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Ecological Inventory

Morrison Headwaters Nature Preserve



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INTRODUCTION

Background

This report summarizes data collected during an ecological inventory project in the MHNP from July 3rd-7th, 2019. While the official name of the subject property is still being developed in consultation with the K'omoks First Nation, the name MHNP is a working title that is used herein without prejudice to the outcomes of First Nation consultations. The inventory was conducted by YER participants Ben Chambers and Doreen Rodriguez (youth participants), Wendy Kotilla (YER Coordinator), Tim Ennis (Latitude Conservation Solutions Company) and Jim Palmer (MCS).

The vision of the YER program is to engage vulnerable or at-risk youth in a wider circle of community relationships, in both the human and natural worlds. The program involves them with meaningful work and caring adults who support them in building self-esteem and who have the ability to transform their lives. In YER, youth travel a journey together with their community and experience a better relationship with the people and places of home (YER 2019).

The MHNP was selected as a study site for the 2019 YER Phase II project in consultation between CVRD and YER. The nature preserve (22-hectares) is private land that was acquired in March of 2019 by Comox Valley Land Trust (CVLT) and the CVRD for conservation purposes due to its exceptionally high biodiversity values. The MHNP is adjacent to the Beecher Linton Conservation Area (9-hectares) which is owned by the Province of BC and managed by the Vancouver Island Land Management Program operated by The Nature Trust of BC. CVLT has an active campaign to acquire over 250-hectares of additional lands adjacent to the MHNP in the years ahead.

Purpose of the Study

1. To support vulnerable youth within the Comox Valley by providing them with hands-on opportunities to engage with nature and adult mentors through an ecological inventory project;
2. To provide baseline ecological information to support CVRD park management and decision making.

Study Area

The MHNP is located along Morrison Creek in Electoral Area 'C' of the CVRD between the City of Courtenay and Village of Cumberland. The MHNP is roughly bounded by the Inland Island Highway, Lake Trail Rd, China Trail Ranch and the Village of Cumberland boundary. The study area was identified by the CVLT as a top-priority for conservation in the context of the entire Regional District through its science-based Land Protection Prioritization Project (LPPP). Its high ranking in the LPPP derives from its size, adjacency to existing protected areas, relatively in-tact condition of sensitive ecosystems, presence of keystone species such as various salmon species and wide-ranging carnivores as well as species at risk (Ennis 2019). One species at risk in particular, the Morrison Creek Lamprey (*Lampetra richardsoni pop. 1*), is known only from Morrison Creek and its tributaries, and occurs nowhere else on Earth. The larger Morrison Headwaters area is one of the largest remaining areas of core wildlife habitat remaining in the Comox Lowlands.

The MHNP occurs within the Nanaimo and Area Lowlands Ecoregion (NAL) and the leeward variant of the very dry (xeric) maritime subzone of the Coastal Western Hemlock biogeoclimatic zone (CWHxm1). This biogeoclimatic variant/subzone has warm, dry summers and moist, mild winters with little snowfall. The growing season is long, and moisture deficits are common during the summer months (Green and Klinka, 1994).

The headwaters of Morrison Creek are contained within a U-shaped escarpment of sand and gravel that is likely the toe of a terminal moraine deposited by the same retreating glacier that formed Comox Lake. At the base of the escarpment are a series of springs which result from deep Comox Lake water percolating through an unconfined aquifer and rising in several locations along the base of the escarpment. These springs flow year-round providing a reliable supply of cool water to Morrison Creek and its tributaries. As a result, Morrison Creek experiences stable baseflows throughout the summer drought period when most other streams of its size are dry, or nearly so. This 'climate-proof' hydrology likely explains why Morrison Creek is the most productive salmon stream of its size anywhere on southeast Vancouver Island (Davies 2018).

METHODS

The methods employed by this ecological inventory were adapted from the Describing Ecosystems in the Field methodology for Site Description and Vegetation (MOE 1998). Only a subset of the Site Description data was recorded for this project. Decisions regarding which data to record or omit were made during a pre-project planning meeting between CVRD and YER based on the following considerations:

1. Maximizing the utility of the inventory data to park management and decision making;
2. Maximizing the engagement of the youth participants in the data collection process;
3. Logistical (time) constraints.

In some cases, the methods of data collection were also modified. For example, vegetation cover data was recorded as categorical data not percent cover to reduce observer bias, and to speed up the data collection process.

Pre-typing of Ecological Units on the property was completed by Carly Palmer and Jan Gemmell of the MCS under instruction from Tim Ennis in the summer of 2018 (Palmer and Gemmell 2018). The

Ecological Units they delineated were refined by Tim Ennis prior to undertaking this study. Palmer and Gemmell sampled a sub-set (10) of the Ecological Units with a site description/vegetation plot, but were unable to complete one plot for each Ecological Unit due to time constraints. In this study, Ecological Units not previously sampled were chosen to build on the baseline of information previously recorded for the site. One Ecological Unit was sampled a second time for instructional purposes. Potential plot locations for this study were also determined based on their suitability for subsequent visitation during a public tour at the end of the project.

The plots were 11.28 m radial plots (400 m²). The plot location was adapted as necessary in the field in order to ensure that the plot captured an area that was representative of the Ecological Unit and could be safely accessed. Plot data was recorded on July 3rd, 4th and 5th. Youth participants were trained in the field on data collection methods while completing the first plot. Plot data was used to determine the ecological community (aka Site Series) of the Ecological Unit. Plant taxonomy followed Pojar and MacKinnon (2004).

All wildlife seen, heard or for which sign was encountered was recorded on a property-scale data sheet regardless of whether the animal was identified in the plot or while the surveyors were moving between plots. Plants that were observed on the property, but which did not occur in plot data, were also recorded on the property-scale data sheet.

In-stream flow monitoring for all the tributaries of Morrison Creek is being conducted by Jim Palmer of the MCS with funding from the Freshwater Fisheries Society of BC. Monitoring included the use of a 90-degree V-notch weir, an electronic level-logger and a thermometer. Jim has developed some modifications on the typical in-stream flow monitoring methods such that all equipment used (e.g. 90-degree V-notch weir) is portable and is removed upon completion of data recording. This ensures that no potential impediments to fish passage, on entrainment of sediments or organic matter result from the study. Due to time and logistical constraints only Nellie Creek (a tributary of Morrison) was measured in this study. It was selected as the flow-monitoring demonstration site due to ease of access both for the youth participants recording the data and the public tour participants. Flow monitoring took place on the morning of Thursday July 4th, 2019 from 10:05 – 10:31 am.

For demonstration purposes, a minnow trap was also deployed on Saturday July 6th and Sunday July 7th. Recording data from the fish sampled was not an objective of this study but intended for illustrative purposes on the public tour (July 7th) as both youth participants have been actively engaged in salmonid enhancement and monitoring activities in their previous involvements with the YER program.

RESULTS

Palmer and Gemmell delineated a total of 30 Ecological Units on the property, but these were aggregated to 21 by Ennis in July 2019. Of these, Palmer and Gemmell sampled 10 Ecological Units. In this study an additional 5 Ecological Units were sampled (Figure 1) including:

1. The riparian corridor of the mainstem of Morrison Creek (teal);
2. A mixed deciduous-coniferous upland forest (pink);
3. A mature coniferous up-land forest (olive green);
4. A young coniferous tree plantation, and (dark green);
5. A deciduous up-land forest (light green).

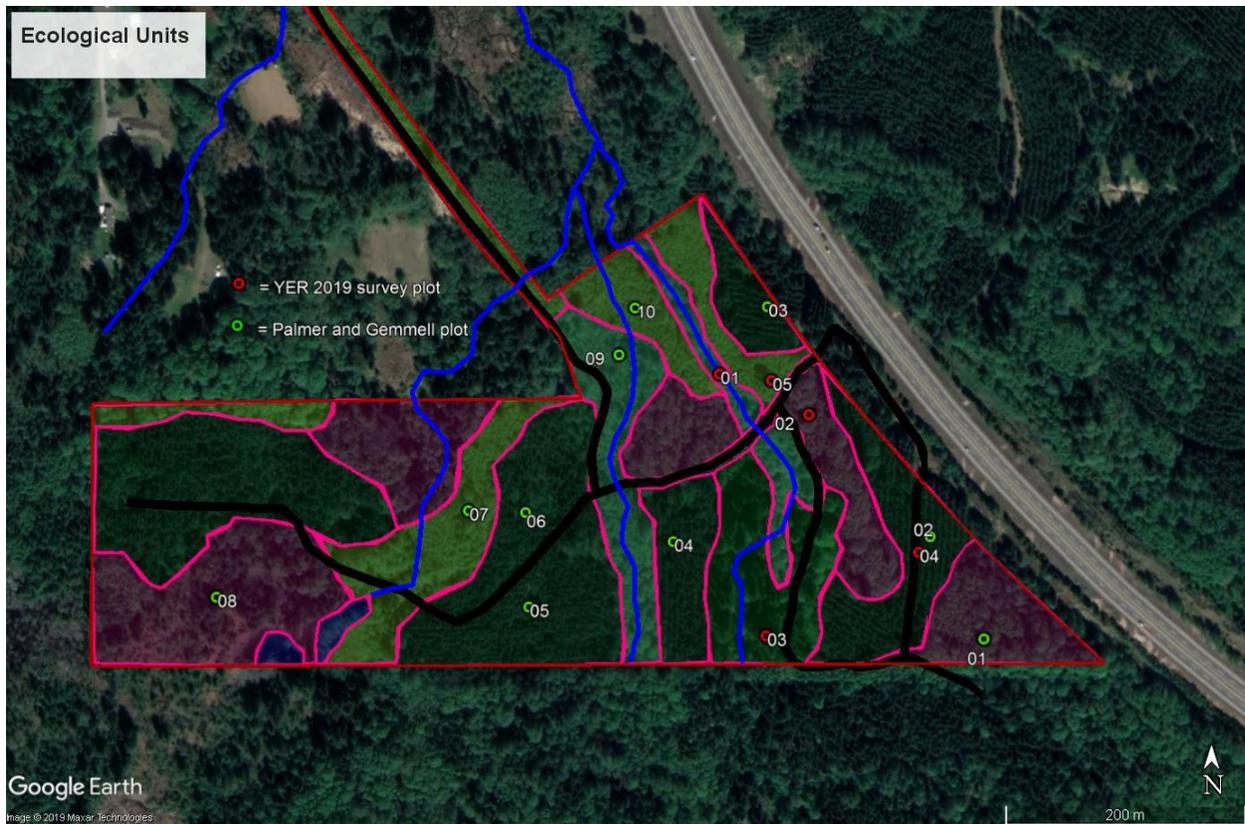


Figure 1. Ecological Units and study plots (adapted from Palmer and Gemmell)

Property-scale

Wildlife data and vegetation data was recorded within each plot but was also opportunistically recorded while moving between plots. These data were collated into a property-scale data sheet that summarizes the plant and wildlife diversity encountered during this study. Property-scale data is presented below, followed by detailed plot data.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM				
PROPERTY-SCALE FIELD FORM			Weather:	
			Cloudy and warm with periodic showers	
Project:	MHNP	Day:	03-07	Month: 7
		Year:	2019	
Surveyors: Wendy Kotilla, Tim Ennis, Ben Chambers and Doreen Rodriguez				
Project Area (Ha):	22-ha	BEC Zone:	CWHxm1	Ecosection: NAL
General Property Description:				
Historically logged forest with wet, moist and well-drained soils on undulating terrain. Historic sawmilling, farming, recreational trails, equestrian use. Lots of creeks with fish, diverse wildlife including bird life. Periodic mature and veteran trees, but mostly young trees. Particularly Red Alder, Western Redcedar and Douglas-fir				
Animals:		Plants:		
Banana Slug, American Robin, Paper Wasp, Varied Thrush, Common Raven, Cobo Salmon (fry), Garter Snake sp., Pileated Woodpecker, Pacific Wren, Swainson's Thrush, Pacific Side-band Snail, Pacific-slope Flycatcher, Raccoon, American Black Bear, Bald Eagle, Columbian Black-tailed Deer, Signal Crayfish, Red-legged Frog.		Native: Sitka Spruce, Western Redcedar, Western Hemlock, Douglas-fir, Grand Fir, Big-leaf Maple, Red Alder, Black Cottonwood, Cascara, Western Flowering Dogwood, Willow sp., Devil's Club, Pacific Ninebark, Salmonberry, Stink Currant, Red-osier Dogwood, Black Gooseberry, Red Elderberry, Red Huckleberry, Dull Oregon Grape, Salal, Saskatoon, Trailing Blackberry, Hardback (Pink Spirea), Thimbleberry, Blackcap Raspberry, Swordfern, Lady Fern, Spiny Wood Fern, Bracken Fern, Skunk Cabbage, Cooley's Hedge-nettle, Pacific Bleeding-heart, Vanilla Leaf, Western Trillium, Clasping Twistedstalk, Three-leaved Foamflower, Siberian Miner's Lettuce, Mountain Sweet-cicely, Red Columbine, Gallium sp., Sedge sp., Grass sp., Common Horsetail, Pearly Everlasting. Non-native: European Ash, English Holly, Herb Robert, Wall Lettuce, Self-heal, Curled Dock, Oxeye Daisy, Hairy Cat's Ear, Orchardgrass, Sweet Vernal Grass, Thistle sp., Broad-leaved Plantain, Lance-leaved Plantain, St. John's Wort, Clover sp., Common Tansy, Timothy, Reed Canarygrass.		

Table 1. Property-scale description of the Morrison Headwaters Nature Preserve.

Morrison Creek Riparian Area

Within the MHNP the mainstem of Morrison Creek flows from south to north through the eastern third of the property. It is contained within a floodplain of variable width bounded by gently sloping terrace walls. Site description and vegetation data for the riparian area is presented in Tables 2 and 3 below.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM					
ECOSYSTEM FIELD FORM - Site Description				Weather: <i>Cloudy, 16C</i>	
Project:	<i>MHNP</i>	Day:	<i>3</i>	Month:	<i>7</i>
		Year:	<i>2019</i>		
Surveyors:		<i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>			
Ecological Unit:	<i>MC Riparian</i>	Plot Number:	<i>1</i>	UTM Zone:	<i>10 U</i>
Slope:	<i>1-5%</i>	Aspect:	<i>0/360</i>	Elevation:	<i>111 m</i>
		N:	<i>3542801</i>		
		E:	<i>5502435</i>		
Structural Stage:		<i>5-6 (YF - MF)</i>			
		Disturbances: <i>Logging, Flooding</i>			
Cover by Layer (%)					
Trees:	<i>65%</i>	Shrubs:	<i>50%</i>	Herbs:	<i>50%</i>
		Moss:	<i>35%</i>	Bare Ground:	<i>65%</i>
Ecological Unit Description:					
<i>Right bank of Morrison Creek downstream from the BC Rail bridge. Plot was arranged in a linear fashion (not radial) to avoid upland forest influences. The plot location was characteristic of the unit.</i>					
Tree Species in Canopy:					
<i>Western Redcedar</i>					
<i>Red Alder</i>					
<i>Black Cottonwood</i>					
<i>Big-leaf Maple</i>					

Table 2. Site description data for the Morrison Creek riparian area.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM							
ECOSYSTEM FIELD FORM - Species Data			Weather: <i>Cloudy, 16C</i>				
Project:	<i>MHNP</i>	Day:	<i>3</i>	Month:	<i>7</i>	Year:	<i>2019</i>
Surveyors:		<i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>					
Ecological Unit:	<i>MC Riparian</i>	Plot Number:	<i>1</i>	Canopy Closure (%):		<i>65%</i>	
Cover by Species (Categorical) 1 = one or two; 2=a few; 3=many; 4=dominant							
Species	1	2	3	4	Dead/Alive		
<i>Red Alder</i>				X	<i>A</i>		
<i>Western Redcedar</i>		X			<i>A</i>		
<i>Big-leaf Maple</i>	X				<i>A</i>		
<i>Pacific Ninebark</i>	X				<i>A</i>		
<i>Salmonberry</i>				X	<i>A</i>		
<i>Trailing Blackberry</i>			X		<i>A</i>		
<i>Stink Currant</i>		X			<i>A</i>		
<i>Red Elderberry</i>		X			<i>A</i>		
<i>Red Huckleberry</i>		X			<i>A</i>		
<i>Swordfern</i>				X	<i>A</i>		
<i>Lady Fern</i>		X			<i>A</i>		
<i>Spiny Wood Fern</i>		X			<i>A</i>		
<i>Skunk Cabbage</i>			X		<i>A</i>		
<i>Vanilla Leaf</i>		X			<i>A</i>		
<i>Three-leaved Foam Flower</i>		X			<i>A</i>		
<i>Common Horsetail</i>	X				<i>A</i>		
<i>Cooley's Hedge Nettle</i>	X				<i>A</i>		
<i>Pacific Bleeding-heart</i>	X				<i>A</i>		
<i>Wall Lettuce</i>	X				<i>A</i>		
<i>Sedge sp.</i>	X				<i>A</i>		

Table 3. Vegetation plot data for the Morrison Creek riparian area.

Based on the data collected by the youth within the plot, and observations of indicator plants just upstream and downstream from the plot (e.g., Sitka Spruce, Devil’s Club) the ecological community in the riparian area of Morrison Creek within the MHNP is best described as the *Sitka Spruce – Salmonberry* high-bench floodplain community (CWHxm1/08).

Mixed Forest

Mixed forests occur in the MHNP area on sites where natural forest succession since the turn of the century logging on moist soils has resulted in some shade-tolerant coniferous species again becoming re-established in low-density in the otherwise deciduous-dominated canopy. Typically, these areas did not have sufficient mature coniferous tree cover to warrant a second harvesting regime in the late 1980’s. Therefore, the maturing seral communities of deciduous trees are slowly transitioning to a young climax forest. Site description and vegetation data for the riparian area is presented in Tables 4 and 5 below.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM					
ECOSYSTEM FIELD FORM - Site Description				Weather: <i>Cloudy, 16C</i>	
Project:	<i>MHNP</i>	Day:	<i>3</i>	Month:	<i>7</i>
		Year:	<i>2019</i>		
Surveyors:		<i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>			
Ecological Unit:	<i>Mixed Forest</i>	Plot Number:	<i>2</i>	UTM Zone:	<i>10 U</i>
Slope:	<i>3%</i>	Aspect:	<i>228 degrees</i>	Elevation:	<i>106 m</i>
		N:	<i>352861</i>		
		E:	<i>5502423</i>		
Structural Stage:		<i>6 (MF)</i>		Disturbances:	<i>Logging</i>
Cover by Layer (%)					
Trees:	<i>80%</i>	Shrubs:	<i>20%</i>	Herbs:	<i>55%</i>
		Moss:	<i>15%</i>	Bare Ground:	<i>70%</i>
Ecological Unit Description:					
<i>Upland forests on moist soils where shade-tolerant coniferous species are beginning to return to the canopy layer amidst dominant deciduous trees.</i>					
Tree Species in Canopy:					
<i>Western Redcedar</i>					
<i>Big-leaf Maple</i>					
<i>Western Hemlock</i>					
<i>Red Alder</i>					

Table 4. Site description data for the mixed forest area.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM							
ECOSYSTEM FIELD FORM - Species Data			Weather: <i>Cloudy 16C</i>				
Project:	<i>MHNP</i>	Day:	<i>3</i>	Month:	<i>7</i>	Year:	<i>2019</i>
Surveyors:		<i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>					
Ecological Unit:	<i>Mixed Forest</i>	Plot Number:	<i>2</i>	Canopy Closure (%):	<i>80%</i>		
Cover by Species (Categorical) 1 = one or two; 2=a few; 3=many; 4=dominant							
Species	1	2	3	4	Dead/ Alive		
<i>Western Redcedar</i>			X		<i>A</i>		
<i>Big-leaf Maple</i>		X			<i>A</i>		
<i>Western Hemlock</i>	X				<i>A</i>		
<i>Red Alder</i>		X			<i>A</i>		
<i>Dull Oregon Grape</i>		X			<i>A</i>		
<i>Red Huckleberry</i>	X				<i>A</i>		
<i>Swordfern</i>				X	<i>A</i>		
<i>Vanilla Leaf</i>			X		<i>A</i>		
<i>Herb Robert</i>		X			<i>A</i>		
<i>Bracken Fern</i>	X				<i>A</i>		
<i>Wall Lettuce</i>	X				<i>A</i>		
<i>Western Trillium</i>	X				<i>A</i>		
<i>Clasping Twistedstalk</i>	X				<i>A</i>		

Table 5. Vegetation data for the mixed forest area.

Based on the plot data collected by the youth, the ecological community in the mixed forest area of the MHNP is best described as the *Western Redcedar – Foamflower* community (CWHxm1/07).

Coniferous Forest

One area of mature coniferous forest remains in the MHNP on a terrace above the mainstem of Morrison Creek at the southern boundary of the property. Notable individual mature Douglas-fir (*Pseudotsuga menziesii*) dominate the canopy and species typical of a Douglas-fir forest dominate the understory. This stand is currently best described as mature seral and shade tolerant climax tree species are becoming well established in the sub-canopy indicating that it is transitioning to a mature climax successional stage. Site description and vegetation data for the riparian area is presented in Tables 6 and 7 below.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM					
ECOSYSTEM FIELD FORM - Site Description				Weather: <i>Cloudy, 17C</i>	
Project: <i>MHNP</i>		Day: <i>4</i>	Month: <i>7</i>	Year: <i>2019</i>	
Surveyors: <i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>					
Ecological Unit: <i>Coniferous Forest</i>		Plot Number: <i>3</i>	UTM Zone: <i>10 U</i>		
Slope: <i>10%</i>	Aspect: <i>288 degrees</i>	Elevation: <i>109 m</i>	N: <i>352812</i>	E: <i>5502229</i>	
Structural Stage: <i>6 (MF)</i>			Disturbances: <i>Logging, bench, memorial</i>		
Cover by Layer (%)					
Trees: <i>70%</i>	Shrubs: <i>30%</i>	Herbs: <i>40%</i>	Moss: <i>5%</i>	Bare Ground: <i>70%</i>	
Ecological Unit Description: <i>Coniferous dominant forest on well-drained soils in upland areas where post-logging regeneration was primarily Douglas-fir that has over-topped any deciduous competition long ago. Shade-tolerant coniferous understory well established.</i>					
Tree Species in Canopy:					
<i>Western Redcedar</i>					
<i>Douglas-fir</i>					
<i>Western Hemlock</i>					
<i>Red Alder</i>					

Table 6. Site description data from the coniferous forest area.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM							
ECOSYSTEM FIELD FORM - Species Data			Weather: <i>Cloudy 17C</i>				
Project:	<i>MHNP</i>	Day:	<i>4</i>	Month:	<i>7</i>	Year:	<i>2019</i>
Surveyors:		<i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>					
Ecological Unit:	<i>Coniferous Forest</i>	Plot Number:	<i>3</i>	Canopy Closure (%):	<i>70%</i>		
Cover by Species (Categorical) 1 = one or two; 2=a few; 3=many; 4=dominant							
Species	1	2	3	4	Dead/ Alive		
<i>Western Redcedar</i>				X			
<i>Douglas-fir</i>			X				
<i>Western Hemlock (1 dead)</i>		X					
<i>Red Alder (1 dead)</i>	X						
<i>Red Huckleberry</i>			X				
<i>Salmonberry</i>			X				
<i>Dull Oregon Grape</i>				X			
<i>English Holly (pulled out by surveyors)</i>	X						
<i>European Ash</i>	X						
<i>Saskatoon</i>	X						
<i>Swordfern</i>			X				
<i>Vanilla Leaf</i>			X				
<i>Clasping Twistedstalk</i>		X					
<i>Wall Lettuce</i>	X						
<i>Bracken Fern</i>	X				<i>A</i>		
<i>Pacific Ninebark</i>	X				<i>A</i>		
<i>Red Columbine</i>	X				<i>A</i>		
<i>Salal</i>	X				<i>A</i>		

Table 7. Vegetation data from the coniferous forest area.

Based on the plot data collected by the youth, the ecological community in the coniferous forest area of the MHNP is best described as the *Western Redcedar – Swordfern* community (CWHxm1/05). This community occurs on sites with average moisture regimes, but slightly richer than average soils.

Plantation Forest

Several areas of the MHNP are occupied by coniferous tree plantations (typically Douglas-fir). These occur on well drained areas where coniferous forests had regenerated following turn of the century logging, and a second harvest of commercially valuable trees took place in the late 1980's. Following logging, the stumps were removed and end-hauled from the property. The land was plowed into rows and planted with Douglas-fir. Sometime after the trees had grown beyond the pole-sapling stage the lower branches were removed in a silvicultural prescription to promote high quality wood in the third rotation. Site description and vegetation data for the riparian area is presented in Tables 8 and 9 below.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM					
ECOSYSTEM FIELD FORM - Site Description				Weather: <i>Cloudy with showers, 17C</i>	
Project: <i>MHNP</i>		Day: <i>5</i>	Month: <i>7</i>	Year: <i>2019</i>	
Surveyors: <i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>					
Ecological Unit: <i>Plantation Forest</i>		Plot Number: <i>4</i>		UTM Zone: <i>10 U</i>	
Slope: <i>Level</i>	Aspect: <i>\</i>		Elevation: <i>114 m</i>	N: <i>352964</i>	E: <i>5502325</i>
Structural Stage: <i>5 (YF)</i>			Disturbances: <i>Logging, stump removal, harrowing, pruning, highway</i>		
Cover by Layer (%)					
Trees: <i>85%</i>	Shrubs: <i>15%</i>	Herbs: <i>30%</i>	Moss: <i>35%</i>	Bare Ground: <i>65%</i>	
Ecological Unit Description: <i>Third-growth coniferous tree plantation. Intense silvicultural prescription whereby after the second growth was logged, the stumps were removed, the land was plowed/harrowed and an even-aged stand of Douglas-fir was planted in perfect rows. Sometime after sapling development, the lower branches were removed to promote wood quality. Dense canopy with little understory, though some seedling shrubs are beginning now to colonize the area.</i>					
Tree Species in Canopy:					
<i>Douglas-fir</i>					

Table 8. Site description data for the plantation forest area.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM							
ECOSYSTEM FIELD FORM - Species Data			Weather: <i>Cloudy with Showers, 17C</i>				
Project:	<i>MHNP</i>	Day:	<i>5</i>	Month:	<i>7</i>	Year:	<i>2019</i>
Surveyors:		<i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>					
Ecological Unit:	<i>Plantation Forest</i>	Plot Number:	<i>4</i>	Canopy Closure (%):	<i>85%</i>		
Cover by Species (Categorical) 1 = one or two; 2=a few; 3=many; 4=dominant							
Species	1	2	3	4	Dead/Alive		
<i>Douglas-fir</i>				X	<i>A</i>		
<i>Grand Fir</i>	X				<i>D</i>		
<i>Trailing Blackberry</i>				X	<i>A</i>		
<i>Salmonberry</i>			X		<i>A</i>		
<i>Cascara</i>	X				<i>A</i>		
<i>Red Elderberry</i>	X				<i>A</i>		
<i>Black Gooseberry</i>	X				<i>A</i>		
<i>Wall Lettuce</i>		X			<i>A</i>		
<i>Galium sp.</i>			X		<i>A</i>		
<i>Vanilla Leaf</i>	X				<i>A</i>		
<i>Swordfern</i>		X			<i>A</i>		
<i>Herb Robert</i>	X				<i>A</i>		
<i>Mountain Sweet Cicely</i>			X		<i>A</i>		
<i>Siberian Miner's Lettuce</i>		X			<i>A</i>		

Table 9. Vegetation data from the plantation forest area.

The heavily modified flora and soils of the plantation forest area makes the identification of the potentially natural occurring ecological community challenging. However, based on the plot data collected by the youth, the ecological community in the plantation forest area of the MHNP is best described as the *Western Hemlock / Western Redcedar – Deer fern* community (CWHxm1/06). This community occurs on sites with slightly moister than average moisture regimes, but average nutrients in the soil.

Deciduous Forest

In wetter soils on upland sites throughout the MHNP the initial removal of coniferous trees during turn of the century logging has resulted in naturally regenerating deciduous stands dominated by Red Alder (*Alnus rubra*). Wet soils are common in the MHNP area, and thus mature seral deciduous forests are equally common. Site description and vegetation data for the riparian area is presented in Tables 10 and 11 below.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM					
ECOSYSTEM FIELD FORM - Site Description				Weather: <i>Cloudy with showers, 17C</i>	
Project: <i>MHNP</i>		Day: <i>5</i>	Month: <i>7</i>	Year: <i>2019</i>	
Surveyors: <i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>					
Ecological Unit: <i>Deciduous Forest</i>		Plot Number: <i>5</i>	UTM Zone: <i>10 U</i>		
Slope: <i>2%</i>	Aspect: <i>256 degrees</i>	Elevation: <i>101 m</i>	N: <i>352853</i>	E: <i>5502456</i>	
Structural Stage: <i>5 (YF)</i>			Disturbances: <i>Logging</i>		
Cover by Layer (%)					
Trees: <i>60%</i>	Shrubs: <i>75%</i>	Herbs: <i>12%</i>	Moss: <i>5%</i>	Bare Ground: <i>7%</i>	
Ecological Unit Description: <i>Deciduous, Red Alder-dominated forest. Prior to historic logging, was likely a Western Redcedar dominated swamp or upland forest with very wet soils. These areas are known to revert to Red Alder and become "stuck" in that phase with very little cedar recruitment/succession for a very long time.</i>					
Tree Species in Canopy:					
<i>Red Alder</i>					

Table 10. Site description data for the deciduous forest area.

YOUTH AND ECOLOGICAL RESTORATION PROGRAM							
ECOSYSTEM FIELD FORM - Species Data			Weather: <i>Cloudy with showers, 17C</i>				
Project:	<i>MHNP</i>	Day:	<i>5</i>	Month:	<i>7</i>	Year:	<i>2019</i>
Surveyors:		<i>Wendy Kotilla, Tim Ennis, Ben Chambers, Doreen Rodriguez</i>					
Ecological Unit:	<i>Deciduous Forest</i>	Plot Number:	<i>5</i>	Canopy Closure (%):	<i>60%</i>		
Cover by Species (Categorical) 1 = one or two; 2=a few; 3=many; 4=dominant							
Species	1	2	3	4	Dead/Alive		
<i>Red Alder</i>				X	<i>A</i>		
<i>Red Alder</i>		X			<i>D</i>		
<i>Trailing Blackberry</i>				X	<i>A</i>		
<i>Salmonberry</i>				X	<i>A</i>		
<i>Big-leaf Maple</i>			X		<i>A</i>		
<i>English Holly</i>	X				<i>A</i>		
<i>European Ash</i>	X				<i>A</i>		
<i>Swordfern</i>		X	X		<i>A</i>		
<i>Herb Robert</i>		X			<i>A</i>		
<i>Vanilla Leaf</i>		X			<i>A</i>		
<i>Broad-leaved Starflower</i>		X			<i>A</i>		
<i>Three-leaved Foamflower</i>		X			<i>A</i>		
<i>Cooley's Hedge Nettle</i>		X			<i>A</i>		
<i>Willow sp.</i>	X				<i>A</i>		
<i>Sedge sp.</i>		X			<i>A</i>		
<i>Lady Fern</i>		X			<i>A</i>		
<i>Grass sp.</i>	X				<i>A</i>		

Table 11. Vegetation data for the deciduous forest area.

Based on the plot data collected by the youth, the ecological community in the deciduous forest area of the MHNP is best described as the *Western Redcedar / Swordfern – Skunk Cabbage* community (CWHxm1/12 and CWHxm1/Ws53). This community occurs on sites with much wetter and richer than average soils, and is considered a swamp (forested wetland). It is common for this community to remain “stuck” in a deciduous successional stage following the removal of coniferous trees from historic logging practices (CDC 2019b). Commonly this deciduous stage is dominated by Red Alder with a dense understory of Salmonberry (*Rubus spectabilis*) and Red Elderberry (*Sambucus racemosa*) such as is the case here. Coniferous growth is normally restricted to elevated microsites as was evident just outside the plot.

Flow Monitoring

During the 26-minute interval within which the flow of Nellie Creek was measured by this study, the flow (discharge) was calculated to be 0.0142 m³/s. A screen shot of the software (V-lab) which was used to calculate the streamflow (Q) is provided below in Figure 2. The youth measured variables, P, H, B and b and this was entered into V-lab to calculate Q by Jim Palmer of the Morrison Creek Streamkeepers.

Vlab online_vee_notch2: Calculation of discharge through a partially contracted 90° V-notch weir

Formula:

$$Q = 4.28 C_e (H + 0.0029)^{5/2} \quad [\text{in U.S. Units}]$$

Head H on the weir, in m [or ft]
 Width B of the channel, in m [or ft]
 Height P to the weir crotch, in m [or ft]
 C_e is a function of H/P and P/B

Discharge Q in L/s [or cfs]

For a partially contracted 90° V-notch weir: $H/B \leq 0.4$
 Fully contracted weir calculator
 See USBR Manual for general methodology

INPUT DATA: [Description]

Select Units:

Head H : m
 [$H > 0$]

Width B : m
 [$B > 0$]

Height P : m
 [$P > 0$]

OUTPUT:

Warning: Ratio $H/B = 0.1633 < 0.2$.
 Weir is fully contracted.

Warning: Ratio $H/P = 1.3333 > 1.2$. Too high.

Discharge Q : 0.0142 m³/s

Figure 2. Discharge of Nellie Creek measured during this study.

The youth also recorded the water depth from the electronic level-logger and determined the depth of the stream to be 0.109 m. The temperature of the stream was 11.9 degrees Celsius. Figure 3 below illustrates water depth and temperature during the period of July 1-6th 2019 in Nellie Creek as recorded by the level-logger. The specific moment that the youth measured the level of the stream is indicated by the red square. While this data was instructional for the youth to collect, the interpretation of these results is dependant on longer-term analysis and comparisons between Nellie Creek and other tributaries of Morrison Creek.

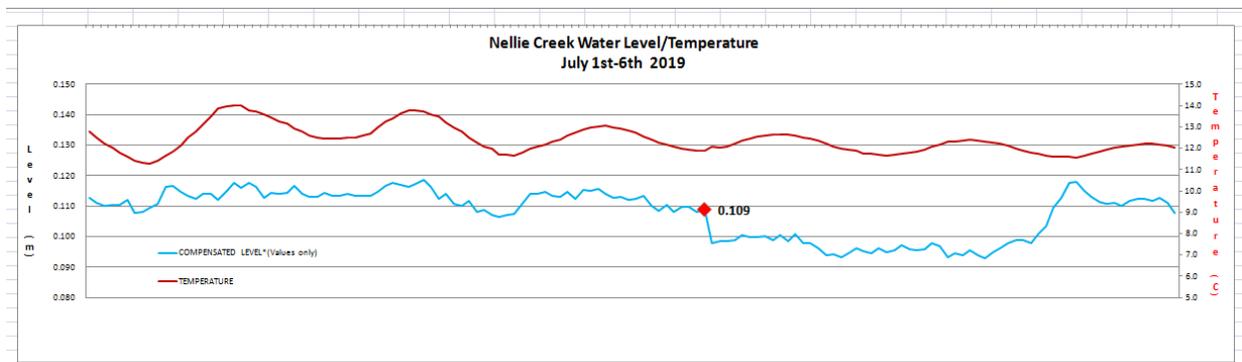


Figure 3. Water depth and temperature of Nellie Creek, July 1-6, 2019.

DISCUSSION

The MHNP protects excellent examples of riparian forests flanking one of the most important salmon streams in the Comox Valley, tributary creeks, adjacent deciduous forest/swamp habitats, as well as moist and relatively rich upland forest types. The property provides high-quality habitat for many

species, including species at risk, as well as regionally significant populations of Coho, and Pink Salmon (*Oncorhynchus kisutch* and *O. gorbuscha*). The MNHP plays a key role in protecting Critical Habitat for the endangered Morrison Creek Lamprey, which is only known from Morrison Creek and its associated tributaries and connected wetlands and occurs nowhere else on Earth. It also provides an important refugium of core habitat for common species of fish and wildlife in a region that is under increasing pressure from development and resource extraction.

Vegetation plot data collected at 5 sites within the MHNP suggests that the entire area is comprised of rare-listed ecological communities. These are detailed in Table 12 below.

Youth and Ecological Restoration Program						
Ecological Communities and Status Ranks						
Scientific Name	English Name	Ecological Unit	Global Status	Prov Statu	BC List	BEC
<i>Thuja plicata</i> / <i>Polystichum munitum</i> Very Dry Maritime	western redcedar / sword fern Very Dry Maritime	Coniferous Forest	GNR	S2S3	Blue	CWHxm1/05
<i>Tsuga heterophylla</i> - <i>Thuja plicata</i> / <i>Struthiopteris spicant</i>	western hemlock - western redcedar / deer fern	Plantation Forest	G2G3	S2	Red	CWHxm1/06
<i>Thuja plicata</i> / <i>Tiarella trifoliata</i> Very Dry Maritime	western redcedar / three-leaved foamflower Very Dry Maritime	Mixed Forest	G3	S2S3	Blue	CWHxm1/07
<i>Picea sitchensis</i> / <i>Rubus spectabilis</i> Very Dry Maritime	Sitka spruce / salmonberry Very Dry Maritime	Riparian Area	G3	S2	Red	CWHxm1/08
<i>Thuja plicata</i> / <i>Polystichum munitum</i> - <i>Lysichiton americanus</i>	western redcedar / sword fern - skunk cabbage	Deciduous Forest / Swamp	GNR	S3?	Blue	CWHxm1/12; CWHxm1/Ws53;

Table 12. Ecological communities and status ranks.

Our field work indicates that the ecology of these forests has changed significantly as a result of historic logging which took place first in the early part of the 20th century over nearly all of the property and then again over a subset of the property in the late 1980's. The remnants of the Gwilt family sawmill on the property is a reminder of the era of steam-powered sawmills and logs transported on narrow-gage railways. Areas that were harvested only once tend to be sites where coniferous regeneration has been slowed by wet to moist soil conditions that favoured competing deciduous regeneration, although some shade tolerant conifers are beginning to form part of the canopy now. Currently these forests are dominated by mature Bigleaf Maple (*Acer macrophyllum*), Black Cottonwood (*Populus trichocarpa*) and Red Alder with maturing Western Hemlock (*Tsuga heterophylla*), Sitka Spruce (*Picea sitchensis*) and Western Redcedar (*Thuja plicata*) now starting to form part of the canopy in some places.

Areas that were harvested twice tend to be sites with better drained soils that favoured coniferous regeneration following the turn of the century logging. In one case, where the coniferous forest is mature, we know from conversations with the previous owner that the site was spared from the second wave of logging as it was identified as a potential building site for a cabin (Ennis 2019). However, throughout the remainder of the well drained areas, the coniferous forests were harvested a second time and replanted and managed with an intensive silvicultural regime that is uncommon in BC. These areas are not natural forests undergoing natural succession following a disturbance, but rather are highly modified coniferous plantations. In these areas, the natural soil moisture and nutrient regimes should, and will eventually, support an ecological community that is globally and provincially endangered. Whether or not to intervene further through a program of ecological restoration or to let nature take its course should be a topic of interest to park managers and conservationists involved in the site.

Ongoing threats to the ecology of the MHNP, and the Morrison Headwaters ecosystem as a whole, include private land logging and road building in the headwater systems upstream, as well as industrial development and associated hydrological impacts along the Bevan Road corridor. The CVLT intends to acquire as much land as possible in the headwaters of Morrison Creek, to circumvent the former, while the Comox Valley Conservation Partnership intends to encourage local governments to employ low-impact best practices in any development that takes place in the latter. Support from the CVRD in both will tend to enhance the ecological integrity of the property. Although non-native species appear common along old roads, very few were noted elsewhere. Of primary concern is the sporadic occurrence of young English Holly (*Ilex aquifolium*) which is shade tolerant and has the potential to outcompete and replace native shrubs and herbs throughout the property as it has done elsewhere in areas where it has been established for longer periods of time.

YOUTH LEAD TOUR

On the fourth day of the program (July 6th) the youth participants designed and practiced for a public tour of the MNHP, which they lead on the fifth day (July 7th). The tour had several stops and included introductory/closing remarks, ecological and historical information, information on the impacts of forestry and a discussion on potential restoration approaches.

Twelve members of the public attended the tour. At each stop the youth shared with the public the knowledge they had learned throughout the course of the program. This included historical information about the Leung Farm, fish and wildlife observations, plot data, inventory techniques, ecological information, medicinal plants, and anecdotes or stories of notable things that happened during the fieldwork. During the tour, there were many questions from the public, and the youth had no problem answering the questions. The medicinal plant aspect of the tour in particular lent itself to a hands-on, experience-based opportunity for tour participants to interact with the native plants growing in the MHNP.

At the end of the tour, the youth were presented with a certificate, a reference letter, a YER program hoodie, and \$50 honorarium. It was clear from the engagement of the public in attendance and the response they received from the public, that the youth had done an excellent job of providing an informative and entertaining nature interpretation program for the tour participants.

SUMMARY AND RECOMMENDATIONS

The purpose of the YER Phase II study of the MHNP was twofold:

1. To support vulnerable youth within the Comox Valley by providing them with hands-on opportunities to engage with nature and adult mentors through an ecological inventory project;
2. To provide baseline ecological information to support CVRD parks managers and other decision makers.

With respect to the first objective, it is clear that this project was a success. The youth participants were immersed in a program which paired them with adult mentors in a natural setting. The youth thrived under these circumstances, learning both significant nature-based curriculum and important life skills in a supportive and nurturing social context. The importance and effectiveness of teamwork, positive

communications, focus, listening and consistent effort were clearly reinforced and understood. The confidence-building associated with learning advanced topics in ecology and then teaching that material to a much older audience of community members was profound.

This project is now one of a growing number of ecological and hydrological studies to take place within the larger Morrison Headwaters area and on the MHNP specifically. However, a focus on hydrology related to upstream developments, salmonid productivity and the Morrison Creek Lamprey have been three areas of particular focus in the past decades. Currently, the MCS continue to work to understand in more detail the hydrology of the area, to improve on wetland ecosystem and fish distribution mapping and to document the full range of species present in the area using iNaturalist. This information will be extremely useful to CVRD park managers engaged in management of the MHNP as well as to the CVLT as they move forward with additional land protection initiatives in the area. However, understanding the ecological communities remains an important knowledge gap. We offer the following recommendations:

1. That the CVRD continue to support the YER project and/or others in the coming years to expand on the number of ecological community plots completed in the MHNP such that this work can be considered complete. Understanding the ecological communities within the preserve could be useful in:
 - a. Attributing wildlife and other species data to habitat types;
 - b. Minimizing impacts from recreation by informing park managers on the relative rarity (status) of ecological communities and thus avoiding the location of park services in rare-listed ecosystems, and;
 - c. Developing restoration plans for tree plantations based on suitable reference ecosystems.
2. That the CVRD continue to play a leadership role in supporting the expansion of the MHNP for conservation purposes, including supporting education and outreach targeting incompatible uses of the nature preserve.

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APPENDIX 1 – PHOTO-PLATES



Tim Ennis (Latitude Conservation Solutions Company) instructing youth participants Ben Chambers and Doreen Rodriguez in ecological inventory methodologies in the Morrison Headwaters Nature Preserve.



Youth participants Doreen Rodriguez and Ben Chambers recording ecological inventory data in the Morrison Headwaters Nature Preserve.



Jim Palmer (Morrison Creek Streamkeepers) describing water monitoring equipment to youth participants Doreen Rodriguez and Ben Chambers in the Morrison Headwaters Nature Preserve.



Youth participants Doreen Rodriguez and Ben Chambers monitoring the flow (discharge) of water in Nellie Creek on the Morrison Headwaters Nature Preserve with Jim Palmer (Morrison Creek Streamkeepers)



Tim Ennis (Latitude Conservation Solutions Company) describing the ecology of a forest plantation to youth participants Doreen Rodriguez and Ben Chambers in the Morrison Headwaters Nature Preserve.



Youth participants Ben Chambers and Doreen Rodriguez leading a public tour of the Morrison Headwaters Nature Preserve describing the ecological inventory work they were involved with.



Wendy Kotilla (Youth and Ecological Restoration Program) and Tim Ennis (Latitude Conservation Solutions Company) with youth participants Doreen Rodriguez and Ben Chambers during the recognition and awards ceremony at the end of the project.