

# Mary Lake Nature (W̱MÍYEFEN) Sanctuary Baseline Report

Prepared by Keefer Ecological Services Ltd.

2021-03-15



## Contents

Mary Lake Nature (W̱MÍYEFEN) Sanctuary Baseline Report.....	i
List of Figures .....	iii
List of Tables .....	iii
1. Summary .....	1
1.1. Objectives.....	1
1.2. Contributors.....	1
2. Parcel Location and Identification .....	1
3. Indigenous Land Acknowledgment.....	1
4. General Description .....	4
5. Property Access.....	5
6. Methods.....	5
6.1. Terrestrial Ecosystem Mapping .....	5
6.2. Past Studies and Species Inventories.....	6
7. Significance of the Land and the Amenities.....	7
8. Description and Mapping of Natural State .....	9
8.1. Ecological Classifications.....	9
Conifer forests – Douglas-fir / dull Oregon grape.....	10
Freshwater .....	11
Woodlands - Douglas-fir / arbutus.....	13
Anthropogenic .....	14
Wetlands.....	15
Rock outcrop.....	16
Riparian forest – western redcedar / Douglas-fir – Oregon beaked-moss.....	17
Forested swamp – western redcedar / sword fern – skunk cabbage.....	18
8.2. Historical Land Uses .....	18
8.3. Anthropogenic Features .....	18
8.4. Significant Natural Features.....	21
Ranked Ecological Communities .....	21
Species of Conservation Concern.....	23
9. Threats to condition and natural state .....	24
10. References .....	26

## List of Figures

Figure 1. Parcels under covenant at Mary Lake Nature (W̱MÍYƐƐEN) Sanctuary, and adjacent property boundaries .....	3
Figure 2. Protected areas surrounding Mary Lake.....	7
Figure 3. Terrestrial Ecosystem Map. Polygons are labelled with unique identifiers and an abbreviated code representing the two major deciles classifying communities.....	8
Figure 4. Mature conifer forests are the predominant community represented in Polygon 24.....	10
Figure 5. Millstream Creek flows through a culvert beneath the paved road south of Polygon 24 .....	11
Figure 6. A small woodland patch crests a bluff at the margin of Polygon 29 .....	13
Figure 7. An anthropogenic disclimax community borders the bend in the road in Polygon 12. ....	14
Figure 8. A stand of trembling aspen towers above a seasonally flooded wetland in Polygon 19 .....	15
Figure 9. Rock outcrops define the shoreline at the margin of Polygon 20. ....	16
Figure 10. A small patch of riparian forest emerges at the base of a gully in Polygon 28.....	17
Figure 11. Anthropogenic features .....	19
Figure 12. Natural features .....	20
Figure 13. Listed Ecological Communities. Note: polygons are encoded based on dominant ecosystem components. Some ranked communities occur as minor components or deciles, however, and are therefore not reflected by the map symbology. ....	22

## List of Tables

Table 1. Project contributors .....	1
Table 2. Data Sources.....	6
Table 3. Ecological communities and land cover types mapped at Mary Lake Nature (W̱MÍYƐƐEN) Sanctuary .....	9
Table 4. CDC Ranked Ecological Communities.....	21
Table 5. Species at risk reported for Mary Lake .....	23
Table 6. Exotic Plant Species reported for Mary Lake .....	25

## 1. Summary

### 1.1. Objectives

Keefer Ecological Services Ltd. (KES) was contracted to undertake an ecological inventory of the Mary Lake Nature (W̱MÍYƐƐEN) Sanctuary, to describe the current condition of the property's ecosystems and natural values, which may be relied upon as necessary for future enforcement of a conservation covenant.

### 1.2. Contributors

**Table 1.** Project contributors. The contributors wish to thank Koi Neah, Ben van Drimmelen, Robert McMinn and Tim Boesenkool for providing background information, access, and orientation to the property.

Name	Title	Organization
Tom Braumandl, BScF, RPF	Senior Ecologist	Keefer Ecological Services Ltd.
Mike Keefer, MSc, PAg	Lead Visionary	Keefer Ecological Services Ltd.
Andrew Simon, MSc	Biodiversity Specialist & GIS Analyst	Keefer Ecological Services Ltd.
Jason Straka, MSc, RPBio	Program Ecologist	BC Ministry of Environment Conservation Data Centre
Elliott Mann, MA, BATech	GIS Specialist	Keefer Ecological Services Ltd.

## 2. Parcel Location and Identification

Located in the Highlands District of the Saanich Peninsula, Vancouver Island, BC, the Mary Lake Nature (W̱MÍYƐƐEN) Sanctuary (hereafter MLNS) includes two parcels of land at approximately 48.4994, -123.5170, west of Millstream Road. These parcels include one 12.94 ha lot (003-346-668) and another 4.04 ha lot (030-506-000) (Figure 1).

## 3. Indigenous Land Acknowledgment

The MLNS lies within the traditional territories of the WSÀNEC (Saanich)—SENĆOƐEN-speaking peoples who continue to value the land as grounds for hunting and medicine collection, and as a place of physical and spiritual cleansing. The cultural significance of the land has been attested by Tom Sampson, a respected Elder of Tsartlip First Nation (Jones et al., 2019), as well as by community members and Elders among other nations of SENĆOƐEN-speaking peoples, including the Pauquachin, Tsawout, Tseycum, Esquimalt, and Whyomilth (Songhees) (Greater Victoria Greenbelt Society, 2021). Engagement with First Nations was beyond the scope of this report. Its contents therefore should not be interpreted

as representing or limiting Indigenous rights or knowledge related to the MLNS. The Mary Lake Nature (W̱MÍYEFEN) Sanctuary is called W̱MÍYEFEN Sanctuary in the SENĆOŦEN language. Where possible, the SENĆOŦEN names are provided for plants and animals with translations from Camosun College (2021) and the SENĆOŦEN Classified Word List (2015).





Figure 1. Parcels under covenant at Mary Lake Nature (W̱MÍYƐFƐN) Sanctuary, and adjacent property boundaries

## 4. General Description

The 17 ha MLNS is situated at approximately 160 m above sea level within the 13,000-year-old Millstream Watershed, which begins near Jocelyn Hill in the Gowlland Range and flows 18 km to the ocean at the Esquimalt Harbour, draining an area of 26 km<sup>2</sup> (Greater Victoria Greenbelt Society, 2021). The underlying geology is composed of metamorphic Wark Gneiss (Muller, 1983). The radiometric ages on this unit mark metamorphism as occurring somewhere between 160–200 million years ago (Canil et al., 2013).

The central feature of the property is Mary Lake, a naturalized lake that is the namesake of the property, which is surrounded by a diversity of wetland and riparian communities associated with several creeks, including the potentially salmon-bearing Millstream Creek. The vast remainder of the land is forested, with coniferous and mixed stands at various stages of ecological succession. This complex landscape includes a broad diversity of ecosystem types, spanning a hydrological gradient from non-forested rock outcrops and dry woodlands to moist riparian forests and freshwater communities, providing habitat for a great diversity of species.

The MLNS lies within the Coastal Douglas-fir moist maritime (CDFmm) Biogeoclimatic Zone, an ecoregion with a semi-Mediterranean climate that supports the highest density of species at risk in the province of British Columbia (BC CDC, 2021a). In this densely populated region, habitat loss and fragmentation continue to pose the greatest threats to ecological communities. Cumulative anthropogenic impacts associated with these threats include: human-induced changes to predator-prey dynamics, which have resulted in increasing browsing pressures by deer and, in turn, diminished native plant abundances, as well as other higher level trophic impacts (*e.g.*, Martin et al., 2011); long-term declines in wildlife populations resulting from fragmentation of surrounding matrix habitat (Shackelford et al., 2018); the dispersal of exotic plant and animal species (Marx et al., 2016; Shackelford et al., 2018); and numerous stressors associated with climate change (Austin et al., 2008; Klassen et al., 2015; Salathé et al., 2008; Spies et al., 2010).

The most significant anthropogenic impacts on the MLNS landscape include small-scale agricultural practices dating to 1887 and logging dating to the period of ca 1935–1947 (Greater Victoria Greenbelt Society, 2021). The earthen dam which initially gave rise to Mary Lake also dates to this period. Mary Lake and its associated watercourses have since been further modified and expanded with the construction of a concrete dam and fish ladder in 1964 (Greater Victoria Greenbelt Society, 2021). Continuing anthropogenic impacts at MLNS include the “Highlands Nature House,” several adjacent cabins and out-structures, roads, skidder trails and foot paths, as well as the modified lake, dams, ditches, and associated watercourses. Nevertheless, despite a history of occupancy by First Nations and European settlers, the land remains relatively intact ecologically, retaining many natural values.

## 5. Property Access

The MLNS can officially be accessed from a gated laneway off Millstream Road, near its intersection with Stewart Mountain Road, approximately 6 km north from exit 14 off HW-1.

## 6. Methods

### 6.1. Terrestrial Ecosystem Mapping

Terrestrial ecosystem mapping (TEM) stratifies a landscape into map polygons based on ecological variables such as climate, vegetation, physiography, surficial material, bedrock geology, and soil (Resource Inventory Committee, 1998). Based on the Biogeoclimatic Ecosystem Classification (BEC) system, which was first developed to classify and manage forested ecosystems of British Columbia, the TEM methodology is currently applied to map a range of forested and non-forested communities, supporting ecosystem-based land management of a diverse range of landscapes throughout BC.

Ecological inventory and mapping of the MLNS first entailed the interpretation of satellite imagery and existing geospatial data to divide the landscape into recognizably distinct areas, circumscribed as polygons in a geographic information system (GIS). Field work was then conducted by trained ecologists with expertise in terrestrial ecosystem mapping, and the ecology and biodiversity of the CDF Zone, to ground-truth and classify the communities identified through aerial interpretation. Preliminary terrestrial ecosystem mapping was then refined using spatial analysis tools in QGIS and ArcGIS, to improve the delineation of polygons and ascribe attributes to the ecological communities present at the MLNS.

The terrestrial ecosystem mapping of the MLNS was developed according to RISC standards (Resource Inventory Committee, 1998), meeting the requirements of survey intensity level 1—a level appropriate for an area of the scale of the property. Ecosystem attribution includes sites series, structural stage, and site modifiers. Polygons were classified with up to three ecosystem components or deciles, representing each community present as a fraction of total percent land cover. Components with less than 5% cover were not noted. Site series and map code descriptions used for the attribution of ecosystems are described in Section 8 of this report.

Field work was conducted from November 18<sup>th</sup> to 19<sup>th</sup> 2020, focusing on the classification of ecological communities represented at the MLNS, supplemented by information from a brief site visit and orientation on October 6<sup>th</sup> and 8<sup>th</sup> 2020. Due to the seasonality and limited budget of this survey effort, comprehensive species inventory was beyond the scope of this contract. The resulting TEM mapping for the MLNS provides a summary of the condition and extent of ecological communities present on the land, which may serve as the basis for covenant monitoring, and to inform sampling designs to guide future inventories.



## 6.2. Past Studies and Species Inventories

Prior to conducting inventory work at the MLNS, we conducted a literature review and prepared a summary of species reported for the property (Appendix A). We also queried element occurrences in CDC iMap (BC CDC, 2021b) and the Global Biodiversity Information Facility (GBIF, 2020) to aggregate species reports based on several sources of species occurrence data (Table 2), including biological specimens deposited in herbaria, and observations made on the citizen science platforms eBird and iNaturalist. This geospatial query was based on the property boundary of the MLNS, hence all species reports derived from GBIF are based on georeferenced records.

On review of the total list of historical records, some species reports, including a report of *Hypomychia heterophylla* (Prato et al., 2020), were deemed spurious. In effort to validate the occurrence of this taxon, which is considered threatened in Canada (1-T SARA 2010; COSEWIC, 2008), we made targeted collections of *Hypomychia* specimens at the MLNS, which were identified with reference to Goward et al. (1994) using microscopy and chemical spot tests. Based on the evidence summarized in Section 8.4 of this report, the MLNS record of *Hypogymnia heterophylla* should be ruled out.

Historical data based on museum voucher specimens, including the report of the blue-listed bryophyte *Fissidens ventricosus* (S2S3 2015; BC CDC, 2021a), should also be regarded with caution, as the georeferencing of historical voucher specimens is often inaccurate. When considering the species list compiled in Appendix A, land managers should scrutinize sources and make efforts to confirm any questionable reports.

**Table 2.** Data Sources

Note: records sourced from the Consortium of Pacific Northwest Herbaria (CPNWH) were redundant, referring to collections at the Royal British Columbia Museum, and are therefore not presented here.

Title	Author(s) / Observer(s)
BC Conservation Data Centre element occurrences	BC CDC (2021b)
Birds at the Mary Lake Nature (W̱MÍYEFEN) Sanctuary	Greater Victoria Greenbelt Society (2020)
Cornell Lab of Ornithology (CLO) / eBird	Various (metadata anonymous) (GBIF 2020)
Identified Wildlife In Mary Lake Nature (W̱MÍYEFEN) Sanctuary	Ben van Drimmelen (2020)
iNaturalist	Various (iNaturalist 2020)
Mary Lake Nature (W̱MÍYEFEN) Sanctuary Lake Stewardship Project (2020)	B. Prato, H. Morrell, & L. Stewart (2020)
Mary Lake Stewardship Report	T. Jones, B. Le, A. May, & E. Ross (2019)
Mary Lake Vegetation Report	H. Roemer (2010)
National Collection of Vascular Plants (DAO)	J. H. Ginns (GBIF 2020)
Royal British Columbia Museum (BCPM, RBCM)	A. & O. Ceska; G. Copley (GBIF 2020)
Species at Risk in Mary Lake Nature (W̱MÍYEFEN) Sanctuary	Greater Victoria Greenbelt Society (2019)
University of Alberta	S. Ewan & L. Pugsley (GBIF 2020)
University of Tennessee Herbarium (TENN)	F. M. Boas (GBIF 2020)

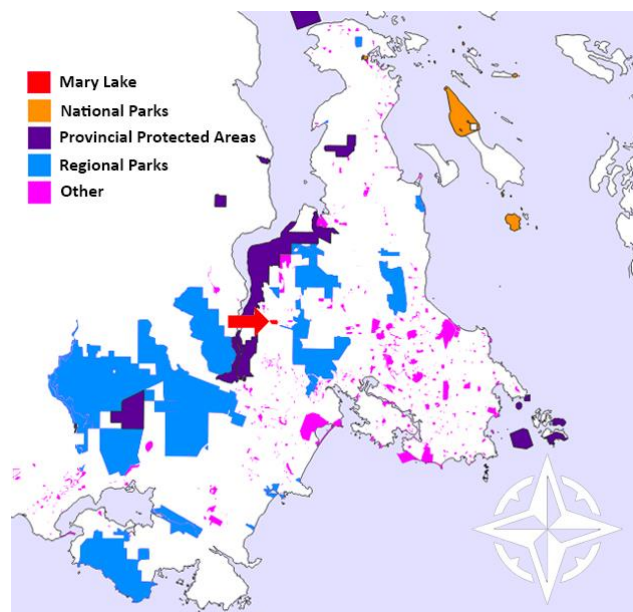
University of British Columbia Herbarium (UBC)

Various (GBIF 2020)

Utah State University Intermountain Herbarium (USU)

S. Flowers (GBIF 2020)

## 7. Significance of the Land and the Amenities

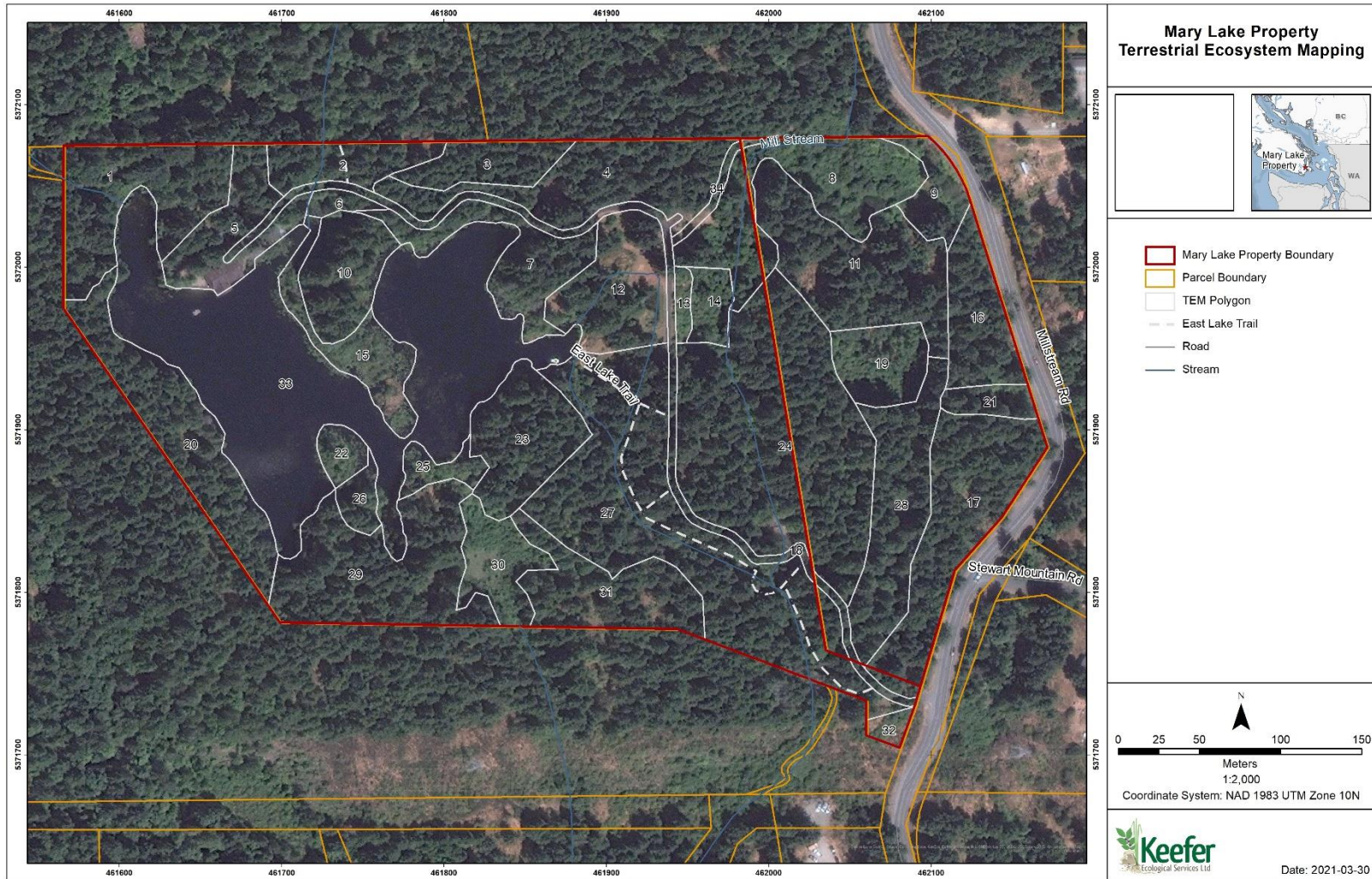


**Figure 2.** Protected areas surrounding Mary Lake

The MLNS protects a small (17 ha) yet ecologically significant parcel of land in the imperiled CDF Zone. While the property has historically been subjected to considerable disturbance, large tracts of its forested ecosystems have advanced to mature states of ecological succession. These mature forests are significant in the context of the CDF: a landscape that has been dramatically diminished and fragmented by logging, agriculture, and urbanization. Approximately 90% of the CDF Zone has been logged as of the 1990s, leaving only <1% of its forest ecosystems in a mature or old growth state (Austin et al., 2008). In contrast, approximately 8.6 ha (roughly half) of the MLNS comprise of mature forests. The biodiversity values of these forested ecosystems will continue to increase with age, as stand structure becomes more

complex, giving rise to an increasing number of microhabitats for species.

Beyond these forested ecosystems, the MLNS protects a broad range of habitat and species diversity. This ecologically diverse landscape is important not only by virtue of its current ecological state, and species currently present on site, but also for its potential to serve as habitat for the future migration and dispersal of species from the surrounding matrix habitat. Despite its small size, the protection of MLNS represents a significant contribution to efforts to conserve the ecological integrity of the region, which is imperiled by ongoing development pressures. For example, less than 5% of the Saanich Peninsula remains in its natural state (MacDougall et al., 2004). Set into the context of this heavily fragmented area, the biologically rich landscape of Mary Lake serves as an important conservation area that helps to extend the reach of a broader protected area network (Figure 2).



**Figure 3.** Terrestrial Ecosystem Map. See Table 3 for classifications of ecological communities represented in each polygon.



## 8. Description and Mapping of Natural State

### 8.1. Ecological Classifications

The terrestrial ecosystem mapping developed for the MLNS circumscribes ten major groups of recognizable ecosystems and land cover types, including forested and non-forested communities. Forested ecosystems fall within several biogeoclimatic units (CDFmm/01, CDFmm/02, CDFmm/05, and CDFmm/11), which are described in the following section. Unforested ecosystems (CDFmm/00) have mostly been classified using a set of more generic map codes (*e.g.*, LA, PD, Ro), though some wetland communities are more precisely classified (*e.g.*, Wm05, Ws50). Other land cover types include anthropogenic rural areas, roads, and “disclimax” communities (*e.g.*, CX, RP, RA, Xa). These forested and non-forested communities are tabulated (Table 3) and described below, in descending rank order of area covered.

**Table 3. Ecological communities and land cover types mapped at Mary Lake Nature (WMIYEFEN) Sanctuary (November 2020)**

Names and rankings were derived from the BC Conservation Data Centre Ecosystem Explorer (BC CDC, 2021a)

Ecological community	Biogeoclimatic Unit	Map Codes	Polygons	Area (ha)	% Total Area
Douglas-fir / dull Oregon grape	CDFmm/01		1, 2, 3, 4, 6, 7, 10, 11, 12, 16, 17, 20, 22, 23, 24, 27, 28, 29, 31, 32	9.0	53
Freshwater	CDFmm/00	LA, PD	8, 33	2.6	15
Douglas-fir - arbutus	CDFmm/02		2, 3, 4, 6, 10, 11, 12, 13, 16, 17, 24, 25, 29, 31	1.9	11
Anthropogenic	CDFmm/00	CX, RW, RZ, Xa	5, 12, 13, 18, 25, 34	1.2	7
Wet meadows, swamps, shallow water	CDFmm/00	Wm, Ws, Ww	8, 14, 15, 19, 22, 25, 30, 33	1.0	6
Hardhack / Sitka sedge	CDFmm/00	Ws50	15, 22	0.5	3
Rock outcrop	CDFmm/00	Ro	11, 15, 31	0.3	2
Western Redcedar - Douglas-fir / Oregon Beaked-moss	CDFmm/05		9, 26, 28	0.3	2
Common cattail marsh	CDFmm/00	Wm05	19, 21, 30	0.1	<1
Western redcedar / sword-fern - skunk cabbage	CDFmm/11	Ws53	28	0.1	<1





**Figure 4.** Mature conifer forests are the predominant community represented in Polygon 24

### Conifer forests – Douglas-fir / dull Oregon grape

#### CDFmm / 01 – *Pseudotsuga menziesii* / *Berberis nervosa* (*Pseudotsuga menziesii* / *Mahonia nervosa*)

Conifer forests represent about 53% (9.0 ha) of the MLNS. This ecosystem forms the dominant forest matrix of the Coastal Douglas-fir (CDF) Biogeoclimatic Zone, occurring at middle- to upper-slope positions, on all aspects, and is characterized by a moderately dry (submesic to mesic) soil moisture regime and a poor to medium soil nutrient regime (BC CDC, 2021a). At the MLNS these forests occur at various successional stages but are most prominent as mature forests (Figure 4). These mature second-growth forests feature structurally complex understories and canopies, dominated by Douglas-fir (*Pseudotsuga menziesii*; JSÁ, lŁĆ) in the age class of roughly 80–140 years of age, based on knowledge of logging history at the site (stand age was not measured during this survey).

At the drier end of the spectrum, these forested ecosystems transition to more open woodland environments classified in the CDFmm/02 site series, with more arbutus (*Arbutus menziesii*; ĶEKĪŁĆ) and oceanspray (*Holidiscus discolor*; KÁŹELĆ). Where these forests lie in proximity to wetlands and riparian communities, they transition to moist riparian forests classified in the CDFmm/05 site series, with increasing occurrence of western redcedar (*Thuja plicata*; XPÁ) and bigleaf maple (*Acer macrophyllum*; ŹFÁ, ELĆ). Often this riparian influence was found to be quite marginal, however, due to the site's very rocky terrain. For example, the forested community surrounding Millstream Creek in



Polygon 24 was not found to exhibit a significant ecotone in proximity to the creek, hence retaining the classification of CDFmm/01.

The understory of this forested ecosystem is dominated by salal (*Gaultheria shallon*; DAKE IŁĆ), with shrubs such as oceanspray (*Holodiscus discolor*), red huckleberry (*Vaccinium parvifolium*; SKEKĆES), and beaked hazelnut (*Corylus cornuta* ssp. *californica*; KBOX) occurring in gaps in the canopy. On all sites, the moderately well-developed moss layer is dominated by Oregon beaked-moss (*Eurhynchium oregonum*), electrified cats-tail moss (*Rhytidiadelphus triquetrus*), and step moss (*Hylocomium splendens*).

Significant natural features within this ecological community include numerous veteran conifers retained since the last major disturbance, some of which have cavities that offer nesting habitat for birds, as well as a large shore pine (*Pinus contorta* ssp. *contorta*) that stands on an outcrop nearby the margin of a wetland in Polygon 23.



**Figure 5.** Millstream Creek flows through a culvert beneath the paved road south of Polygon 24

### Freshwater

#### CDFmm / 00 – LA, PD)

Approximately 2.6 ha (15%) of the Mary Lake landscape have been classified as freshwater communities, including Mary Lake itself, and several other open water bodies, such as the seasonal pond in Polygon 8. The main tributaries to Mary Lake include two creeks which enter the property at its northwestern



margins. The major watercourse, Millstream Creek (Figure 5), runs through the eastern extent of the property. Millstream Creek does not feed into Mary Lake, and is not known to bear anadromous fish at this time.

Mary Lake likely has little extant fish species diversity present, because of its hydrological isolation, and because of the documented presence of pumpkinseed fish (*Lepomis gibbosus*) which is known to reduce invertebrate populations and compete with native fish (Copp et al., 2017). The lake is up to 3.5 m deep, providing habitat for diving ducks, and the water temperature is reportedly sufficient to support salmonids (Jones et al., 2019). The shallow-water margins (technically classified as wetlands) of the lake feature emergent aquatic vegetation that provides important wildlife habitat for a diversity of birds and waterfowl such as dabbling ducks. Other wildlife species observed in association with freshwater ecosystems at Mary Lake include the American beaver (*Castor canadensis*; SKĚL,ÁU,) and the North American river otter (*Lontra canadensis*; SKÁ,ET). Bats (SĚEL,BEL,AXEN), several species of which are reported for Mary Lake, are also attracted to freshwater environments due to high levels of aquatic invertebrate productivity.

The streams at Mary Lake, including Millstream Creek, are mapped as linear features. These water features were not incorporated into spatial analysis, as the scope of this baseline report primarily concerns the property's terrestrial ecosystems, and the extent of freshwater ecosystems can be seasonally variable. As such, the extent of freshwater ecosystems may be slightly underestimated in this report.



**Figure 6.** A small woodland patch crests a bluff at the margin of Polygon 29

### Woodlands - Douglas-fir / arbutus

#### CDFmm / 02 – *Pseudotsuga menziesii* / *Arbutus menziesii*

About 1.9 ha (11%) of the MLNS are woodlands classified in the CDFmm/02 site series. These mixed woodlands tend to occur on slopes and rocky knolls in dry southern exposures, supported by shallow soils found in fissures in the bedrock, though they are also present on different aspects at Mary Lake. Owing to its slope position and gradient, the soil moisture regime of this community is very dry (xeric) to dry (subxeric), and the soil nutrient regime medium to very poor. Prominent tree species include Douglas-fir and arbutus, and, to a lesser extent, Garry oak (*Quercus garryana*; CEN, IŁĆ). Shrubs such as oceanspray and Scouler's willow (*Salix scouleriana*) also occur frequently throughout this community. At Mary Lake, the occurrence of this ecological community is limited to small patches, generally about 500 m<sup>2</sup> (0.05 ha) or less in area (Figure 6).

Because this survey was conducted in November it was not possible to undertake a comprehensive inventory of the herbaceous layer, which is generally highly diverse in this community. Characteristic herbaceous and graminoid species previously mapped at Mary Lake include small camas (*Camassia quamash*; SPÁÁNW), sea blush (*Plectritis congesta*), pink twink (*Microsteris gracilis*), western fescue (*Festuca occidentalis*), Pacific fescue (*Vulpia microstachys* var. *pauciflora*), and white fawn lily (*Erythronium oregonum*). In contemporary times, these woodland communities have been dramatically diminished by intensified deer browsing pressure, owing in part to declines in hunting and low-intensity burning practiced by Indigenous peoples, but primarily due to the decline or exclusion of dominant apex predators such as a cougars (*Puma concolor*; WTEKTNEĆ) (Martin et al., 2011). The invasion of Scotch broom (*Cytisus scoparius*) and other exotic species also represents a major threat to this community. (Note, however, that the only occurrence of Scotch broom documented during this inventory occurred at the disturbed margins of the woodland community in Polygon 25, though this invasive species is likely present elsewhere on the property.)

A remarkably dense epiphytic community was noted during surveys of the woodlands present at Mary Lake, including liverworts such as *Porella navicularis* and *Frullania nisquallensis*. This latter liverwort species is much less common in woodland environments throughout other parts of the CDF, such as the southern Gulf Islands, where its occurrence is generally limited to humid riparian forests. Its abundance at Mary Lake likely owes to the more humid mesoclimatic regime associated with the surrounding riparian and freshwater ecosystems of the extensive Millstream Watershed. Indeed, watersheds of this extent are uncommon in many other many parts of the CDF Zone, such as the southern Gulf Islands. Other significant natural features mapped in woodland environments include a number of Garry oaks occurring in Polygon 29, though these were of small size (< 15cm dbh) and generally of poor vigour), and the herbaceous communities that occur among rock outcrop complexes mapped in Polygon 31.





**Figure 7.** An anthropogenic disclimax community borders the bend in the road in Polygon 12.

### Anthropogenic

#### CDFmm / 00 – RW, RZ, Xa

Anthropogenic communities extend across approximately 1.2 ha (7%) of the MLNS landscape. These non-forested areas are classified as skidder trails or industry-related disturbances (CX), rural (RW), permanent road surface (RP), and disclimax (Xa) communities. While some of these areas are heavily impacted and ecologically compromised (*e.g.*, the road), other areas remain reasonably ecologically intact, albeit transformed from their natural condition. Such “disclimax” communities are relatively stable ecological communities that have been altered due to human modification, interrupting the natural process of ecological succession (Figure 7). At Mary Lake, such modifications to the landscape include features such as the earthen dam in Polygon 25, and disturbed clearings alongside the road (Polygons 12 and 13). These areas are largely dominated by exotic species, and without ongoing management may present a threat to surrounding natural ecosystems as a source of exotic seed dispersal.





**Figure 8.** A stand of trembling aspen towers above a seasonally flooded wetland in Polygon 19

### Wetlands

#### CDFmm / 00 – Wm05, Wm, Ws50, Ws, Ww

About 1.6 ha (10%) of MLNS are classified as open wetlands. The greater extent (1 ha) of wetland habitats at the MLNS have been significantly modified through a long history of anthropogenic and natural (beaver) disturbances. This disturbance regime is especially well exhibited in the inundated gardens adjacent to Millstream creek (Polygon 8), around which stand numerous dead trees.

Locally mapped ecological communities recognized by the CDC include shrubby hardhack swamps (Ws50) characterized by hardhack (*Spiraea douglasii*; DÍŦELÍĆ), willow (*Salix* spp.; SĚLE,ÍĆ), and red alder (*Alnus rubra*), and the blue-listed (S3 2004, CDC 2021) common cattail marshes (Wm05) that skirt Mary Lake's rocky shoreline, which are characterized by the presence of the common cattail (*Typha latifolia*; SĀ,ĶEN). Other wetland communities present at Mary Lake include marshes (Wm), swamps (Ws), and shallow waters (Ww), featuring emergent aquatic plants such as pond lily (*Nuphar* sp.; LEQI,) and spring water-starwort (*Callitriche palustris*).

Wetland vegetation is predominantly shrubby, composed of a mosaic of native and exotic species. Prominent native plant species include common cattail, hardhack, Pacific ninebark (*Physocarpus capitatus*), red-osier dogwood (*Cornus sericea*), and salmonberry (*Rubus spectabilis*). Common exotic plants include reed canary grass (*Phalaris arundinacea*), sweetbrier rose (*Rosa rubiginosa*), and



creeping buttercup (*Ranunculus repens*). The introduced eastern soft rush (*Juncus effusus* ssp. *elatus*) was also identified at the margins of Mary Lake (Polygon 5), and Himalayan blackberry (*Rubus bifrons*) in a roadside clearing (Polygon 13). Yellow-flag iris (*Iris pseudacorus*) and reed canary grass present the greatest management concerns in wetlands. These taxa are mapped in Polygon 8 and Polygons 12, 14, & 29 respectively, though they likely have more extensive distribution on the property.

A stand of aspen (*Populus tremuloides*; KÉYÁ,LEŚILĆ), which occurs infrequently in the CDF, represents a significant wetland feature (Polygon 19, Figure 8). Although this community shares an affinity with the rare ecological community classified as CDFmm/14, it lacks key species characteristic of that community (e.g., *Carex obnupta*) and was therefore mapped as CDFmm/00 - Ws in this inventory. Further study is required to adequately classify and map the distribution of this community type in the region.



**Figure 9.** Rock outcrops define the shoreline at the margin of Polygon 20.

### Rock outcrop

#### CDFmm / 00 – Ro

About 0.3 ha (2%) of the MLNS comprise rock outcrops (Ro). Such outcrops occur wherever the underlying metamorphic bedrock becomes exposed, often forming complexes in association with adjacent shallow-soiled woodland environments. These formations generally hold little to no soil, supporting a sparse veneer of herbaceous species such as broadleaf stonecrop (*Sedum spathulifolium*), licorice fern (*Polypodium glycyrrhiza*; TESIP), with drought-tolerant bryophytes such as *Polytrichum*



*piliferum* found in more exposed aspects, and those preferring moister conditions (e.g., *Bartramia pomiformis*) occurring in seeps and shaded aspects. Variation in the underlying geology may also give rise to microhabitats hosting taxa associated with more basic (e.g., calcite) or acidic (e.g., gneiss) conditions. Rock outcrops are mapped throughout Polygons 11, 13, and 31. They also represent a marginal (unmapped) community type defining the rocky shoreline in Polygon 20 (Figure 9).



**Figure 10.** A small patch of riparian forest emerges at the base of a gully in Polygon 28.

**Riparian forest – western redcedar / Douglas-fir – Oregon beaked-moss**  
**CDFmm / 05 – *Thuja plicata* - *Pseudotsuga menziesii* / *Eurhynchium oregonum* (*Thuja plicata* / *Pseudotsuga menziesii* - *Kindbergia oregana*)**

Riparian forests classified as CDFmm/05 encompass about 0.3 ha (2%) of the MLNS. This community is mapped in Polygons 28 and 9, where it is represented in both old forest (28) and early seral/young forest structural stages (9). Polygon 9 includes an open, disturbed area at the margins of a flooded area near Millstream Creek, featuring bigleaf maple (*Acer macrophyllum*). A drainage runs south from this area through a narrow gully (Polygon 28) that includes a lush riparian community with salmonberry, red-osier dogwood, red alder (*Alnus rubra*; SKONEŁĆ), and occasionally, western yew (*Taxus brevifolia*; TEN\_KIŁĆ). At the southern reaches of this gully the CDFmm/05 site series comes into its fullest expression in a small patch of old forest dominated by large-diameter western redcedar, with an understory dominated by salal and dull Oregon grape (*Berberis nervosa*; SENI\_IŁĆ) (Figure 10).



### Forested swamp – western redcedar / sword fern – skunk cabbage

#### CDFmm / 11 / Ws53 – *Thuja plicata* / *Polystichum munitum* - *Lysichiton americanus*

A small pocket of forested swamp classified as CDFmm/11/Ws53 was mapped at Mary Lake, representing about 0.1 ha (<1%) of the landscape. This community lies to the southernmost reaches of the narrow drainage in Polygon 28, surrounded by old riparian forests mapped as CDFmm/05, and is characterized by the presence of skunk cabbage (*Lysichiton americanus*; ʔOQI,) and sword fern (*Polystichum munitum*; SFXÁLEM), which together form an understory beneath a canopy of western redcedar. An ephemeral pool dominated by slough sedge (*Carex obnupta*) is also found within this community.

## 8.2. Historical Land Uses

The documentation of Indigenous land-use at the MLNS lies beyond the scope of this report, though testimonials by Indigenous community members in the WSÀNEC community have been documented by the Greater Victoria Greenbelt Society. After colonization, in 1887, the lands were modified with the construction of a house and gardens to the eastern extent of the property, along Millstream Road (Greater Victoria Greenbelt Society, 2021). Subsequently, from 1935 through 1947, the lands were extensively logged, and an earthen dam constructed, giving rise to Mary Lake. Then began an era of conservation, with efforts made by subsequent owners to conserve and enhance the natural and modified cultural amenities of the property. In 1964, Mary Lake and its associated watercourses were further modified and expanded with the construction of a concrete dam and fish ladder (Greater Victoria Greenbelt Society, 2021). The original homestead constructed in 1887 was removed, and a new house built at the northwestern margins of the lake.

## 8.3. Anthropogenic Features

Among the anthropogenic features currently mapped at the MLNS are several adjacent cabins and out-structures, a paved road, skidder trails and foot paths. Mary Lake itself may also be considered an anthropogenic feature, along with the dams, ditches, and associated watercourses which have dramatically altered this landscape historically. Other anthropogenic features include several bridges constructed along the East Lake Trail, a wooden platform in Polygon 12, and a pile of debris in Polygon 24. An inventory of anthropogenic features and land cover types are presented in Figure 11.



Figure 11. Anthropogenic features mapped at Mary Lake Nature (WMÍYEƒEN) Sanctuary (November, 2020)





## 8.4. Significant Natural Features

Most prominent among the natural features at the MLNS are Mary Lake, Millstream Creek, and their associated wetlands and riparian communities. These freshwater and wetland communities would be mapped as sensitive ecosystems under Sensitive Ecosystem Inventory (SEI) protocols, though they may arguably be considered anthropogenic. Other sensitive ecosystems represented at the MLNS include woodlands, rock outcrops (Ro) and associated terrestrial herbaceous communities, most of which have been mapped in association with the red-listed Douglas-fir - Arbutus ecological community (S2 2004: BC CDC 2021a) correlated with the CDFmm/02 site series.

Other natural features of note at Mary Lake include: veteran conifers, which were mapped as point features wherever they were encountered; a large shore pine in Polygon 23; and a stand of trembling aspen which lies at the centre of the shrub wetland community in Polygon 19. Figure 5 identifies the locations of the natural features mapped during this baseline inventory.

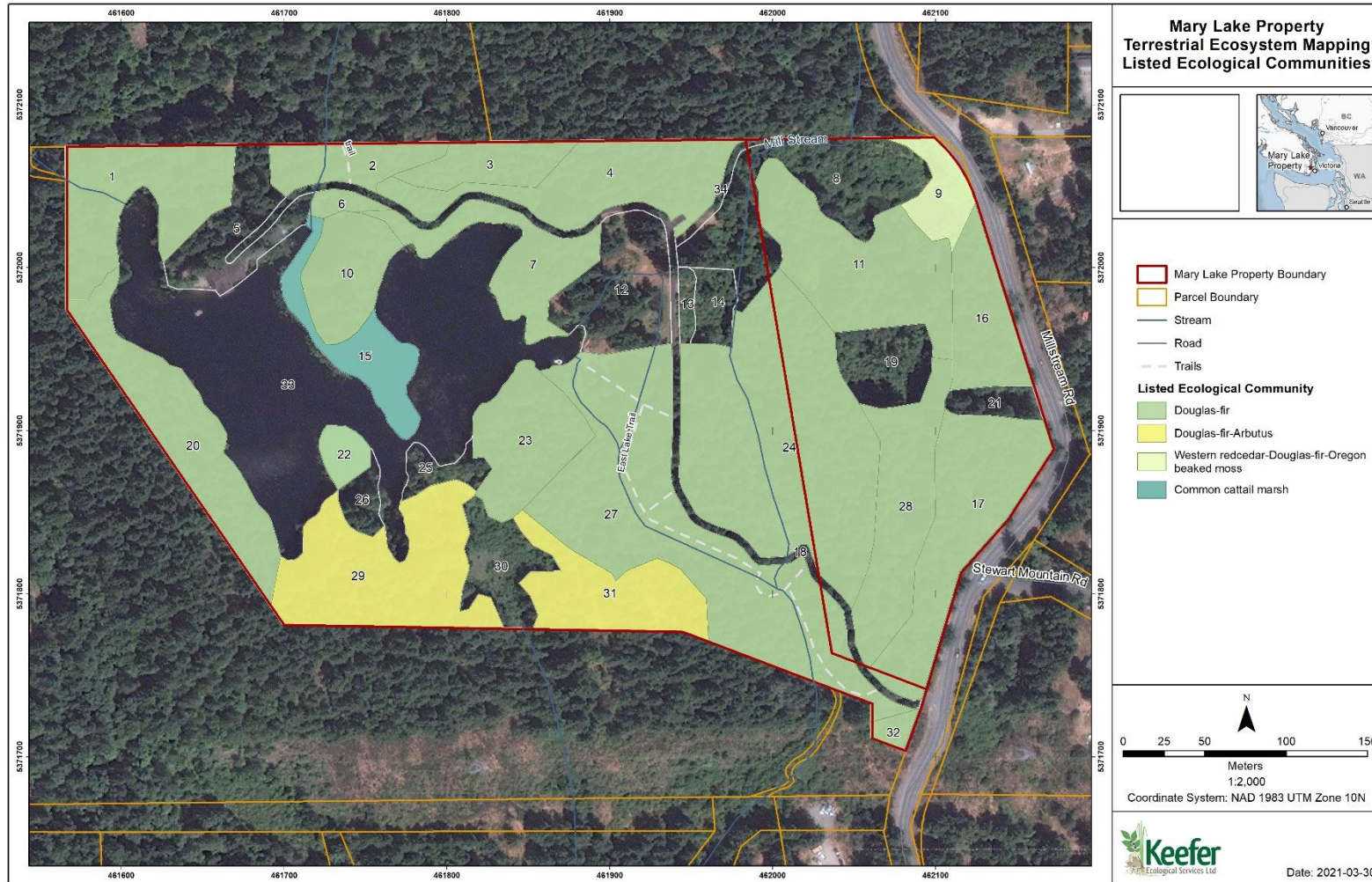
## Ranked Ecological Communities

Five of the ecological communities mapped at Mary Lake are listed by the BC Conservation Data Centre as at-risk ecosystems (BC CDC, 2021a), including three red-listed communities and two blue-listed communities (Table 4). A description of these ecological communities, and a summary of their proportional representation across the landscape of the MLNS, is presented in Section 8.1. Figure 13 and Table 4 identify the polygons within which each of these communities are represented. Note, however, that these communities are mapped as deciles or components of each polygon, following the TEM methodology described in Section 6.1. Thus, there are numerous instances where one ranked community may coincide with other ranked and/or unranked communities within a given polygon. These dimensions of the TEM methodology should be borne in mind when interpreting the map symbology in Figure 13.

**Table 4.** CDC Ranked Ecological Communities

Ranking	Biogeoclimatic Unit	Ecological community
S1 (2018)	CDFmm / 01	Douglas-fir / dull Oregon grape
S2 (2004)	CDFmm / 02	Douglas-fir / shore pine - arbutus
S1 (2009)	CDFmm / 05	western redcedar / Douglas-fir - Oregon beaked-moss
S3? (2012)	CDFmm / 11	western redcedar / sword-fern - skunk cabbage
S3 (2004)	CDFmm / Wm05	common cattail marsh





**Figure 13.** Distribution of ecological communities of conservation concern at Mary Lake Nature (WMÍYEFEN) Sanctuary (November, 2020). Note: polygons are encoded based on dominant ecosystem components. Some ranked communities that occur as minor components or deciles of polygons (Western redcedar / sword-fern - skunk cabbage and Hardhack / Sitka sedge) are not reflected on this map. All communities and their distribution are summarized in Table 3.

### Species of Conservation Concern

The MLNS provides habitat for nine reported species or subspecies at risk, including six birds, one invertebrate (butterfly), one moss species, and one plant species (Table 5). Two of these are red-listed in British Columbia, while the remainder are blue-listed (BC CDC, 2021a). Species or subspecies assessed by the Committee On the Status of Endangered Wildlife In Canada (COSEWIC) or listed under the Species at Risk Act (2002) include the western screech-owl, kennicottii subspecies (SPEPELÍXƎ), great blue heron, fannini subspecies (SNEKE), peregrine falcon, anatum subspecies, band-tailed pigeon (HEM,EU), olive-sided flycatcher, barn swallow, and western branded skipper, oregonia subspecies (See Table 5). Other species of conservation concern may be documented with further inventory work.

This report omits record of the seaside bone lichen (*Hypogymnia heterophylla*)—an implausible report (Prato et al., 2020) that could not be verified during inventory work at Mary Lake. Within British Columbia, this lichen species is found only in windswept shoreline environments, with a distribution restricted to the southwest tip of Vancouver Island, Bentinck Island, Sheringham Point, where it primarily occurs as an epiphyte on shore pine, Sitka spruce (*Picea sitchensis*), and Douglas-fir (COSEWIC, 2018). Given the ecological requirements of this species, it is highly unlikely to occur at Mary Lake. Specimens of this genus collected from the MLNS during this inventory included *Hypogymnia apinnata*, *H. enteromorpha*, *H. imshaugii*, *H. inactiva*, and *H. physodes*, all of which are common species of *Hypogymnia* expected to occur in the region.

The Mary Lake record of *Fissidens ventricosus* should be considered plausible but unconfirmed. This record dates to a voucher specimen collected by S. Flowers in 1962, accessioned at Utah State University Intermountain herbarium (GBIF, 2020). Historical voucher specimens deposited in herbaria often have inaccurate georeferencing, hence it is uncertain whether this specimen was indeed collected at the MLNS. The locality information for this specimen reads “Vancouver Island, Millstream, ca. 6 miles W of Victoria,” which suggests a considerable amount of uncertainty regarding the precise location of this report. Effort should be made to confirm this report and other uncertain records in the Mary Lake baseline species inventory.

**Table 5.** Species and subspecies at risk reported for Mary Lake as of November, 2020. Scientific names follow conventions used by the BC CDC (2021a). Species marked by an asterisk (\*) are likely, based on nearby element occurrences (BC CDC 2021b).

Scientific Name	Common (English) Name	Group	Provincial Status	COSEWIC	SARA
<i>Ardea herodias</i>	great blue heron,	<b>Bird</b>			
<i>fannini</i>	fannini subspecies		S2S3B, S4N (2018)	SC (2008)	1-SC (2010)
<i>Patagioenas fasciata</i>	band-tailed pigeon	<b>Bird</b>	S3S4 (2015)	SC (2008)	1-SC (2011)
	olive-sided	<b>Bird</b>			
<i>Contopus cooperi</i>	flycatcher		S3S4B (2014)	SC (2018)	1-T (2010)
<i>Hirundo rustica</i>	barn swallow	<b>Bird</b>	S3S4B (2015)	T (2011)	1-T (2017)

<i>Falco peregrinus</i>	peregrine falcon,	<b>Bird</b>			
<i>anatum*</i>	anatum subspecies		S2? (2011)	NAR (2017)	1-SC (2012)
<i>Megascops</i>	western screech-	<b>Bird</b>			
<i>kennicottii</i>	owl, kennicottii				
<i>kennicottii*</i>	subspecies		S2S3 (2017)	T (2012)	1-T (2005)
	western branded	<b>Inverteb</b>			
<i>Hesperia colorado</i>	skipper, oregonia	<b>rate</b>			
<i>oregonia*</i>	subspecies		S1 (2013)	E (2013)	NA
<i>Fissidens ventricosus</i>	NA	<b>Moss</b>	S2S3 (2015)	NA	NA
<i>Pyrola aphylla</i>	leafless wintergreen	<b>Plant</b>	S3 (2019)	NA	NA

## 9. Threats to condition and natural state

The MLNS is surrounded by a matrix of private land designated for agricultural, commercial, urban, and rural residential use. The activities associated with agriculture, recreation, roads, utility corridors, and nearby subdivision development contribute to numerous stressors having cumulative impacts on the surrounding ecology. These cumulative environmental impacts may result in diminishing wildlife habitat, intensified grazing by ungulates such as black-tailed deer; and increasing invasion by alien species (Martin et al., 2011; Shackelford et al., 2019; Shackelford et al., 2018).

Climate change is also altering the ecology of the Coastal Douglas-fir BEC Zone, causing increasing forest fire risk and drought stress (Klassen et al., 2015), the signs of which are particularly evident in the decline of western redcedar in the region (Seebacher, 2007). These signs of stress were not noted among western redcedar observed at Mary Lake. Nevertheless, the property may still be considered subject to potential risks associated with increasing seasonal drought and more extreme winter precipitation forecasted under future climate scenarios (Klassen et al., 2015; Salathé et al., 2008; Spies et al., 2010).

The Invasive Species Council of BC defines an invasive plant as “any invasive plant species that have the potential to pose undesirable or detrimental impacts on people, animals or ecosystems” (ISC, 2020). Invasive plants can reduce soil productivity, impact water quality and quantity, degrade wildlife habitat, threaten biodiversity, poison livestock and wildlife, and introduce disease (ISC, 2020). Economic losses may also be incurred through the loss of productive forage and the cost of controlling and managing invasive populations (ISC, 2020).

Table 6 provides a list of invasive plant species detected at Mary Lake, based on all field work conducted to date. An asterisk\* denotes species of particular concern which may be managed effectively given sufficient resources. Where possible, detections are located with reference to the unique identifiers

(PNUM) assigned to the ecological communities mapped in Figure 3. See Appendix A (accompanying spreadsheet) for a species checklist of all taxa reported for Mary Lake as of January 2021.

Exotic animal species reported include the red-eared slider (*Trachemys scripta*), the pumpkinseed fish, and the American bullfrog (*Lithobates catesbeianus*), the latter of which has been identified as a priority management concern (Jones et al., 2019). See Appendix A for a comprehensive summary of species reported for Mary Lake, which have been tabulated according to provenance and conservation status.

**Table 6.** Exotic Plants reported for Mary Lake as of November 2020

An asterisk\* marks invasive species of particular concern.

Note: *Mentha aquatica*\*\* may be misreported / misapplied to *M. canadensis*. See Appendix A.

Scientific Name	Common Name	Polygon Number	Source
<i>Agrostis stolonifera</i>	creeping bentgrass		H. Roemer (2010)
<i>Anthoxanthum odoratum</i>	sweet vernal grass		H. Roemer (2010)
<i>Cirsium arvense</i> *	Canada thistle	14, 18	H. Roemer (2010)
<i>Clematis vitalba</i>	Traveler's joy		H. Roemer (2010)
<i>Cytisus scoparius</i> *	Scotch broom	25	H. Roemer (2010)
<i>Dactylis glomerata</i>	orchard grass	24	H. Roemer (2010)
<i>Digitalis purpurea</i>	common foxglove	13	H. Roemer (2010)
<i>Draba verna</i>	common draba		J.H. Ginns (1968) (DAO 10945)
<i>Geranium molle</i>	dovefoot geranium	13	H. Roemer (2010)
<i>Geranium robertianum</i>	Robert's geranium	27	H. Roemer (2010)
<i>Hypochaeris radicata</i>	hairy cat's-ear		H. Roemer (2010)
<i>Ilex aquifolium</i> *	English holly	23, 24	T. Braumandl, A. Simon, & J. Straka (2020)
<i>Iris pseudacorus</i> *	yellow flag iris	8	T. Braumandl, A. Simon, & J. Straka (2020)
<i>Juncus effusus ssp. solutus</i>	soft rush	5	T. Braumandl, A. Simon, & J. Straka (2020)
<i>Lepidium heterophyllum</i>	Smith's pepper-grass		G.A. Hardy (1925) (RBCM V007558)
<i>Mentha spicata</i>	spearmint		H. Roemer (2010)
<i>Mycelis muralis</i>	wall lettuce		H. Roemer (2010)
<i>Phalaris arundinacea</i> *	reed canarygrass	12, 14, 29	H. Roemer (2010)
<i>Ranunculus repens</i>	creeping buttercup	14	H. Roemer (2010)
<i>Rosa rubiginosa</i>	sweetbrier		H. Roemer (2010)
<i>Rubus armeniacus</i>	Himalayan blackberry		H. Roemer (2010)
<i>Rubus laciniatus</i>	cutleaf evergreen blackberry	14	T. Braumandl, A. Simon, & J. Straka (2020)
<i>Rumex acetosella</i>	sheep sorrel	12, 29	H. Roemer (2010)
<i>Stellaria media</i>	common chickweed		H. Roemer (2010)
<i>Urtica dioica ssp. dioica</i>	stinging nettle	14	T. Braumandl, A. Simon, & J. Straka (2020)



*Mentha aquatica*\*\*

water mint

B. Prato, H. Morrell, &amp; Laura Stewart (2020)

At the MLNS, invasive species such as Scotch broom, Himalayan blackberry (*Rubus armeniacus*), and American bullfrogs have been actively managed with some success by volunteers and caretakers (K. Neah, pers. comm. 2021). However, a systematic approach to controlling invasive species is necessary to ensure that measures are effective in the long term. Each species requires a particular management regime that should be carefully considered in any subsequent management plans developed for the property. Any further modification of the lands, including construction, maintenance, and the everyday use of trails and other infrastructure, may increase the abundance of invasive species on the land. Management plans should account for potential increases in these activities in the future, to ensure the integrity of the ecosystems at Mary Lake. Although Mary Lake has one official, gated, entrance, several alternative (unofficial) access points were noted during field work. The property can theoretically be accessed through trails or historical roads connecting it to adjacent properties at approximately 48.5009, -123.5146; 48.5010, -123.5179; and 48.4980, -123.5246.

## 10. References

- Austin, M.A., Buffet, D.A., Nicholson, D.J., Scudder, G.G.E., & Stevens, V. (2008). Taking nature's pulse: the status of biodiversity in BC. [http://www.biodiversitybc.org/assets/pressReleases/BBC\\_StatusReport\\_Web\\_final.pdf](http://www.biodiversitybc.org/assets/pressReleases/BBC_StatusReport_Web_final.pdf)
- BC Conservation Data Centre (2021a). *BC Species & Ecosystems Explorer*. <https://a100.gov.bc.ca/pub/eswp/> (accessed March 15, 2021).
- B.C. Conservation Data Centre (2021b). Victoria, British Columbia, Canada. <http://maps.gov.bc.ca/ess/sv/cdc/> (accessed March 17, 2021).
- Canil, D., Johnston, S. T., Larocque, J., Friedman, R., & Heaman, L. M. (2013). Age, construction, and exhumation of the midcrust of the Jurassic Bonanza arc, Vancouver Island, Canada. *Lithosphere*, 5(1), 82-91.
- Camosun College. (2021). Native Plants: Key Tag ID and Information - Na'tsa'maht Indigenous Plant Garden. <http://camosun.ca/sustainability/garden/plant-id.html>.
- Copp, G. H., Britton, J. R., Guo, Z., Edmonds-Brown, V. R., Pegg, J., Vilizzi, L., & Davison, P. I. (2017). Trophic consequences of non-native pumpkinseed *Lepomis gibbosus* for native pond fishes. *Biological Invasions*, 19(1), 25-41.

- COSEWIC. (2008). *COSEWIC assessment and update status report on the seaside bone Hypogymnia heterophylla in Canada*. [https://www.registrelep-sararegistry.gc.ca/virtual\\_sara/files/cosewic/sr\\_seaside\\_bone\\_0808\\_e.pdf](https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr_seaside_bone_0808_e.pdf)
- GBIF (2021, January 26) *GBIF Occurrence Download*. Global Biodiversity Information Facility. <https://doi.org/10.15468/dl.9sf5fn>
- Goward, T., McCune, B., & Meidinger, D. (1994). The Lichens of British Columbia. *Illustrated keys. Part, 1*, 1-181.
- Greater Victoria Greenbelt Society (2021, March 15). Mary Lake Nature (W̱MÍYEFEN) Sanctuary. <https://www.marylakeconnections.ca/>
- Invasive Species Council of B.C. (ISC). (2020). <https://www.bcinvasives.ca/>
- Jones, T., Le, B., May, A., & Ross, E. (2019). *Mary Lake Stewardship Report*. Unpublished report.
- Klassen, H., Saunders, S. C., Kranabetter, J. M., MacKinnon, A., Griesbauer, H., & Fitzpatrick, O. (2015). Establishment of an interdisciplinary project to evaluate ecological implications of climate change in dry south coast forest ecosystems. *Technical Report-Ministry of Forests, Lands and Natural Resource Operations, British Columbia*, (086).
- MacDougall, A. S., Beckwith, B. R., & Maslovat, C. Y. (2004). Defining conservation strategies with historical perspectives: a case study from a degraded oak grassland ecosystem. *Conservation Biology*, 18(2), 455-465.
- Martin, T. G., Arcese, P., & Scheerder, N. (2011). Browsing down our natural heritage: deer impacts on vegetation structure and songbird populations across an island archipelago. *Biological Conservation*, 144(1), 459-469.
- Marx, H. E., Giblin, D. E., Dunwiddie, P. W., & Tank, D. C. (2016). Deconstructing Darwin's Naturalization Conundrum in the San Juan Islands using community phylogenetics and functional traits. *Diversity and Distributions*, 22(3), 318-331.
- Muller, J.E. (1983) *Geology of Victoria, British Columbia*. Geological Survey of Canada.
- Prato, B., Morrell, H., & Stewart L. (2020). *Mary Lake Nature (W̱MÍYEFEN) Sanctuary – Lake Stewardship Project*. Unpublished report.
- Resources Inventory Committee. (1998). Standard for terrestrial ecosystem mapping in British Columbia. [https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/tem\\_man.pdf](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/tem_man.pdf)
- Salathe Jr, E. P., Steed, R., Mass, C. F., & Zahn, P. H. (2008). A high-resolution climate model for the US Pacific Northwest: Mesoscale feedbacks and local responses to climate change. *Journal of Climate*, 21(21), 5708-5726.

- Seebacher, T. M. (2007). *Western redcedar dieback: possible links to climate change and implications for forest management on Vancouver Island, BC* (Doctoral dissertation, University of British Columbia).
- SENĆÓFEN Classified Word List. (2015). <https://itservices.cas.unt.edu/~montler/saanich/wordlist/>. (accessed March 18, 2021).
- Shackelford, N., Murray, S. M., Bennett, J. R., Lilley, P. L., Starzomski, B. M., & Standish, R. J. (2019). Ten years of pulling: Ecosystem recovery after long-term weed management in Garry oak savanna. *Conservation Science and Practice*, 1(10), e92.
- Shackelford, N., Standish, R. J., Ripple, W., & Starzomski, B. M. (2018). Threats to biodiversity from cumulative human impacts in one of North America's last wildlife frontiers. *Conservation Biology*, 32(3), 672-684.
- Spies, T. A., Giesen, T. W., Swanson, F. J., Franklin, J. F., Lach, D., & Johnson, K. N. (2010). Climate change adaptation strategies for federal forests of the Pacific Northwest, USA: ecological, policy, and socio-economic perspectives. *Landscape ecology*, 25(8), 1185-1199.