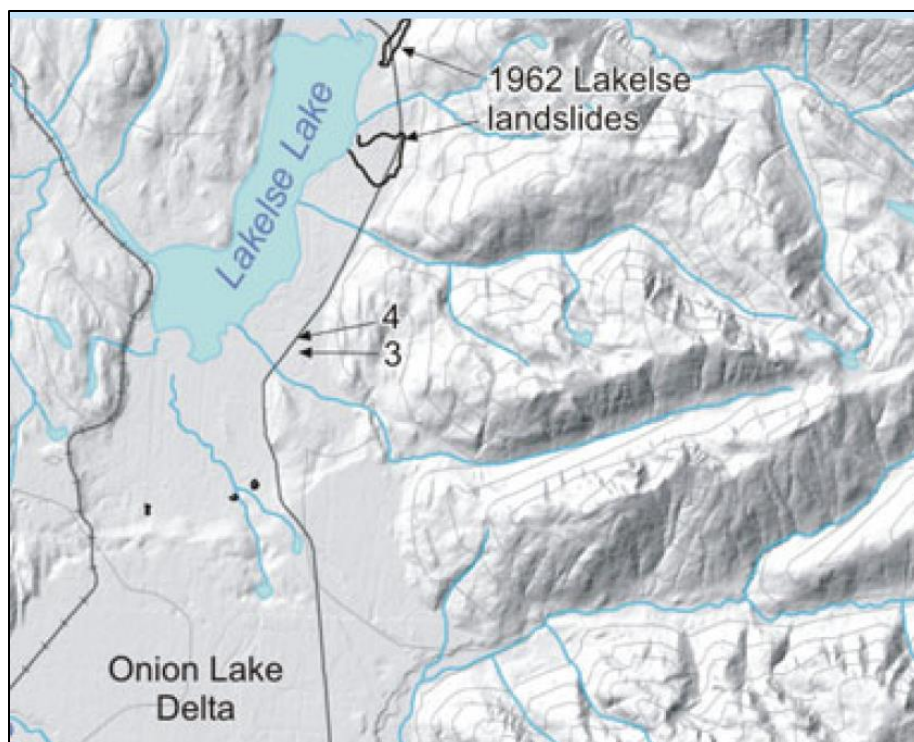


Figure 4. Image excerpted from Geertsema *et al.* 2017b, showing historic landslide scarps (black polygons). Three historic slides occurred in the wetlands park and two occur slightly to the northeast (3, 4).

Lakelse Lake Wetlands Park lies in a fault-bounded valley within the Stikine volcanic belt, part of the Pacific “Ring of Fire”. Mount Layton hot springs are believed to be the warmest (89°C), and second largest, in Canada. The hot temperatures are caused by deep faults (as deep as 6 km) that heat groundwater that has percolated deep into the faults (GeoScience BC 2015). A series of hot and warm springs have been identified near the established resort and east of Highway 37 (GeoScience BC 2015).

Borealis Geopower has been studying the deep faults in the vicinity of the park (e.g. immediately adjacent to the southern boundary, and near sections of eastern perimeter and near the northeast corner of the park) for future geothermal energy development (electricity). There are graben faults mapped below the park but their locations are not certain, and only estimated (See Figure 5, excerpted from GeoScience BC 2015). These faults join a fault line that crosses Mount Layton hot springs but it is not known that any warm or hot springs emerge in the park. Further searching in hard-to-access locations may find evidence of hot springs, but the likelihood is low. No unusual plant species were recorded.

Because Andalus and Clearwater Creeks remain free of snow and ice during winter, warm-water springs were believed to feed into them. A shallow groundwater spring was found near the headwaters of Andalus and Clearwater Creeks by Fred Heikkinen (*pers. comm*). The spring was open in the heart of the winter with a water temperature of 6°C, close to the average annual air temperature. Water temperature, chemistry and other properties from the spring did not suggest deep-fault origins (Heikkinen 2023, *pers. comm.*). This groundwater spring was not visited during the survey but Sentinel satellite imagery showed this area ice-free and the creeks open in early March 2023 (Sentinel Hub 2023). The location of the source is marked on Figure 1.

This spring is not believed to be part of the Mount Layton deep-seated fault system but rather it emerges from the base of the 100 to 200-m deep escarpments of glaciofluvial sediments that form the Onion Lake delta to the south. It is therefore likely that high levels of groundwater flow from the base of this delta (from 1-2 km south) may keep the creeks ice-free in winter. Groundwater-fed systems like this one are under-studied, globally rare and their ecological importance not well understood.

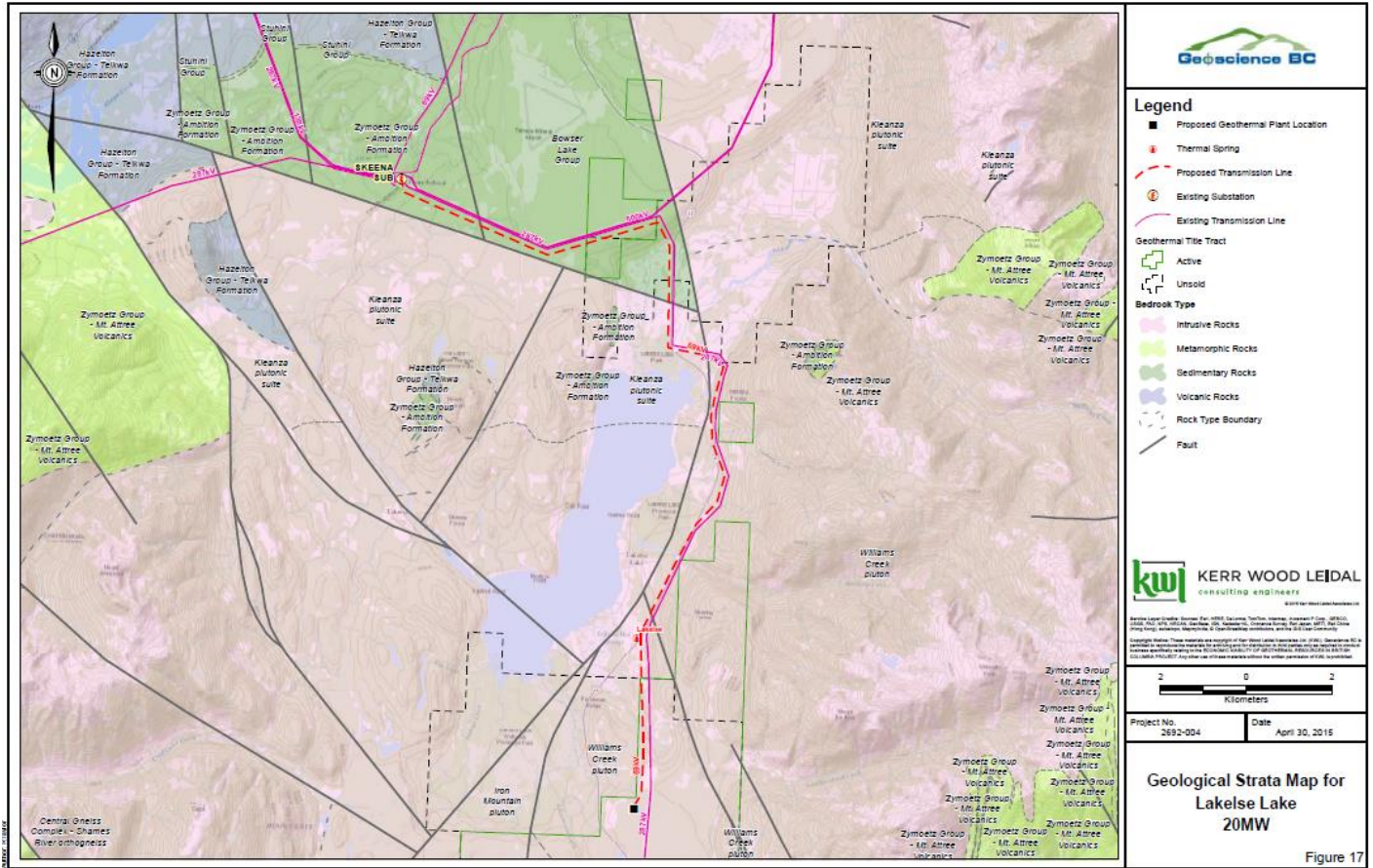


Figure 5. Image excerpted from GeoScience BC (2015) showing grey fault lines, rock types and proposed geothermal development.

Field survey results

Two red-listed and two blue-listed ecological communities were found in Lakelse Lake Wetlands Park. The site association descriptions that follow are drawn from field notes and from *Land Management Handbook 52: Wetlands of British Columbia* (MacKenzie and Moran 2004) and *Land Management Handbook 26* (Banner *et al.* 1993).

Day 1 – long transect from logging road at southeastern corner to lake foreshore

As mentioned earlier, a large portion of the park is comprised of second growth forests (~ 40 years old) which have poor understory development, high density and closed canopies (Figure 6). They have low potential for supporting rare vascular plants or lichens. Large stumps were observed suggesting that productive, oldgrowth forests once occurred in some locations.



Figure 6. Dense regeneration cut blocks (above) were frequent in the southern part of Lakelse Lake Wetlands Park. Note: Forestry research tags.

Large stumps (right) found during the survey suggest that big-treed oldgrowth forests once occupied some of the park.



Beaver flooding has created ponds, some quite large, and wet swamps throughout the regenerating forests in this part of the park.

The frequent beaver ponds were often fringed with **cattail marshes** (Figures 7 and 8; CWHws1/wm05) and swamps of skunk cabbage, small-flowered bulrush, mountain alder, horsetails, and pink spiraea (Figure 9, CWHws1/ws01 and ws02) (Placemarks 87-89, 93; Appendix 1). None of the site associations are considered rare.

Both mountain alder swamp ecosystems are productive and have very high value for wildlife. Transitional sites having characteristics of both swamps were also present.



Figure 7. Cattail marshes and large ponds were located within the complex of regenerating cut-blocks in the southern half of the park.



Figure 8. Large beaver pond with Sitka sedge fringing the shore (left) and a tributary of the Clearwater Creek with lush riparian vegetation were observed in the middle of the park (Placemark 94)



Mountain alder – skunk cabbage – lady fern (CWHws1/ws01) sites occurs where there is continuous seepage near the surface and poor drainage (MacKenzie and Moran 2004). *Alnus incana* often dominates these sites, which have a lush understory of skunk cabbage, lady fern, horsetails, and Sitka sedge.

Mountain alder – Pink spirea – Sitka sedge (CWHws1/ws02) swamps are common in wet climates in the Coast and Mountains (MacKenzie and Moran 2004). This site association occurs on beaver-flooded flats of small drainages, near wetlands and lakeshores, where there is poor drainage, continuous seepage near the surface and early season flooding (MacKenzie and Moran 2004).



Figure 9. Mountain alder, pink spirea and Sitka sedge swamps border beaver ponds and cattail marshes.

There were small patches of remnant (unlogged) older western redcedar, Sitka spruce and skunk cabbage swamp forests among the regenerating stands (Figure 10, Placemark 106). Crab apples, false azalea, and *Vaccinium* species were also present. These **Western redcedar – Sitka spruce – skunk cabbage** (CWHws1/11 or /ws10) swamp forests were found on level sites, in slightly elevated areas in the wetland basin. High water tables cause low productivity, and open canopies of sparse, mostly short statured-trees (Banner *et al.* 1993). This site association is analogous to the blue-listed, **Western redcedar – western hemlock – skunk cabbage** (CWHws1/Ws54) swamp forests described in MacKenzie and Moran (2004). These forests were part of an intricate mosaic of wetlands, open water and bog woodlands.



Figure 10. Here is an example of a small pocket of old forest found within regenerating cut-blocks. Red alder and younger trees surround western redcedar – Sitka spruce – skunk cabbage forest.

Intermixed within the young dense forests and the swamp forests were small stands of Pacific crab apple. Pacific crab apple – skunk cabbage ecosystems were relatively frequent in the park (Figure 11, Appendix 2).



Figure 11. Pacific crab apple – skunk cabbage ecosystems were found within the bog woodland and the regenerating cut-blocks.

Pacific crab apple is found primarily near the coast, where it is found frequently along estuaries (EFlora BC 2022). Banner *et al.* (1993) did not describe Pacific crab apple ecosystems for the CWHws1 or other interior subzones, but they described three site series in the outer coast. The three site series are shoreline Sitka spruce forests in the very wet, hyper-maritime subzone of the CWH (CWHvh2/16, 18 and 19).

However, it does grow further inland along the Skeena River valley in moist to wet habitats. Large stands of Pacific crab apple, growing along with other culturally-important plant species, are generally believed to represent indigenous forest gardens (Armstrong 2017). Because there are historic forest gardens in the vicinity of Lakelse Lake and elsewhere in the Kitimat – Kitsumkalum trough (Armstrong 2017, Armstrong *et al.* 2021), the presence of large stems of Pacific crab apple was diligently noted and mapped in the Lakelse Lake Wetlands Park. Pacific crab apple trees also support rare epiphytic lichens due to nutrient enrichment (*e.g.* calcium). No large stands were observed but clusters of large-stemmed crab apple were frequently found along with other garden species (**Appendix 2**).

Some of the stems had been cut down by beavers and many of the stems were dying back in the dense canopies of regenerating cutblock. It was not evident if some of the trees were dying back from hydrological changes or from a defoliator. Crab apple leaves were observed to be heavily grazed by an insect defoliator. There is a web worm (*Hyphantria cunea*) that attacks cultivated apples in the Kitimat and Terrace areas which may be attacking the native, Pacific crab apples. The regional forest entomologist is looking into this.

Lodgepole pine – Sphagnum bog woodlands (CWHws1/10) were comprised of open canopies of scrubby western hemlock, western redcedar, lodgepole pine and rarely mountain hemlock (Figures 12, 13). Many of the trees were dead-topped or standing dead. These bog woodlands are uncommon in the CWHws1, where they are restricted to peat-filled depressions at the base of slopes or in valley floors (Banner *et al.* 1993). Sitka spruce was found in wetter, richer areas within the large bog woodland complex.

The understory was characterized by Labrador tea, *Vaccinium* species, bracken fern (in parts), false azalea, sweet gale, pink spiraea, skunk cabbage, sedges and *Sphagnum*.

Only a few small pockets of ‘true’ peat bog were encountered and they occurred as small raised peatlands within the matrix of the bog woodland ecosystem – a system that generally had high shrub cover or bracken fern over the majority of the area surveyed. The small areas of true bog harboured the only occurrences of round-leaved sundew, *Kalmia microphylla*, bog cranberry, and cloudberry found during this survey. However, there could be additional peat bogs in un-surveyed areas in the park.

The bog woodlands in Lakelse Lake Wetlands Park are extensive (estimated 200 ha) and formed a mosaic with other wetland types. Lodgepole pine – Sphagnum woodlands are currently yellow listed in B.C. but is regionally rare and may be listed in the future.



Figure 12. Bog woodlands were extensive in the park. Woodlands were characterized by scrubby western redcedar, lodgepole pine and western hemlock.

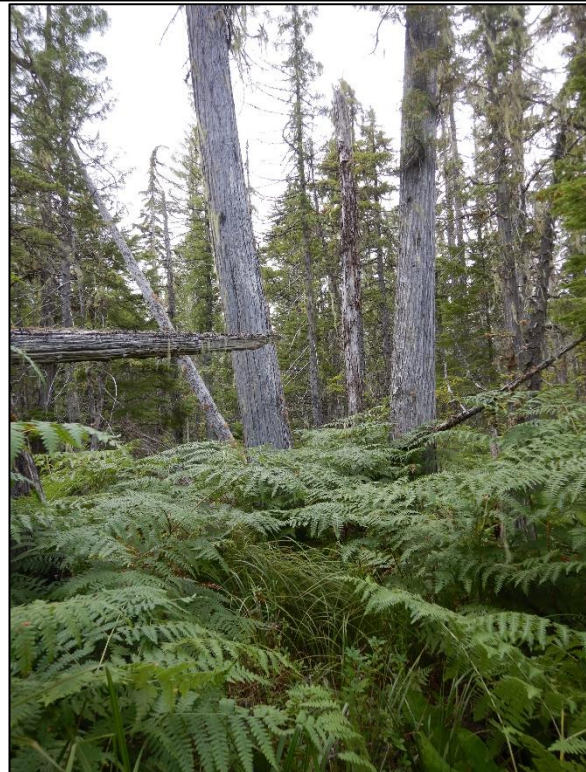


Figure 13. The understory of the bog woodlands varied across the site with some dominated by skunk cabbage (above), while others were thick with bracken fern (right).

The **Sweet gale – Sitka sedge fen (CWHws1/wf 52)** is an uncommon fen ecosystem at low elevations in a variety of landscape positions in the Georgia Depression and Coast and Mountains (MacKenzie and Moran). This ecosystem is currently blue-listed by the BC Conservation Data Centre. “*This wetland ecological community has a small Area of Occupancy that is impacted by widespread development of forestry roads and increasingly drier and warmer summers*” (BC Conservation Data Centre 2022).

Lakelse Lake Wetlands Park supports a relatively large amount of this blue-listed wetland where it is interwoven throughout the bog woodland in wetter, low-lying areas (Figures 14 and 15). Further ground truthing would be necessary to map this site accurately. The site occurs intermingled with small deep, slow-moving drainage channels as well as other wetland site series.

This ecosystem is characterized by relatively dense shrub thickets (1 to 1.5 m tall) dominated by *Myrica gale*, with lesser amounts of *Spiraea douglasii* and *Lonicera involucrata*. Sitka sedge (*Carex sitchensis*) is the dominant sedge. The water level tends to be just below the surface during the growing season but this ecosystem often experiences shallow flooding in the early season (MacKenzie and Moran 2004).



Figure 14. Sweet gale - Sitka sedge fens that were frequent in Lakelse Lake Wetlands Park.

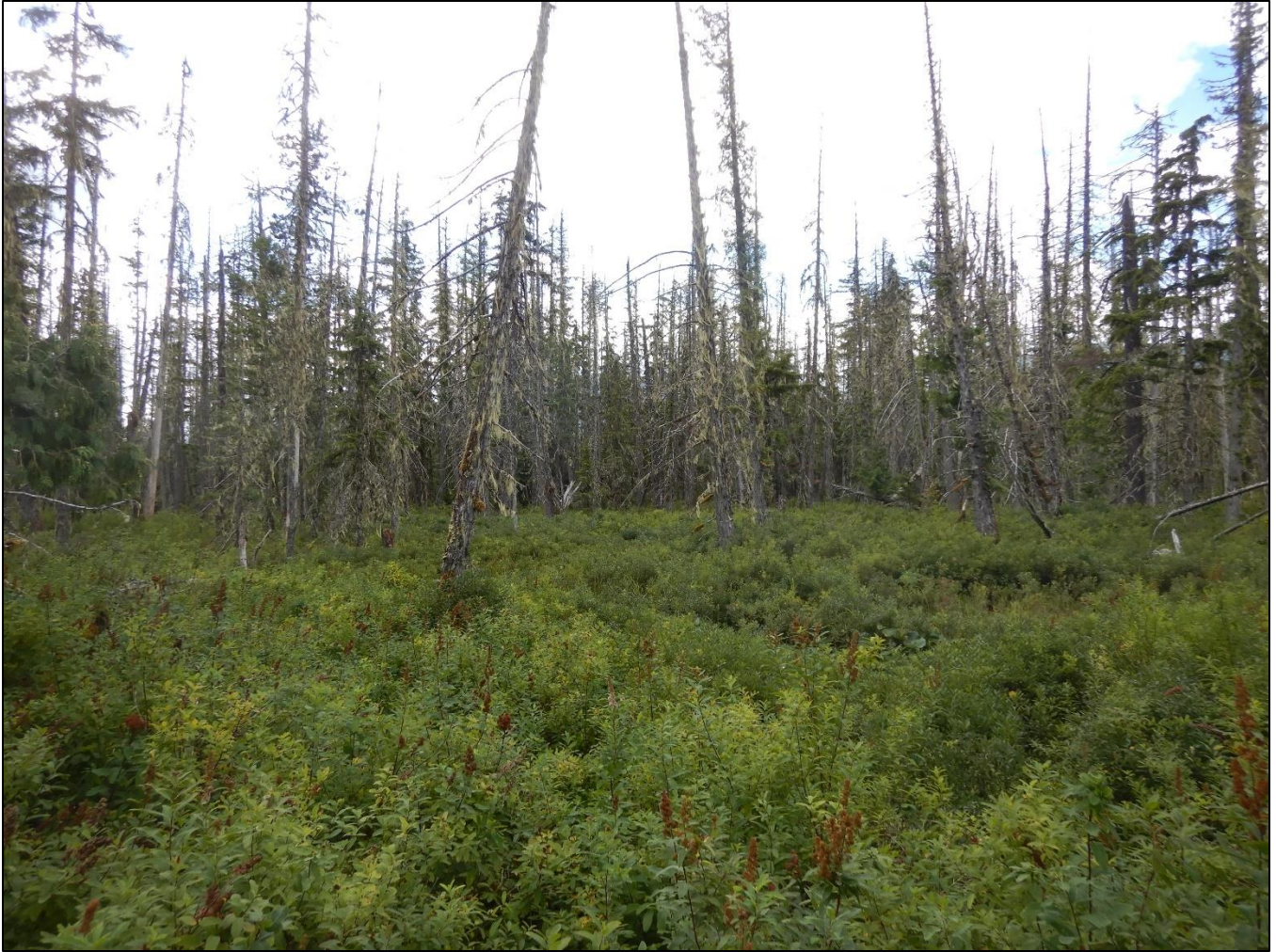


Figure 15. Sweet gale and Sitka sedge fen were found within bog woodland complex. Note the open forest and high proportion of standing dead and dead-topped trees.

Even in the bog woodlands, frequent wet, organic sloughs were deep and impassable. Nodding beggarticks and *Cicuta bulbifera* were found in the organic muck near these sloughs.

The deep-water channels that weave through the bog woodland supported bladderwort (*Utricularia*) species, yellow pondlily and marsh cinquefoil, buckbean, and other aquatic and semi-aquatic species (Figure 16, Appendix 2).

These shallow-water systems are important habitat for aquatic macroinvertebrates and amphibians.



Figure 16. Sloughs and slow-moving drainage channels meandered through the bog woodlands and wetlands.



Day 2 – Northeastern corner of the park

This part of the park is closest to Mount Layton Hotsprings and is bisected by private and public roads accessing lakeshore properties. Schulbackhand Creek flows through this area.

Rich riparian forests of Sitka spruce, red alder, and western hemlock occur in the area near Cabin Road (Placemark 196). Understories were well-developed with lady fern, highbush cranberry, skunk cabbage, red osier dogwood, Pacific crab apple, horsetails and salmonberry. This forest was reminiscent of the **blue-listed black cottonwood – red-osier dogwood mid-bench floodplain forests** (CWHws1/08, Figure 17). It also seemed transitional to the red-listed Sitka spruce – salmonberry forest ecological community (CWHws1/07) that occurs on alluvial fans because black cottonwood was rare or absent at this site. Further work is needed to determine the best site series classification for this site.

Openings filled with tall red-osier dogwood, pink spiraea, alder, *Scirpus microcarpus*, *Viola* species and crab apples occurred throughout the site.

Western hemlock – western redcedar – Sitka spruce forests with feathermoss carpets and sparser understory occurred on a gentle ridge at this area (e.g. Placemarks 207 and 213).



Figure 17. Rich riparian forests bordered creeks at Lakelse Lake Wetlands Park.

An impressive stand of open and productive **Sitka spruce – salmonberry forest** (CWHws1/07) (e.g. Placemark 220) occurs south of Schulbankhand Road (south of the the gated, private road). These red-listed forests develop on alluvial fans and differ slightly from the high fluvial bench ecosystems described in Banner *et al.* (1993). Immense old Sitka spruce were scattered throughout this forest as were large western redcedar and western hemlock (Figures 18-20). Salmonberry, devil’s club, lady fern, oak fern, spiny woodfern, foamflower, enchanter’s nightshade, skunk cabbage, red-osier dogwood and Pacific crab apples.

Where historic partial cutting occurred near the road, red alder was more abundant. An old wooden trap was found on one of the large spruce.



Figure 18. Oldgrowth forests of large Sitka spruce forests were found in the northeastern corner of Lakelse Lake Wetlands Park.



Figure 19. Lush open forests with Sitka spruce, western redcedar and western hemlock (left and below).





Figure 20. Above and right: Last remaining productive oldgrowth forests in Lakelse Lake Wetlands Park.



Foreshore surveys

It was very difficult to access the lake shore and to survey the foreshore vegetation. The long shore line at the southern end of Lakelse Lake was sampled at a few locations (Figure 21). The submerged vegetation communities at the creek outlet appeared to cover a similar area in the 1947 aerial photograph, which suggests they are long-lived. The water was very deep in the wetlands that bordered the lake and access was often prevented because of impassable meandering deep-water channels. In most cases, the homogenous bright green vegetation in the satellite image was too deep to access or sample.



Figure 21. Foreshore vegetation sampling (Day 2) on foot and kayak.

The foreshore wetland communities included the already-mentioned blue-listed Sweet gale – Sitka sedge fen (CWHws1/wf 52) as well as the **Sitka sedge – Pacific water-parsley marshes** (wm50)(Figures 22-23). The latter ecological community is red-listed or analogous to red-listed in BC.

Further out into the lake and near the creek outlet, semi-aquatic plants grew in deep water. Species included great bulrush, mare's tail (*Hippurus vulgaris*), cattails (*Typha latifolia*), water milfoil (*Myriophyllum* species), *Callitriche heterophylla*, *Equisetum fluviatile*, and numerous species of pondweed (*Potamogeton*) (Appendix 2)(Figure 24).

Floating rafts (islands) of vegetation were diverse in species, comprising a mix of wetland and aquatic plant species and sometimes even woody species (e.g. red-osier dogwood, highbush cranberry)(Figures 25 and 26). Some of the floating island plants did not occur elsewhere in the park. Most islands are similar to fen ecosystems but occur on buoyant mats of plant roots and detritus. These islands represent a unique habitat – differing from the shoreline vegetation and from the aquatic plant

communities. Studies have found that floating islands trap nutrients and sediment in the surface vegetation matter. The islands are rich in nutrients compared to surrounding water and sediments at the bottom of the lake or creek (Trivedy *et al.* 1977). Some of the floating islands functioned more as peninsula since they appeared to be attached to the shoreline.

Elodea canadensis was found up both Clearwater and Andalus Creek as far as travelled (Appendix 2)(Figures 1 and 21).



Figure 22. Sweet gale - Sitka sedge fens were found where upland sites meet lake margins and marshes.

Figure 23. Sitka sedge fens and marshes bordered Lakelse Lake in the park (right and below).





Figure 24. Aquatic vegetation: (top) extensive beds of bulrush, (middle) mare's tail and (bottom) cattail.



Figure 25. Floating islands of vegetation at Clearwater Creek outlet. Floating fens are unique, nutrient-rich ecosystems.





Figure 26. Close-up of floating rafts of vegetation at Clearwater Creek outlet. Floating fens are unusual, nutrient-rich ecosystems.

Species

Approximately 100 species of vascular plants, and approximately 40 species of mosses, liverworts, and lichens were identified and recorded during the two-day field survey at Lakelse Lake Wetlands Park (**Appendix 2**). This was not an exhaustive floristic survey as the focus was searching for rare species and ecosystems. No listed vascular plants were found but two at-risk lichen species were reported. More search effort in the park in un-surveyed older forests could lead to further occurrences of the lichen species already recorded as well as potentially new, additional species.

Further search effort however is not likely to result in finding the vascular plants currently listed by the BC Conservation Data Centre for the Coast Mountain Natural Resource District. The potential for these

species to occur in the park is relatively low because their habitats do not occur in the park. Early or ephemeral flowering plants may have been overlooked because of the timing of the surveys in 2022. For example, formerly blue-listed adder's mouth orchids (*Hammarbya paludosa* and *Malaxis brachypoda*) have the potential to occur in bog areas in the site but are very small and flower early.

Furthermore, surveys by a specialist in bryophytes (mosses and lichens) and crust lichens may locate additional species in these groups.

Interesting species found within Lakelse Lake park were goblin's gold (*Schistostega pennata*). This species was found on a tip-up of Sitka spruce. This iridescent moss grows in low-light conditions. It has been collected only 40 times in BC (UBC Herbarium Database 2023) but only one time in the Skeena region and a handful of times in Haida Gwaii.

The insectivorous species, *Drosera rotundifolia* and *Utricularia vulgaris*, were found in the bog woodlands on peat mounds and deep-water channels, respectively (Figure 27, Appendix 2). Two other *Utricularia* species (*Utricularia minor* and *U. intermedia*) were growing in association with the floating island vegetation.

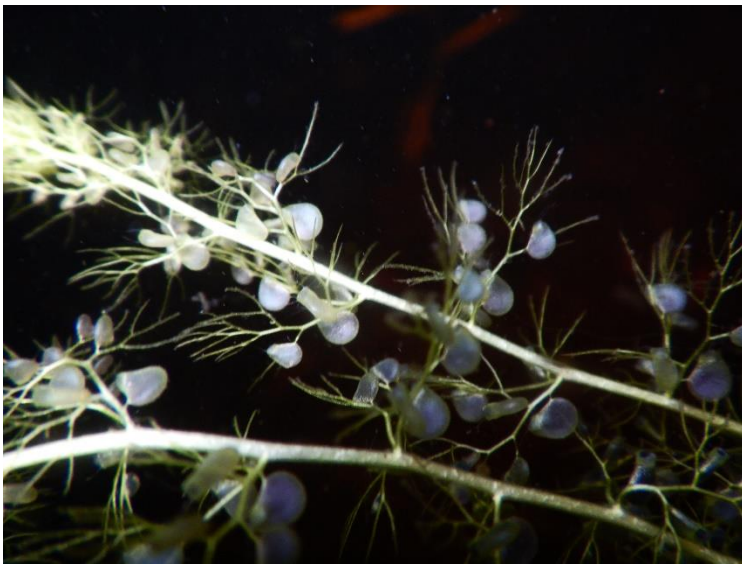


Figure 27. *Utricularia vulgaris* – common bladderwort (above)

and *Drosera rotundifolia* – round-leaved sundew (below)



At-risk species

Two blue-listed lichen species were found in the Lakelse Lake Wetlands Park (Table 1). None of the lichens listed by COSEWIC listed in Appendix 1 were detected despite considerable search effort and years of experience with most of the species.

Table 1. Rare lichen species recorded in the Lakelse Lake Wetlands Park.

Species	Common name	Listing*	No. of placemarks	No. of individuals (estimated)
<i>Leptogium tacomae</i> ¹	Tacoma jellyskin lichen	SNR, GNR. Not ranked, and not yet included in the BC flora. It will likely be red-listed as it was previously known as <i>Leptogium cyanescens</i> (red-listed).	1	20
<i>Pseudocyphellaria citrina</i> ²	Yellow specklebelly lichen	SNR, GNR. Not reviewed. Previously known as <i>P. crocata</i> (blue-listed) which has been separated into several species in BC	2	6

*BC Conservation Data Centre (2023).

¹ In the past, *Leptogium tacomae* has been misidentified as *Leptogium cyanescens*, a red-listed species. The BC Conservation Data Centre has not reviewed the BC material nor added *L. tacomae* to the BC flora.

² *Pseudocyphellaria citrina* is not currently blue listed but it is newly described for BC and North America. Historically, this species was called *Pseudocyphellaria crocata* (Lücking et al. 2017).

***Pseudocyphellaria citrina*. Yellow specklebelly. GNR SNR**



Figure 28. Yellow specklebelly lichen is not currently listed in B.C. because of new taxonomic information but will likely be blue-listed in the future.

Approximately 6 thalli of *Pseudocyphellaria citrina* were found at two locations in the park (Figure 28). Three thalli were found near the centre of the park (Placemark 118) in a bog forest of western hemlock, redcedar, Sitka spruce and lodgepole pine with skunk cabbage, *Myrica gale*, *Spiraea douglasii*, *Sphagnum*, and Sitka sedge. An additional three thalli were found at the northeastern corner the park (Placemark 206) in a riparian forest of Sitka spruce, western hemlock, paper birch and red alder with lady fern, *Viburnum edule*, red osier dogwood, skunk cabbage, and horsetails (Appendix 2). In both cases, yellow specklebelly lichen was found on Pacific crabapple trees. Yellow specklebelly was found at Muller’s Bay during the August 2022 field surveys, and Patrick Williston and Curtis Bjork have both found this species near Lakelse Lake in the past (P. Williston pers. comm. 2021; UBC Herbarium Database 2022).

Yellow specklebelly belongs to a complex of species once grouped under the name *Pseudocyphellaria crocata* in North America. Recent genetic evidence has shown that *P. crocata* does not actually exist in BC and North America (Lücking *et al.* 2017). Further taxonomic work is required in B.C. to understand

the distribution and conservation status of the three BC species in this ‘*crocata*’ group (*P. citrina*, *P. hawaiiensis*, and *P. holarctica*). *P. citrina* is not currently ranked by the BC Conservation Data Centre (2022) or NatureServe (2022). Because we are uncertain of this species’ conservation status it may be prudent to treat it as at-risk until we know more.

Pseudocyphellaria “crocata” was previously blue listed in B.C. before this new work was completed. There are 50 collections of *P. crocata* (which could be any of the three species) and three *P. citrina* in the UBC Herbarium (UBC Herbarium Database 2022). This species group is found more frequently along the Coast: the only occurrences found further inland than Lakelse Lake are from the Kispiox region and from Wells Gray Park (UBC Herbarium Database 2022).

***Leptogium tacomae* SNR GNR**



Figure 29. Close-up photograph of *Leptogium tacomae* taken through the dissecting microscope (left, dry) and field photograph (right, wet, see blue arrow). Specimens look very different when dry or wet.

Leptogium tacomae was first described by P. M. Jørgensen and T. Tønnsberg in 1999 from a single collection in Mt. Rainier National Park, Washington State. Currently, there are approximately 30 to 40 occurrences in Washington, Oregon and California (Stone and Ruchty 2022, *in press*).

It is not formally known from B.C. The B.C. Conservation Data Centre has not yet added this species to B.C. flora or ranked its conservation status. However, it is unofficially known from a few collections in B.C. UBC Herbarium (2023) houses only one specimen collected by Trevor Goward from Port Alice, BC (2006), and there are several specimens back-logged at the herbarium collected by Curtis Bjork at four sites in two of the large fjord systems (Bute and Toba Inlets) from the south coast. Therefore, there could be a total of six or seven known occurrences of *Leptogium tacomae* for B.C.

This species was often mistaken for the red-listed, blue vinyl lichen, *Leptogium cyanescens*. Blue vinyl lichen has been rarely collected in B.C. (three collections) or Alaska (four collections) but has a wide distribution globally (Consortium of Lichen Herbaria 2023).

About 20 to 30 very small thalli were found on an old crab apple tree in an open riparian forest of Sitka spruce, western hemlock, paper birch and red alder near Schulbuckhand Creek (Placemark 206, Appendix 2). The understory with lush and diverse with crab apples, lady fern, *Viburnum edule*, red osier dogwood, skunk cabbage, and horsetails. It was growing with yellow specklebelly.

This occurrence at Lakelse Lake is the most northerly and inland occurrence of *Leptogium tacomae* in B.C. It is also currently known from two sites in Alaska (near Juneau and Kodiak Island) and occurs in analogous inland, coastal-transitional areas in the Pacific Northwest region of the U.S. With further search effort, we may find that it occurs rarely but more-or-less continuously from California to Alaska. Stone and Ruchty (2023, *in press*) concluded that “*L. tacomae* has a wide ecological amplitude. This species is likely under-collected and under-reported, and has often been misidentified as *L. cyanescens*”.



Figure 30. The old, gnarled Pacific crabapple was cloaked in many mosses and lichens as well as *Leptogium tacomae*.

Other noteworthy occurrences and observations

In addition to plants, lichens and ecosystems, numerous observations of wildlife or wildlife sign were made (**Appendix 2**). During the field survey, one Columbia spotted frog was found under red osier dogwood, lady fern and *Scirpus microcarpus* in an open wet riparian forest (Figure 30, Placemark 204).



Figure 31. Columbia spotted frog.

There was evidence that bears foraged in the park frequently. There were bear trails, bear scat, and numerous skunk cabbages harvested (excavated) (Figure 31, **Appendix 2**).



Figure 32.
Skunk cabbage
were
frequently dug
up by bears.

Moose prints and dung were also noted (Appendix 2).

Currently, the presence of beavers are significantly altering the hydrology of the wetlands in the park. Beaver flooding was also encountered in the previously-logged areas. Numerous large beaver homes, beaver-felled trees and ponds were observed throughout the park (**Appendix 2**).



Figure 33. Beaver lodge in Clearwater Creek.

Human disturbances

There was a large amount of garbage dumped in the southern part of the park near old logging roads (Placemark 88).

A forestry research plot with plastic blue number tags was observed also at the southern end of the park (Placemark 147).

An old wooden trap was found on Sitka spruce from a former trapline (Placemark 226).

Conclusions and recommendations

This large park was found to support two rare lichen species (*Pseudocyphellaria citrina* and *Leptogium tacomae*), two red-listed and two blue-listed ecological communities as well as regionally-significant ecosystems such as Pacific crab apple woodlands, lodgepole pine – *Sphagnum* bog forests, oldgrowth forests, and lake shore habitats. One additional blue-listed ecological community may occur but further work is needed to confirm. Over 30 thalli of at-risk lichens were found at two placemarks in the Lakelse Lake Wetlands Park on Pacific crabapple in bog woodland and riparian forest.

These epiphytic lichen species are sensitive to edge effects, such as reduced humidity and increased light levels. Implementing buffers around the conservation area will aid in preserving sensitive species near boundaries, especially linear-shaped sites (Bezzola and Coxson 2020). We currently do not know how wide buffers need to be to ensure that lichens and other sensitive species within them will survive and reproduce. Gauslaa *et al.* (2019) found that lichens in the Kispiox interior rainforests were experiencing negative physiological impacts (i.e. permanent loss of the photosynthetic cells) as far as 100 to 120 m from the forest edge into an intact forest though this relationship tended to level off near 80-90 m from recently-harvested edges. However, because provincial parks play such a crucial role in protecting representative ecosystems in the province, even larger buffers (> 120 m) may be required to protect species and ecosystems from edge effects.

Forests are vulnerable to wind damage from prevailing winds during the fall and winter months that funnel up the trough from Kitimat. Windthrow may result in the direct loss of old trees and rare lichens, and may also degrade the favourable forest interior conditions suitable for lichens. The oldgrowth forest adjoins a regenerating cutblock at its eastern boundary. It is recommended that if this adjacent forest stand is logged in the future, a buffer is designated around the park.

The dying crab apple trees observed throughout this area is a threat for this unusual ecological community and for the epiphytic lichens that grow on them.

Groundwater flow and accumulation as well as small drainage systems are critical for the functioning of the wetlands and bog woodlands in the park. Preserving these wetlands will also preserve amphibians, such as the Columbia spotted frog, and other species associated with them. For example, signs of moose and bear using the wetlands were frequently encountered. Accumulation of nutrient-

rich groundwater is also important for the persistence of lichens and other forest species in oldgrowth, humid forests. Sensitive lichen species have been shown to be associated with close proximity to perennial water bodies (Ellis 2012) and to wet, receiving areas (e.g. toe slopes) in general. Therefore, the preservation of these unique wetland ecosystems, and rare lichen survival, critically depends on ensuring that the functioning of the hydrological systems is not disrupted.

Climate change is a major threat to the wetlands and rare lichens found in the park. Species most at risk from climate change are those that have slow dispersal rates, particular microclimate requirements, small populations, restrictive elevations, and whose habitat is limited or occurs in patches (Gayton 2008). Lichens with these life history characteristics may not be able to move to new habitats if ecosystems and plant assemblages shift quickly in response to climate change.

Climate change may reduce summer soil moisture, reduce stream flows from snow-dominated watersheds, reduce snow pack, and cause other changes in hydrology, which may contribute to the loss of some wetland ecosystems and species in the park (Gayton 2008).

Fires in these maritime wetland and forest habitats, while historically rare, may become more common because of a combination of drought events and more frequent storm events causing ignition.

More frequent storm events may also increase the incidence of windthrow of trees and erosion of lakeshore habitat. Fortunately, the southern end of Lakelse Lake is protected from wind and wave action compared to Muller's Bay at the northern end. The extensive beds of aquatic vegetation and the floating islands at the creek outlets are important aquatic habitats.

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Appendix 1. List of blue and red-listed ecosystems and species that may occur in the Lakelse Lake Wetlands Park, compiled from BC Conservation Data Centre (2022). Their potential for occurring in the park is assessed. Note: Habitat characteristics derived from Goward (1999), Goward *et al.* 1994, Brodo *et al.* 2001, McCune and Geiser 1997, Eflora BC (2022), UBC Herbarium database (2022), BC Conservation Data Centre (2022).

Scientific Name	English Name	Group	Biogeoclimatic Units	Provincial	BC List	Global	Probability of occurring	Notes
<i>Abies amabilis</i> - <i>Thuja plicata</i> / <i>Gymnocarpium dryopteris</i>	amabilis fir - western redcedar / oak fern	Ecological community	CWHms1/04; CWHms2/04; CWHws1/04; CWHws2/04	S3 (2004)	Blue	GNR	moderate	upland forest type - may not be present in basin wetland
<i>Abies amabilis</i> - <i>Thuja plicata</i> / <i>Oplopanax horridus</i> Moist Submaritime	amabilis fir - western redcedar / devil's club Moist Submaritime	Ecological community	CWHms1/06; CWHms2/06; CWHws1/06	S3 (2004)	Blue	G3G4	moderate	upland forest type - may not be present in basin wetland
<i>Carex limosa</i> - <i>Menyanthes trifoliata</i> / <i>Sphagnum</i> spp.	shore sedge - buckbean / peat-mosses	Ecological community	CWHws1/Wb13; CWHws2/Wb13; ICHmc1/Wb13; ICHvc/Wb13; ICHwk2/Wb13; SBSmk1/Wb13	S3 (2014)	Blue	G3	moderate	bog ecosystem
<i>Eleocharis palustris</i> Herbaceous Vegetation	common spike-rush Herbaceous Vegetation	Ecological community	BGxw2/Wm04; CDFmm/Wm04; CWH/Wm04; ESSFdv/Wm04; ESSFdv1/; ESSFdv2/Wm04; IDFXm/Wm04; SBSdk/Wm04; SBSmk2/Wm04	S3 (2004)	Blue	GNR	moderate	found along lake shores and larger water bodies, slow moving oxbows
<i>Menyanthes trifoliata</i> - <i>Carex lasiocarpa</i>	buckbean - slender sedge	Ecological community	CDFmm/Wf06; CWHws1/Wf06; ICHwk1/Wf06; IDFdc/Wf06; IDFdk2/Wf06; SBSdk/Wf06	S3 (2004)	Blue	G3	moderate	wetland ecosystem
<i>Picea sitchensis</i> / <i>Rubus spectabilis</i> Wet Submaritime 1	Sitka spruce / salmonberry Wet Submaritime 1	Ecological community	CWHws1/07	S2 (2010)	Red	G3	high	similar, analogous ecosystem mapped in Lakelse Lk park by Roemer in 2002.

Scientific Name	English Name	Group	Biogeoclimatic Units	Provincial	BC List	Global	Probability of occurring	Notes
<i>Pinus contorta</i> / <i>Arctostaphylos uva-ursi</i>	lodgepole pine / kinnikinnick	Ecological community	CWHws1/02; CWHws2/02	S2 (2004)	Red	GNR	low	Xeric site series. Usually on steep ridges or on very well-drained coarse parent materials.
<i>Populus trichocarpa</i> - <i>Alnus rubra</i> / <i>Rubus spectabilis</i>	black cottonwood - red alder / salmonberry	Ecological community	CDFmm/08; CWHdm/09; CWHds1/09; CWHds2/09; CWHmm1/09; CWHms1/08; CWHms2/08; CWHvm1/10; CWHwm/06; CWHws1/08; CWHws2/08; CWHxm1/09; CWHxm2/09	S3 (2010)	Blue	GNR	low	No middle fluvial bench habitat present but may be analogous ecosystem
<i>Salix sitchensis</i> - <i>Salix lasiandra</i> var. <i>lasiandra</i> / <i>Lysichiton americanus</i>	Sitka willow - Pacific willow / skunk cabbage	Ecological community	CDFmm/Ws51; CWH/Ws51; ICH/Ws51	S3 (2022)	Blue	G2	moderate	Likely to occur
<i>Thuja plicata</i> - <i>Picea sitchensis</i> / <i>Lysichiton americanus</i>	western redcedar - Sitka spruce / skunk cabbage	Ecological community	CDFmm/Ws54; CWHdm/12; CWHdm/Ws54; CWHds1/12; CWHds1/Ws54; CWHds2/12; CWHds2/Ws54; CWHmm1/12; CWHmm1/Ws54; CWHms1/11; CWHms1/Ws54; CWHms2/11; CWHms2/Ws54; CWHvh1/13; CWHvh1/Ws54; CWHvh2/13; CWHvh2/Ws54; CWHvm1/14; CWHvm1/Ws54; CWHvm2/Ws54; CWHwh1/12; CWHwh1/Ws54; CWHwh2/06; CWHwh2/Ws54; CWHws1/11; CWHws1/Ws54; CWHws2/Ws54;	S3? (2004)	Blue	G3?	high	Likely to occur

Scientific Name	English Name	Group	Biogeoclimatic Units	Provincial	BC List	Global	Probability of occurring	Notes
			CWHxm1/Ws54; CWHxm2/Ws54					
<i>Tsuga heterophylla</i> - <i>Pinus contorta</i> / <i>Pleurozium schreberi</i>	western hemlock - lodgepole pine / red-stemmed feathermoss	Ecological Community	CWHws1/03; CWHws2/03	S2S3 (2007)	Blue	G2G3	low	Occurs on dry ridge crests and upper slopes
<i>Acrosyphus sphaerophoroides</i>	mountain crab-eye	Lichen	CWHws	S2 (2019)	Red	GNR	low	occurs on snags of mountain hemlock and yellow cedar in patterned fens, generally at higher elevations.
<i>Fuscopannaria ahlneri</i>	corrugated crackers	Lichen	CWHvm; ESSFwv; ESSFwvp; ICHmc	S3 (2019)	Blue	G4G5 (2002)	moderate	Found nearby
<i>Lobaria retigera</i>	smoker's lung	Lichen	CWHvm; CWHws; ESSFvc; ESSFwcp; ESSFwk; ESSFwvp; ICHmc; ICHvc; ICHvk; ICHwk; MHmm; SBSvk	S3 (2019)	Blue	GNR	high	Found nearby in Lakelse Lake park.

Scientific Name	English Name	Group	Biogeoclimatic Units	Provincial	BC List	Global	Probability of occurring	Notes
<i>Nephroma isidiosum</i>	pebbled paw	Lichen	BAFAun; BGxh; CWHwm; ESSFwc; ESSFwcp; ESSFwv; ESSFwvp; ICHmc; ICHmw; ICHvk; ICHwk; IDFdk; MHmm; MSdm; SBSdh; SBSdw; SBSwk	S3 (2010)	Blue	G3G5 (2006)	high	Found nearby
<i>Nephroma occultum</i>	cryptic paw	Lichen	BAFAun; CWHds; CWHvm; CWHxm; ESSFwcp; ESSFwvp; ICHmc; ICHvk; ICHwk; MHmm; SBSvk	S3 (2019)	Blue	G4 (2007)	high	Found nearby
<i>Peltigera gowardii</i>	northwest waterfan	Lichen		S2 (2019)	Red	G3G4 (2013)	low	known only from subalpine streams
<i>Pseudocyphellaria rainierensis</i>	oldgrowth specklebelly	Lichen	CWHvh; CWHvm; CWHwh	S2S3 (2019)	Blue	G4 (2017)	high	Found at Robinson Lk, south of Lakelse Lk.
<i>Sclerophora peronella</i>	frosted glass-whiskers	Lichen	CWHws	S1 (2002)	Red	G3G4 (2013)	low	Found on large cottonwoods near Kitsumkalum L.
<i>Scytinium californicum</i>	midlife vinyl	Lichen	CDFmm; CWHdm; CWHds; CWHms; CWHvh; CWHwh; CWHws; CWHxm; IDFun	S2S3 (2010)	Blue	GNR	moderate	Habitat is not well understood, new taxonomic work on this group.
<i>Fissidens pauperculus</i>	poor pocket moss	Moss	CWH	S1 (2015)	Red	G3? (2012)	low	Found only once in Canada in Douglas fir forests.

Appendix 2. Geographic locations of species and field observations at the Lakelse Lake Wetlands Park. Listed lichens are highlighted.

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 84	2022-08-26T08:06:28	54.39046632	-128.5336102			Furlong Bay boat launch to look at Elodea canadensis in shallow area. Photos. It is abundant in the 'bay' between boat launch, float and shore. Alnus incana - Carex sitchensis - Cornus stolonifera habitat at shoreline. Estimate > 40 m2 of water surface. It looks like it has patchy distribution from the surface but could be thick below surface. It is the dominant aquatic plant here. It does not appear to be as abundant on other side of the boat launch. There is some washed up in the 'tide line' on the beach.
Placemark 86	2022-08-26T09:48:48	54.3264245	-128.558574			At south end of park on quad road. Boundary sign. Using old logging road to access deeper into park from this end. 2nd growth forest - Dense young canopy, no understory development
Placemark 87	2022-08-26T10:00:29	54.32906787	-128.5617076			Beaver-flooded pond.
Placemark 88	2022-08-26T10:17:53	54.330007	-128.5634612			Still 2nd growth with swamps. Photo of garbage bins, buckets, etc. Photo of bear scat just after this. Edge of Typha latifolia, skunk cabbage, Scirpus microcarpus, Spiraea douglasii wetland. Ws01 site? Saw Steller's jay

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 89	2022-08-26T10:24:12	54.33000363	-128.5640364			Photo of wet area and good crossing spot.
Placemark 90	2022-08-26T10:35:57	54.32910843	-128.5664447			Pink flagging at start of the wetland. Spiraea douglasii, Alnus incana, skunk cabbage, Equisetum fluviatile, Scirpus microcarpus, lady fern, Calamagrostis canadensis.
Placemark 91	2022-08-26T10:47:19	54.32917493	-128.5681059			Squirrel nest? In 2nd growth forest here
Placemark 92	2022-08-26T10:50:20	54.32907297	-128.5686983			Road again
Placemark 93	2022-08-26T10:53:07	54.32952717	-128.5695875			Large beaver pond near road - deep water, Typha latifolia, tall and wide beaver dam.
Placemark 94	2022-08-26T11:06:29	54.33001897	-128.5744759			Tributary of Clearwater Creek - photo
Placemark 95	2022-08-26T11:12:20	54.33193385	-128.5747238			Trail
Placemark 96	2022-08-26T11:14:07	54.33220895	-128.5750578			Dead Malus fusca. Moose prints (photo 11:15 to 11:20). Large Cw Sx skunk cabbage site before logged. Large stumps - see photo
Placemark 97	2022-08-26T11:29:54	54.33544763	-128.5754263			small stand of crabapple-skunk cabbage-lady fern. Most have died back, few still living. Dying back because of canopy closure and decreased light or from insect attack?

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 98	2022-08-26T11:35:27	54.33569625	-128.5751046			Larger Cw, few tip ups. Seems to be a patch of unlogged older forest. Skunk cabbage, lady fern and devil's club. Collected mosses from tip up soils. Lepidozia reptans, Plagiothecium sp, and Plagiochila porelloides
Placemark 99	2022-08-26T11:46:28	54.33610312	-128.5750097			back into logging. Smaller stumps here.
Placemark 100	2022-08-26T11:51:12	54.33692452	-128.5750716			Dead crabapple
Placemark 101	2022-08-26T11:54:45	54.33728202	-128.5756606			crabapple in 2nd growth plantation. Dense rgenerating stand for most part. Old road? Note: the very dark forest on Google Earth is young dense plantation (I had thought it was old at first).
Placemark 102	2022-08-26T12:03:11	54.33879532	-128.577067			small clump of 3 crabapple. All died. Web worm or stem exclusion (reduced light)? Still 2nd growth forest with large stumps. Burned.
Placemark 103	2022-08-26T12:05:56	54.33914885	-128.5772041			nice stand of crabapple and skunk cabbage. Some pressed over (snow?) but most living;. Hookeria lucens and Sphagnum girgensohnii (collected), Jamesoniella autumnalis, Rhizomnium magnifolium.
Placemark 104	2022-08-26T12:10:11	54.33923272	-128.5771973			More Malus fusca (living)
Placemark 105	2022-08-26T12:11:58	54.3393648	-128.5773122			Crabapple is common in this stretch of 2nd growth forest

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 106	2022-08-26T12:13:24	54.33949265	-128.5775854			old forest of Ss, Cw, false azalea and crabapple (some leaning, some thin crowns - defoliated?). Vaccinium ovalifolium, Scirpus microcarpus. Fallen old Cw Hw (rarely Hm). Old large Malus fusca. Very open forest, snags, dead tops, Lobaria oregana, Lobaria linita on crabapple (see photos). Collected Vahliella saubinetii with apothecia from crabapple. Peltigera collina, Frullania nisquallensis Linnaea borealis, Spiraea douglasii, Rhytidiadelphus triquetrus, Rhytidiadelphus loreus, Equisetum arvense, Hylcomium splendens, Vaccinium alaskense, skunk cabbage. Huperzia selago
Placemark 107	2022-08-26T12:31:41	54.33956618	-128.5777856			Same ecosystem - Fuscopannaria/Vahliella saubinetii Collected small piece to compare. > 30 patches of it - abundant on crabapple
Placemark 108	2022-08-26T12:38:04	54.33955122	-128.5783051			Extensive crabapple and skunk cabbage. Many crabapple have died, or if living, then not all all branches living.

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 109	2022-08-26T12:45:32	54.33961212	-128.5785386			Same forest. Ss, Cw, Hw, Hm, feathermosses, false azalea, skunk cabbage, Vaccinium ovalifolium/alaskense. Collected mosses and liverwort on organic turf at edge of depression. Nearby photo of Platismatia herrei, Platismatia glauca
Placemark 110	2022-08-26T12:51:43	54.33992713	-128.5786815			More dead crabapple - photo. Also Ledum groenlandicum, Cornus canadensis, Vaccinium parvifolium
Placemark 111	2022-08-26T12:55:25	54.34016432	-128.5787341			Photo of Alnus incana attacked by leaf roller. Photo is better location.
Placemark 112	2022-08-26T12:57:32	54.34030443	-128.5787803			More dead crabapple with skunk cabbage and Sphagnum girgensohnii
Placemark 113	2022-08-26T13:01:00	54.34065618	-128.5788334			Open forest Hw Cw (few Ss, Hm, maybe a few Yc mixed in?). Bog forest. Many of the Hw are snags/standing dead. Skunk cabbage, Cinna latifolia, Ledum groenlandicum, small crabapple, false azalea, Carex disperma, Lycopus uniflorus, Vaccinium alaskense, Oenanthe sarmentosa, Myrica gale, Carex sitchensis, Sphagnum sp.
Placemark 114	2022-08-26T13:08:01	54.34095883	-128.5788676			Collected Sphagnum sp, Gyrothyria sp.

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 115	2022-08-26T13:18:42	54.34137258	-128.5791935			Carex sitchensis - Spiraea douglasii ecosystem with Hw-Ss-Cw trees on mounds, many standing dead. Widely spaced trees. Deep muck in depressions (sunk to both knees). Skunk cabbage has been excavated here too.
Placemark 116	2022-08-26T13:27:49	54.3420488	-128.5790673			Pine is part of the canopy now. Forest is still very open with widely-spaced trees. Trees on elevated mounds. Lots of shrubs such as Myrica gale, Spiraea douglasii. Carex sitchensis, skunk cabbage, Sphagnum, some Malus fusca (rare), Ochrolechia oregonensis seems same as collected Aug 25.
Placemark 117	2022-08-26T13:34:21	54.34244008	-128.579175			Tall Myrica gale (1.5 m), skunk cabbage, Spiraea douglasii, Carex sitchensis
Placemark 118	2022-08-26T13:39:41	54.34267443	-128.5792291	<i>Pseudocypbellaria citrina</i>	3	Same ecosystem - Pseudocypbellaria citrina on crabapple Seems to be same one as yesterday. At least 3 thalli. Calliergon sp.
Placemark 119	2022-08-26T13:51:17	54.34329608	-128.5799417			More pine, lower shrubs and more Sphagnum. Stopped tracking after this, no PI 120. Notes for Placemark 120 = Bracken fern, Coptis trifoliata, Epilobium ciliolatum,

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 121	2022-08-26T14:11:35	54.34600605	-128.5801013			Lower shrub cover. Skunk cabbage, Sphagnum, lady fern, small-statured crabapple, Lycopus uniflorus, Carex disperma, Ledum groenlandicum, Epilobium ciliolatum, Vaccinium parvifolium, Vaccinium alaskense. Skunk cabbage dug up
Placemark 122	2022-08-26T14:14:03	54.34612865	-128.5801515			Bidens cernua Collected. > 20 plants
Placemark 123	2022-08-26T14:20:28	54.34611943	-128.580247			Sphagnum squarrosum, buckbean, more Bidens cernua, 100 plants
Placemark 124	2022-08-26T14:22:41	54.34619975	-128.5803034			Channels, slough areas, Sparganium angustifolium collected. Photo. Blechnum spicant.
Placemark 125	2022-08-26T14:29:04	54.34729673	-128.5800453			A lot of the skunk cabbage hearts have been excavated here - photo.
Placemark 126	2022-08-26T14:31:28	54.3475411	-128.5797868			Photo of Rubus chaemomorus. Into Carex sitchensis, Myrica gale, Spiraea douglasii, skunk cabbage, Calamagrostis canadensis.
Placemark 127	2022-08-26T14:35:22	54.34765403	-128.5796935			Nuphar polysepalum pond. Too deep to cross. Galium trifidum
Placemark 128	2022-08-26T14:52:55	54.34745158	-128.5804956			Cicuta bulbifera 2 plants, did not collect because not enough. Myrica gale, Spiraea douglasii, skunk cabbage, buckbean, Carex sitchensis, Nuphar in ponds.

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Placemark 129	2022-08-26T14:57:22	54.3473737	-128.580545			Drosera rotundifolia abundant here > 50 indiv, photo. Rubus chamaemorus, Trientalis arcticus, Bidens cernua, bear scat, Oxycoccus oxycoccus, Kalmia microphylla, Ledum groenlandicum on Sphagnum mounds
Placemark 130	2022-08-26T15:06:49	54.34740665	-128.5807537			wet deep channel bordered by Myrica gale, Spiraea douglasii, Sphagnum. In pool, large Utricularia vulgaris
Placemark 131	2022-08-26T15:13:22	54.34716888	-128.5808117			Same Cicutula bulbifera . 2 plants. Comarum palustre, Bidens cernua, Nuphar polysepalum,
Placemark 132	2022-08-26T15:15:57	54.34698665	-128.5807869			Bidens cernua, false azalea, Sphagnum, Linnaea borealis, Vaccinium alaskense, Menyanthes trifoliata, Oxycoccus oxycoccus. More large Utricularia vulgaris
Placemark 133	2022-08-26T15:19:34	54.34667775	-128.5807301			Big bear scat. Edge of slough channel here.
Placemark 134	2022-08-26T15:24:02	54.34661598	-128.5809523			More bear scat. Now across slough. Open forest with abundant snags Hw-Cw (Yc and Hm present, too?) Skunk cabbage, Carex sitchensis, Vaccinium species, Menziesia ferruginea.
Placemark 135	2022-08-26T15:28:35	54.34689443	-128.5811651			Dryopteris expansa. Hw-Cw (Ss) with skunk cabbage, Sphagnum.
Placemark 136	2022-08-26T15:43:12	54.3471643	-128.5824165			Slough, channel with Nuphar polysepalum

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 137	2022-08-26T15:46:15	54.34689753	-128.5825301			Crabapple. Open forest with lots of standing dead trees. Ss, Hw, Cw (rare Yc and Hm, too?) Spiraea douglasii, skunk cabbage, Calamagrostis canadensis, Sphagnum,
Placemark 138	2022-08-26T15:50:55	54.34634842	-128.5830346			Malus fusca, more skunk cabbage digging.
Placemark 139	2022-08-26T16:07:27	54.34438812	-128.5820777			same forest as northern transect. Open Ss, Hw, Cw Pl Sphagnum, Skunk cabbage, Vaccinium alaskense, Ledum groenlandicum bog woodland type. Collected Juncus articulatis and Agrostis aequalis
Placemark 140	2022-08-26T16:13:32	54.3440317	-128.5824006			Same ecosystem, more Bidens cernua
Placemark 141	2022-08-26T16:28:45	54.34253882	-128.5830904			Interesting bracken understory. Ss-Hw-Pl-Cw-Hm with tall dominant bracken fern - Pteridium aquilinum - but also Carex sitchensis, Ledum groenlandicum, Rubus chamaemorus, Vaccinium alaskense, Vaccinium parvifolium, Vaccinium vitis-idaea
Placemark 142	2022-08-26T16:38:36	54.3410789	-128.5835819			Bracken understory continues, sometimes 1.5 m tall. Sphagnum, feathermosses under bracken. Ledum groenlandicum, Kalmia microphylla, Rubus chamaemorus,

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						Cornus canadensis. Hw-Pl-Cw and few Ss.
Placemark 143	2022-08-26T16:50:20	54.33914943	-128.5835776			Bracken understory continued
Placemark 144	2022-08-26T16:51:46	54.33888788	-128.5836806			Back to dense plantation.
Placemark 145	2022-08-26T16:57:35	54.33810263	-128.5822046			Crabapple in plantation with Tiarella trifoliata.
Placemark 146	2022-08-26T17:01:04	54.33761535	-128.5809929			Crabapple clump, fallen over, mostly dead.
Placemark 147	2022-08-26T17:33:35	54.3307963	-128.5727259			Forest growth and yield plot or research? See photos of blue number tags.
Placemark 196	2022-08-30T08:38:04	54.356358	-128.5653877			Day 2 at Lakelse wetlands park. Parked at Cabin road, Snowy owl bay trail sign. Following ATV trail into forest. Near Schulbackhand Creek. Collected Sphaerophorus tuckermanii and Nephroma parile on Ss in rich forest. Ss - Ep - Hw - red alder open forest with lady fern, Viburnum edule, Cornus stolonifera, and some skunk cabbage. Porella navicularis.
Placemark 197	2022-08-30T08:47:49	54.35633288	-128.5654583			Collected Polytrichum commune. Same ecosystem on disturbed soil near the ATV trail.

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 198	2022-08-30T08:50:48	54.35635633	-128.5657164			Wetter, open area. Crabapple with thin crowns, some widely spaced Ep, Ss, Viola sp, tall Cornus stolonifera/sericea, Equisetum arvense
Placemark 199	2022-08-30T08:54:06	54.35628317	-128.5655464			Open Ep and Ss forest. Dead crabapple, lots of Cornus sericea. Peltigera collina, Lobaria scrobiculata, Antitrichia curtispindula, Fuscopannaria leucostictoides.
Placemark 200	2022-08-30T08:59:29	54.35604985	-128.5651206			Same ecosystem. Big opening of Cornus stolonifera - Spiraea douglasii. Goodyera oblongifolia on edge of opening. Same ecosystem.
Placemark 201	2022-08-30T09:07:21	54.35581938	-128.5649636			Big open area with Spiraea douglasii, Cornus stolonifera, Alnus incana, Scirpus microcarpus
Placemark 202	2022-08-30T09:11:21	54.35556608	-128.5650332			Into Ep-Ss rich forest again, same ecosystem as earlier.
Placemark 203	2022-08-30T09:16:48	54.35526553	-128.5651127			Forest is open with Cornus sericea, Spiraea douglasii-skunk cabbage-lady fern openings. Frequent crabapple but they appear to have died.
Placemark 204	2022-08-30T09:20:15	54.3552406	-128.5651442			Photo of frog - Columbia spotted frog. Under Cornus sericea, lady fern and Scirpus microcarpus.

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 205	2022-08-30T09:26:33	54.3552199	-128.5656876			More very large crabapple, died back and some re-sprouting. Thick with Cornus sericea, Spiraea douglasii, tall Athyrium filix-femina, leseor cover skunk cabbage and Equisetum arvense. Salmonberry present.
Placemark 206	2022-08-30T09:30:33	54.3554368	-128.5662036	<i>Pseudocyphellaria citrina</i>	3	Back to forest - Ss Hw-Ep Cw-red alder. three thalli of Pseudocyphellaria citrina. Collected.
Placemark 206	2022-08-30T09:30:33	54.3554368	-128.5662036	<i>Leptogium tacomae</i>	30	Back to forest - Ss Hw-Ep Cw. Interesting Leptogium tacomae on crabapple. Collected. 30-40 small thalli.
Placemark 207	2022-08-30T09:47:17	54.35557137	-128.5665835			On upland forest site, gentle ridge Hw-Cw-Ss feathermosses, Vaccinium species, bunchberry, Vaccinium caespitosum, Commandra lividum. Crabapple are frequent here, all seem dying or dead.
Placemark 208	2022-08-30T09:54:11	54.35590787	-128.5670744			Wall of Spiraea douglasii at water's edge. Channels of deeper water and Carex sitchensis. Very difficult to get to where creek enters lake. Photos
Placemark 209	2022-08-30T10:00:54	54.35604517	-128.5667293			Cw in upland, gentle ridge forest may have old bark stripping scars? Photo
Placemark 210	2022-08-30T10:06:21	54.35616672	-128.566897			Crabapple in Spiraea douglasii thicket

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Placemark 211	2022-08-30T10:10:36	54.35620443	-128.5672023			Spiraea douglasii- Carex sitchensis - Myrica gale. Water is under shrubs. Hard to see what is at creek and lake shore. Water is deep. Gulls, eagles nearby.
Placemark 212	2022-08-30T10:17:14	54.3562513	-128.5675767			End of Myrica gale, Spiraea douglasii, Carex sitchensis fen/marsh area. Fairly deep water. Cicuta douglasii, Comarum palustre, Equisetum fluviatile
Placemark 213	2022-08-30T10:27:33	54.3558903	-128.5664475			Mesic to sub hygric forest Cw-Hw-Ss-Ep interspersed with wet openings. Photo of old scar on Cw but likely caused by tree falling beside it.
Placemark 214 Car	2022-08-30T10:59:05	54.3522482	-128.5642356			At next road to the south in the park, at private road with gate.
Placemark 216	2022-08-30T11:08:19	54.3526375	-128.5654063			Photo of Cw with big scar. Cw-Ss-Alnus rubra-Ep-lady fern and skunk cabbage. Also parts with devil's club, false azalea and oak fern. Seems to have been partially logged in parts. Note there were sockeye in creek where I parked.
Placemark 217	2022-08-30T11:15:58	54.35254422	-128.5657406			Large Cw and Ss with red alder. Scirpus microcarpus, lady fern, skunk cabbage et areas. Lots of Lobaria oregana. Very open with gaps of salmonberry and red osier

Plot/Placemark	Date Created	Latitude	Longitude	Species	Number of individuals	Description (Note: Cw=western redcedar, Hw=western hemlock, Ss=Sitka spruce, Ep=paper birch, Hm=mountain hemlock, Yc=yellow cedar, Pl=lodgepole pine)
Placemark 218	2022-08-30T11:32:27	54.35228518	-128.5662984			Schistostega pennata - Goblin's gold on big Ss tip up. Lady fern, Scirpus microcarpus, Tiarella trifoliata, salmonberry, Circaea alpina some standing water, too.
Placemark 219	2022-08-30T11:41:47	54.35205443	-128.5666781			Large tall Cw Hw Ss devil's club, oak fern, lady fern, Streptopus roseus, Tiarella trifoliata, Dryopteris expansa, Vaccinium alaskense, Coptis trifoliata, Lady fern openings - photo
Placemark 220	2022-08-30T11:52:11	54.352166	-128.5675786			Rich oldgrowth beautiful forest. CwHwSs. Dryopteris expansa, Menziesia ferruginea, oak fern where closed and lady fern dominated gaps.
Placemark 221	2022-08-30T11:58:44	54.35232495	-128.5683259			few crabapples in lady fern, Dryopteris expansa, false azalea openings.
Placemark 222	2022-08-30T12:03:50	54.35236242	-128.5685153			Very large crabapple in lady fern, salmonberry open area.
Placemark 223	2022-08-30T12:10:50	54.35257825	-128.5685555			very big Ss. Photo. Beautiful forest but no rare lichens in understory. Are they in mid and upper canopy?
Placemark 224	2022-08-30T12:19:14	54.3529283	-128.5694173			Very big Ss.
Placemark 225	2022-08-30T12:21:04	54.35296743	-128.5698344			two very large Ss with salmonberry and ferns.
Placemark 226	2022-08-30T12:23:27	54.35284007	-128.5703264			2m+ diameter Ss and old trapline. See photo. Also skunk cabbage digging.

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Placemark 227	2022-08-30T12:25:04	54.35278735	-128.5704079			Edge of trees/Scirpus microcarpus, crabapple, abundant Spiraea douglasii, and Rosa nutkana
Placemark 228	2022-08-30T12:27:34	54.35261355	-128.5700863			Even larger Ss. Beautiful riparian forest. Cornus canadensis, Spiraea douglasii.
Placemark 229	2022-08-30T12:29:45	54.35244622	-128.5695504			Another large Ss and other large ones nearby. Likely this is red-listed ecosystem - Ss - salmonberry
Placemark 230	2022-08-30T12:35:38	54.35176812	-128.5687964			More large Ss with understory of lady fern, devil's club, salmonberry, crabapple, Cornus canadensis, Cornus sericea.
Placemark 231	2022-08-30T12:38:46	54.35157612	-128.5682282			First Sticta fuliginosa. Nephroma helveticum. Both on crabapple
Placemark 233	2022-08-30T15:10:49	54.35442895	-128.5941796			Lakelse Lk kayak survey with Eileen. Schoenoplectus lacustris in deep water. Equisetum fluviatile. Potamogeton natans, Potamogeton richardsonii Also Lemna minor, Typha latifolia, Floating vegetation mats. Utricularia vulgaris, Utricularia minor, U. intermedia? Bidens cernua, Rorippa palustris, Myosotis alpestris, Rorippa palustris, Persicaria hydropiperoides, Menyanthes trifoliata, Epilobium ciliolatum, Lycopodium uniflorus.

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Placemark 234	2022-08-30T15:25:15	54.35395008	-128.5939666			More floating island vegetation. Bidens cernua, Cicuta bulbifera, Comarum palustre, Menyanthes trifoliata, Equisetum fluviatile. Horsetail - buckbean ecosystem around floating mats.
Placemark 235	2022-08-30T15:48:46	54.35241692	-128.5893585			Floating mat vegetation is extensive. Like a peninsula from lake margin. Myrica gale, Calamagrostis canadensis, Typha latifolia, Mentha arvensis, Carex sitchensis, Comarum palustre, Lycopus uniflorus. Buckbean and Equisetum fluviatile ecosystem at water's edge.
Placemark 236	2022-08-30T16:15:07	54.35041842	-128.589914			Elodea canadensis floating almost everywhere that we have paddled. Callitriche heterophylla, Myriophyllum verticillatum
Placemark 237	2022-08-30T16:28:56	54.34908105	-128.593393			Crabapple on lake shore, thin crowns but others have died back. Another floating vegetation patch of Myrica gale, Carex sitchensis, Spiraea douglasii, Viburnum edule, and Cornus stolonifera. Andalus creek is bordered with Sitka sedge, then Myrica gale - Spiraea douglasii.
Placemark 238	2022-08-30T16:38:14	54.34774678	-128.5962611			Dead Malus fusca in centre of island. Myrica gale, Carex sitchensis, Cornus stolonifera, Viburnum edule. Rumex crispus

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Placemark 239	2022-08-30T16:43:06	54.34766758	-128.59727			Beaver lodge on land and under water. Very big. Hippuris vulgaris. Extensive colonies, see photos. Sparganium angustifolium
Placemark 240	2022-08-30T17:36:58	54.33996105	-128.5885889			Alder, Myrica gale, Carex sitchensis. Beaver flooding? Elodea canadensis present to farthest spot reached.