SNOWLINE
Ecological Research

Palmer™

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

Whistler Ecosystems Monitoring Program

2019

Palmer Project #
1602504

Prepared For
Resort Municipality of Whistler

May 20, 2020

SNOWLINE
Ecological Research

Palmer™

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5
Tel: 604-629-9075 | www.pecg.ca

May 20, 2020

Ms. Heather Beresford
Environmental Stewardship Manager
Resort Municipality of Whistler
4325 Blackcomb Way
Whistler, B.C. V0N 1B4

Dear Ms. Beresford,

Re: Whistler Ecosystems Monitoring Program
Project #: 160254

Enclosed you will find the final Whistler Ecosystems Monitoring Program 2019 report. This report has been authored by Palmer and Snowline.

We hope our team-based approach will not only fulfil the conservation goals for the Resort Municipality of Whistler (RMOW) but will maintain the connection to residents and produce a report that is scientifically defensible.

Thank you for this opportunity to support you on this interesting project. Should you have any questions or require additional information, please feel free to contact Irene Tuite (778) 772 7728 or via email at irene.tuite@pecg.ca

Yours truly,

SNOWLINE Ecological Research   Palmer™

Prepared By:

Bob Brett

Bob Brett, M.Sc., R.P.Bio.
Forest Ecologist and Conservation Biologist
Snowline Ecological Research

Prepared By:

Irene Tuite

Irene Tuite, M.Sc, R.P. Bio.
Aquatic Ecologist
Palmer

Acknowledgements

We greatly appreciate the assistance and expertise provided throughout the project by Hillary Williamson (RMOW). We also appreciate the valuable field assistance provided by Jagoda Kozikowska (RMOW), Kristen Jones (project assistant), and Angie Fulton (project volunteer).

Executive Summary

The Resort Municipality of Whistler (RMOW) is located in the southern Coast Mountains of British Columbia, approximately 100 km north of the city of Vancouver. The study area for Ecosystems Monitoring Program (the Program) contains aquatic and terrestrial ecosystems interspersed among areas of urban development.

The RMOW initiated the Ecosystems Monitoring Program in 2013. The program design was based on the use of species, habitat, and climate indicators, to identify temporal and spatial trends in the overall health of ecosystems in the Whistler area. Cascade Environmental Resource Group Ltd conducted the first three years of the Ecosystem Monitoring Program. In 2016, Palmer Environmental Consulting Group Inc. partnered with Snowline Ecological Research and began the next phase of the program. Changes made to the program were designed to maintain comparability and consistency with previous years to the greatest extent possible. The Program continues to evolve as results from past years help direct future monitoring.

The 2019 Ecosystems Monitoring included surveys of benthic invertebrates, fish, Coastal Tailed Frogs (*Ascaphus truei*) and beavers (*Castor canadensis*) as major components. Additional monitoring efforts were directed towards Western Toads (*Anaxyrus boreas*), Northern Goshawks (*Accipiter gentilis laingi*), and black cottonwoods (*Populus trichocarpa*). Complementary monitoring components included water quality, stream temperatures, and climate.

Six stream sites have been established to monitor the aquatic health of streams in the Resort Municipality of Whistler. The 2019 data collection included benthic invertebrate sampling, fish sampling, and *in situ* measurement of water chemistry parameters. In addition, results from RMOW's water and sediment sampling program were screened against the BC water and sediment quality guidelines for protection of aquatic life. *In situ* water quality readings for temperature, dissolved oxygen (DO), pH, turbidity, and conductivity taken concurrently with benthic invertebrate sampling were above minimum guideline values (where available), and readings were within the expected ranges.

Jordan Creek was sampled for both water and sediment in 2019. An exceedance of the BC water quality guideline for calcium was detected at both the upstream and downstream site. Calcium concentrations were 10.7 and 10.6 mg/L, which exceeds the guideline of 8 mg/L. At the upstream site, sediment copper concentration was 35.9 mg/kg (dry weight), which marginally exceeds the BC Interim Sediment Quality Guideline (ISQG) of 35.7 mg/kg.

Crabapple Creek was sampled for both water and sediment quality in 2019. Aluminum concentrations of 0.174 and 0.207 mg/kg were detected, which exceed the BC guideline of 0.1000 mg/kg. Sediment arsenic concentration was 6.45 mg/kg (dry weight) which exceeds the ISQG is 5.9 mg/kg. Sediment copper concentration was 42.9 mg/kg (dry weight) which exceeds the ISQG of 35.7 mg/kg. The benthic invertebrate communities in these streams did not shown impairment that could be attributable to poor water quality. Further monitoring of sediment and water quality in the streams is required to detect if there are any trends in parameter concentrations that could point to deteriorating water or sediment quality.

High proportions (>70%) of pollution sensitive organisms occurred at the upstream site on the River of Golden Dreams, 21-Mile Creek, and Crabapple Creek, which indicates healthy benthic invertebrate communities. The downstream site on the River of Golden Dreams had the lowest proportion of Ephemeroptera, Plecoptera, and Trichoptera (EPT) in 2019 (31%). Jordan Creek, as in previous years, had a relatively low proportion of EPT organisms (44%). The benthic invertebrate data (all years) were analysed using the CABIN Reference Condition Approach. The data were compared to the Fraser Basin 2014 Reference Model. The Bray-Curtis analysis indicated that, in 2019, the downstream site on the River of Golden Dreams was most similar in community structure to reference condition, and the site on21-Mile Creek was the most dissimilar (i.e. furthest from reference condition).

Three species of fish were captured during 2019 sampling: Threespine Stickleback (*Gasterosteus aculeatus*), undifferentiated trout fry from resident populations of Rainbow Trout (*Oncorhynchus mykiss)* and Coastal Cutthroat Trout (*O. clarkii clarkii)* and sculpin (*Cottus* sp.). Relative condition of fish was generally good in 2019, in keeping with previous years.

The 2019 program continued to expand upon past years' surveys of Coastal Tailed Frogs (*Ascaphus truei*) and. Fifteen sites were again surveyed with a continued emphasis on previously unsurveyed creeks on the west side of Whistler Valley (Van West Creek, Sproatt Creek, and "FJ West Creek"). No evidence of negative impacts was detected at any creek, including the two on Whistler Mountain (Whistler Creek and Archibald Creek).

Mapping irregularities were discovered at lower elevations of the west-side creeks during 2018 tailed frog surveys. Further investigation in 2019 located where Sproatt Creek is diverted underground upstream of the CN Rail tracks (which is why it is dry downstream in low flows). It also confirmed that a branch mapped southeast to Alpha Lake is currently dry since there is no connection with the main stream. Evidence of extensive flooding and stream diversion on FJ West Creek was traced to a storm in November 2017. As a result, the RMOW's stream mapping in that area is no longer correct. Increased flows caused by rain precluded locating any underground diversion of Van West Creek in Function Junction so will require additional field work in 2020.

The 2019 beaver (*Castor canadensis*) survey was the most comprehensive yet. It located 27 active lodges, more than ever before, mainly due to determined efforts to fully access the Miller Creek Wetlands. These additional efforts found eight lodges (compared to two in 2018) and confirmed for the first time that the Miller Creek Wetlands provide beaver habitat as significant as the River of Golden Dreams (where seven lodges were found). Based on number of beavers per lodge, the beaver population is now estimated to be 157 in Whistler Valley (low to high estimates range from 113 to 173 beavers). A field survey of the beaver-affected area in the Miller Creek Wetlands showed that almost double the area visible from air photos was actually flooded. This correction brings the total area of beaver-affected wetlands to 100.3 hectares, approximately two-thirds the total area of wetlands mapped in Whistler Valley, and further demonstrates the importance of beavers in creating habitat that is also critical for many other species. Based on these 2019 results, Whistler's beaver population and the area of beaver-affected wetlands appear to be stable, though larger than previously known.

Three exploratory indictors added to the program in 2018 were again included in 2019: Northern Goshawk (*Accipiter gentilis laingi*), Western Toad (*Anaxyrus boreas*), and black cottonwood (*Populus trichocarpa*). Recent breeding of Northern Goshawks has been sporadically documented since 2011 in Whistler's unlogged forests at low elevations. There were 11 records of goshawks, including evidence of breeding near Comfortably Numb Trail. Based on a concentration of visual records between Whistler Creekside and Kadenwood, it is possible there was a second pair in 2019 there but no evidence of breeding was reported. No evidence of breeding of Western Toads has been recently found south of Lost Lake, including in 2019. Several new ponds adjacent to Highway 99 in the Callaghan Creek area were confirmed to be suitable for inclusion in 2020 surveys. A plan to improve the mapping of black cottonwoods in Whistler Valley using the RMOW orthophotography and new LIDAR layer was unsuccessful which means field surveys will be needed instead.

Table of Contents

List of Figures

List of Tables

List of Appendices

1. Introduction

1.1 Overview

This report describes monitoring studies conducted in 2018 by Palmer and Snowline Ecological Research (Snowline) on aquatic and terrestrial environments in Whistler, British Columbia. The 2019 study was the seventh year of the Ecosystem Monitoring Program and the fourth conducted by this team. The purpose of the program is to monitor the health of ecosystems over time through ecological indicators (proxies) to help guide the conservation of species and ecosystems and inform sustainable land use planning and development in Whistler.

Monitoring is a vital component of ecosystem management. It is therefore important that methods used to establish long-term data collection be done in a scientifically defensible manner. Appropriate selection of indicator species and monitoring methods will provide valuable insight into ecosystem health and functioning.

1.2 Background

The Whistler Biodiversity Project (WBP), funded in significant part by the Resort Municipality of Whistler (RMOW) from 2006 through 2012, began surveys in late 2004. This work led to the first publicly documented record of several important and/or at-risk species. Including Coastal Tailed Frog (*Ascaphus truei*), and Red-legged Frog (*Rana aurora*), initiated the first beaver census, and greatly enhanced the inventory of species documented within Whistler. Early results were summarized in a report (Brett 2007) that recommended further inventory work, as well as the identification and monitoring of indicator species. This work was the precursor to a report the RMOW commissioned that in turn proposed a framework for the establishment and application of ecological monitoring in Whistler (Askey *et al*. 2008).

The Ecosystem Monitoring Program was initiated by the RMOW in 2013. The program design was based on the use of species, habitat, and climate indicators to identify temporal and spatial trends in the overall condition of ecosystems. The initial study design and selection of indicators (Cascade 2014) was based on information from:

- Askey *et al*. (2008) proposed framework;
- Species data collected through the Whistler Biodiversity Project (Brett 2007 and online lists[1]); and
- Local data held by Cascade Environmental Resource Group Inc (Cascade).

Cascade was contracted to conduct the first three years from 2013 through 2015 of the Ecosystem Monitoring Program (Cascade 2014-2016). In 2016, PECG and Snowline were contracted to conduct the program for the following three years. Several changes were made to the study design in 2016 to make it more scientifically robust (e.g. adopting data collection methods which allow for statistical analysis) while maintaining comparability and consistency with previous years to the greatest extent possible. The changes implemented in 2016 included:

- The addition of benthic invertebrates as an indicator for aquatic ecosystem health;
- The use of multiple pass depletion electrofishing methods for fish;

---

[1] *www.whistlerbiodiverisity.ca*

- Alterations to previously defined species thresholds;
- Changing the methodology for Coastal Tailed Frog surveys from area-constrained to time constrained and increasing the elevational range of study sites on each creek;
- Moving Pileated Woodpecker (*Dryocopus pileatus*) surveys to breeding season and expanding the scope of the cavity tree survey;
- Removal/replacement of some study sites; and
- A return to a full beaver census throughout Whistler Valley.

The work plan has continued to evolve since 2016 as results are evaluated and priorities re-assessed. Some of the main changes made for 2017 and 2018 included:

- The installation of two additional temperature loggers at aquatic sampling sites in Crabapple Creek and 21 Mile Creek;
- Use of the single-pass electrofishing method with no stop nets for fish sampling;
- An increase in the number of tailed frog survey sites, especially on the west side of the valley.
- The first mapping to calculate the area affected by beaver flooding and other activities ("beaver-affected wetlands").
- Expanded efforts to census the beaver population, notably on the River of Golden Dreams and in the Miller Creek Wetlands.
- The addition of new species of conservation and monitoring value (Northern Goshawks, Western Toads, and black cottonwoods).

Brett (2018) identified monitoring priorities for species and habitats most important to conserving biodiversity within the RMOW's Development Footprint. Recommendations for the future of the Ecosystem Monitoring Program will build on past results within that context and propose methods to effectively monitor priority species and habitats in the future.

1.3 Study Area

The RMOW is located in the southern Coast Mountains of British Columbia, approximately 100 km north of Vancouver. The study area, defined by the extent of the RMOW municipal boundaries (Figure 1-1), contains a range of aquatic and terrestrial ecosystems at montane to alpine elevations. Most development (within the municipal "Development Footprint"[2]) is in the valley bottom, from Function Junction to Green Lake.

1.4 Study Design

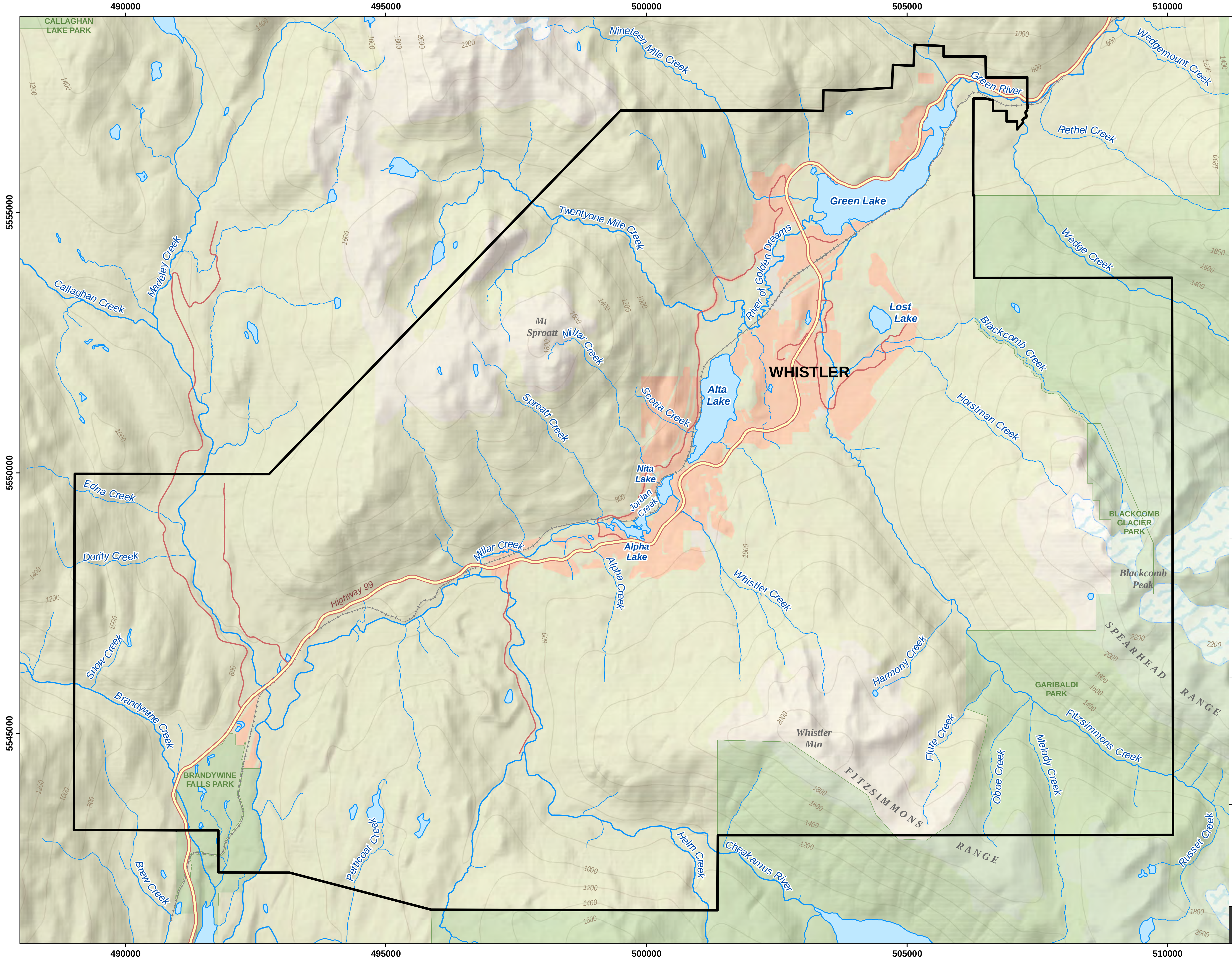
The Ecosystems Monitoring Program is based on the use of indicators that reflect the health of a broader range of populations, taxa, and/or overall ecosystem health. Table 1-1 shows the indicators, field methodologies, and metrics for each program component; detailed study designs are provided in the associated component sections of this report.

---

[2] *Now termed "Urban Development Containment Area" in the latest draft Official Community Plan (https://www.whistler.ca/ocp).*

Table 1-1. 2019 Ecosystems Monitoring Program.

Study Component	Indicator(s)	Methodology/ Equipment	Metrics/Parameters
Aquatic Habitat	Water Quality	*In Situ* measurements using a digital meter	• *In Situ* parameters: pH, conductivity, dissolved oxygen
	Stream Temperature	Temperature loggers set to hourly logging, installed in the study streams	• Daily and monthly summary statistics for the open water period
Aquatic Species	Benthic macroinvertebrate community	CABIN protocol	• Abundance • Taxa richness • EPT taxa richness • Percentage EPT • Diversity indices
	Fish	One-pass electrofishing and minnow traps	• Species identification • Fish length to weight relationships • Fish Health (Condition)
Riparian Species	Coastal Tailed Frog *(Ascaphus truei)*	Time constrained surveys Malt et al 2014a,b)	• Tadpole abundance and density • Counts of tadpoles by development stage • Water temperature and habitat descriptors
	Beaver (*Castor canadensis*)	Field inventories of beaver lodges and activity	• Number and distribution of active lodges • Area of beaver-affected wetland
Additional Species	Northern Goshawk (*Accipiter gentilis laingi*	Compilation of existing data	• Documented observations and nest locations
	Black cottonwood (*Populus trichocarpa*)	Previous RMOW mapping	• Preliminary analysis by area, age, and abundance
	Western Toad (*Anaxyrus boreas*)	Field surveys for presence	• Presence of tadpoles or metamorphs
Climate	Alta Lake freeze and thaw dates	Annual observations by The Point Artists Centre	• Ice-on and Ice-off dates • Days frozen



Legend

- RMOW Boundary
- Highway
- Local Road
- Railway
- Elevation Contour (200 m Interval)
- Watercourse
- Lake
- Permanent Snow and Ice
- Developed Land
- Park or Protected Area

Data Sources: Developed land provided by RMOW. Legally Defined Administrative Areas of BC; Freshwater Atlas; BC Parks, Ecological Reserves, and Protected Areas all licensed under the Open Government Licence – British Columbia. Other base data from Canvec (250k) and licenced under the Open Government Licence - Canada.

0 1 2 3
kilometres

N

DRAWN: B. Elder
CHECKED: I. Tuite
PROJECT: 1602505
DATE: Feb 11, 2020

Scale 1:70000
UTM Zone 10N
NAD 1983

[redacted]

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2019

2019 Ecosystem Monitoring Program Study Area, Whistler, BC

FIGURE 1-1

Document Path: C:\Egnyte\Shared\Projects\Active\16025 - Resort Municipality of Whistler\160254 - 2018 Annual Monitoring\Mapping\mxd\160252_Figure1_StudyArea.mxd

2. Stream Water Quality

Lead Biologists: Palmer

2.1 Introduction

The objectives of stream water quality monitoring as a component of the Aquatic Ecosystems Monitoring are to allow consideration for the influence of water chemistry on biological communities and assess water quality by comparing parameter readings to provincial guidelines for the protection of aquatic life. *In situ* water quality measurements included temperature, dissolved oxygen (DO), pH, turbidity, and conductivity. These five analytes describe fundamental characteristics of a water body. Temperature loggers installed in the RMOW streams record hourly readings, which provides a continuous temperature record during the open water season.

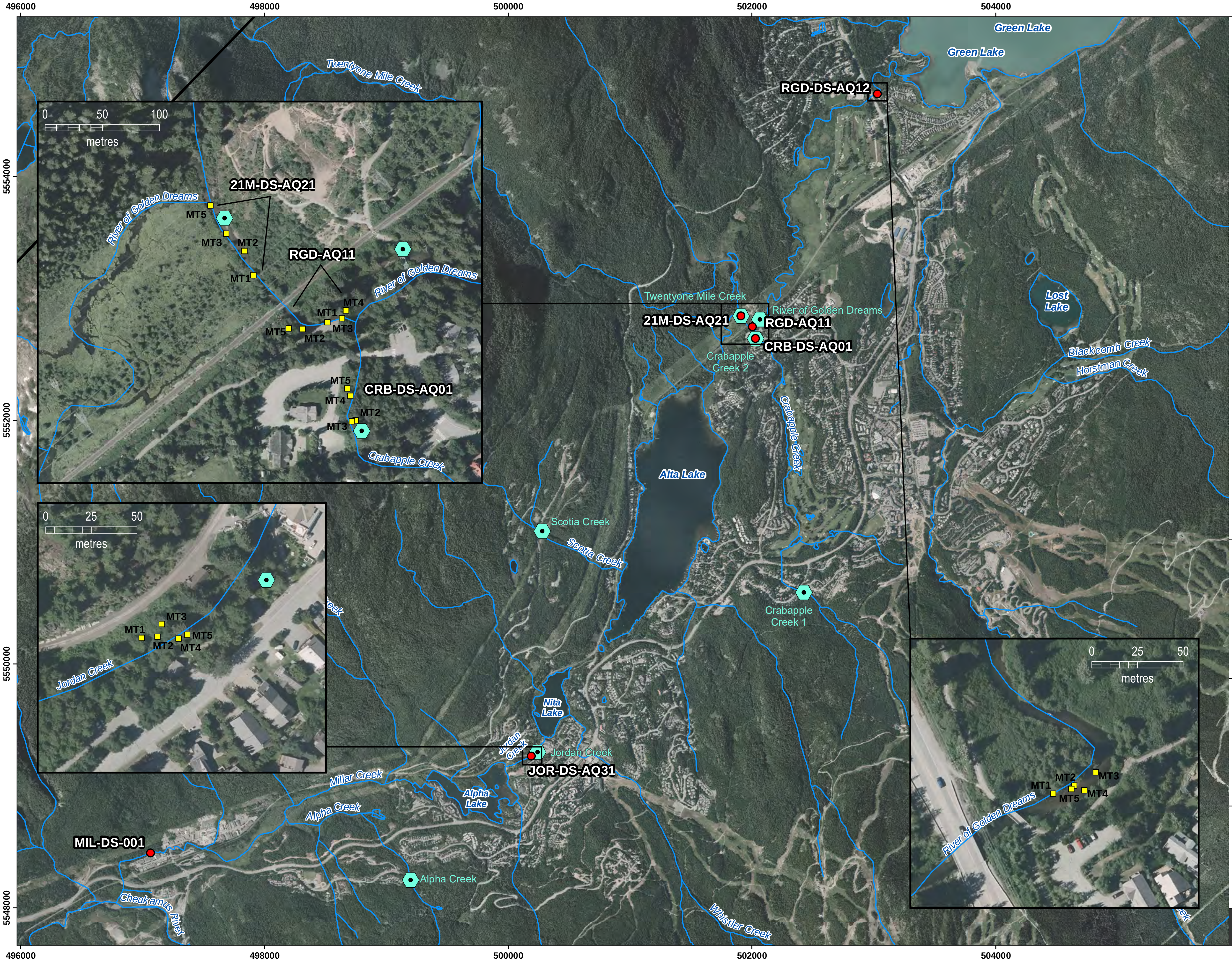
2.2 Methods

2.2.1 In Situ Water Quality

As in previous years, *in situ* water quality parameters and stream temperature were measured in 2019 using a hand-held YSI Pro plus meter, at each of the six established stream sites (Figure 2-1). Measurements were taken concurrently with benthic invertebrate sampling (Table 2-1).

Table 2-1. 2019 Ecosystem Monitoring Program sampling locations and 2019 sampling dates for in situ water quality (concurrent with benthic invertebrate sampling).

Site	UTM Location (Zone 10)		Aquatic Site ID	Access (Bridge Crossing)	Data Sampled	
	Easting	Northing			In Situ Water Quality & Benthic Invertebrates	Fish
Jordan Creek	500242	5549278	JOR-DS-AQ31	Lake Placid Road	31-Jul-19	31-Jul-19
Crabapple Creek (2)	502030	5552670	CRB-DS-AQ01	Lorimer Road	30-Jul-19	31-Jul-19
River of Golden Dreams (Upper)	502066	5552829	RGD-US-AQ11	Lorimer Road	30-Jul-19	1-Aug-19
River of Golden Dreams (Lower)	503035	5554687	RGD-DS-AQ12	Off Nicklaus North Golf Course	31-Jul-19	31-Jul-19
21 Mile Creek	501910	5552856	21M-DS-AQ21	Lorimer Road	30-Jul-19	31-Jul-19

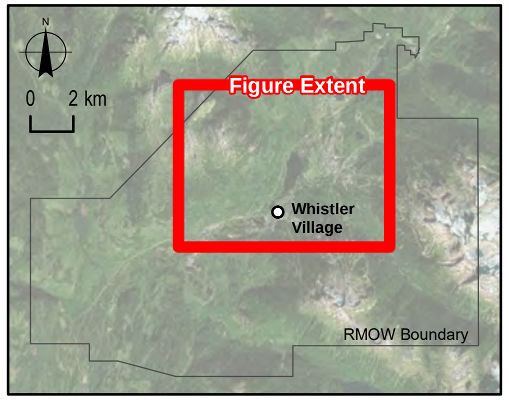


Legend

- ● 2019 Aquatics Site
- ⬢ Temperature Logger
- ■ Minnow Trap
- — Watercourse

Notes:
(1) Orthoimagery (2014) provided by RMOW.
(2) Watercourse data from BC Freshwater Atlas (accessed 2017).

Contains information licensed under the Open Government Licence - British Columbia. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



0 500 1,000
metres

N

DRAWN: B. Elder
CHECKED: I. Tuite
PROJECT: 1602505
DATE: Feb 11, 2020

Scale 1:30000
UTM Zone 10N
NAD 1983

[redacted]

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2019

2019 Ecosystem Monitoring Program Aquatic Sampling Sites

FIGURE 2-1

Document Path: C:\Egnyte\Shared\Projects\Active\16025 - Resort Municipality of Whistler\160254 - 2018 Annual Monitoring\Mapping\mxd\160254_Figure2_AquaticSites.mxd

2.2.2 Stream Temperature

Five HOBO Water Temperature Pro v2 Data Logger (Model # U22-001) temperature loggers currently record hourly temperatures of stream systems within the RMOW study area (Table 2-2). Five loggers were deployed in December 2015. An additional two loggers were deployed for hourly temperature recordings in August of 2017. The most recently installed (2018) logger locations include 21 Mile Creek and downstream on Crabapple Creek. Table 2-2 lists the location of each temperature logger and the date the loggers were deployed and downloaded. Two temperature logging stations (Crabapple Creek (1) and 21 Mile Creek) were damaged during the spring freshet and not downloaded in 2019.

Daily and monthly summary statistics (means, maxima, and minima) were calculated during the open water period for each creek between August 2018 and July 2019. The temperature time series were examined to identify periods where data were suspect (e.g. elevated readings, when a logger may have been dry), and any suspect data were excluded from the calculations. Mean, minimum and maximum daily stream temperature data from August 2018 to July 2019 can be found in Appendix A.

Table 2-2. Location of Temperature Loggers installed for the Ecosystem Monitoring Program

Site	UTM Location (Zone 10)		Location Description	Aquatic Site ID	Access (Bridge Crossing)	Installation Date	Most Recent Download Date
	Easting	Northing					
Alpha Creek	499199	5548227	At Tailed Frog Site #1	-	Spring Creek Drive	15-Dec-15	01-Aug-19
Jordan Creek	500242	5549278	Near Aquatics Site	JOR-DS-AQ31	Lake Placid Road	15-Dec-15	31-Jul-19
Scotia Creek	500280	5551092	At Tailed Frog Site #2	-	Stone Bridge Drive	15-Dec-15	01-Aug-19
Crabapple Creek (1)	502426	5550589	At Tailed Frog Site #2	-	Sunridge Drive	15-Dec-15	03-Aug-18*
Crabapple Creek (2)	502030	5552670	At Aquatics Site	CRB-DS-AQ01	Lorimer Road	02-Aug-17	31-Jul-19
River of Golden Dreams	502066	5552829	Near Aquatics Site	RGD-US-AQ11	Lorimer Road	15-Dec-15	01-Aug-19
21 Mile Creek	501910	5552856	At Aquatics Site	21M-DS-AQ21	Lorimer Road	02-Aug-17	31-Jul-18**

** Crabapple Creek (2) temperature logger was not downloaded in 2019*

*** 21 Mile Creek temperature logger was not downloaded in 2019*

2.3 Results and Discussion

2.3.1 Water Quality

2.3.1.1 In Situ Parameters

In situ readings for DO, pH, Specific Conductance and water temperature, (recorded during benthic invertebrate sample collection), are presented in Table 2-3. Results from all years are shown for comparison.

Table 2-3. In situ water quality results, 2016-2019.

Creek	Site ID	Date	Dissolved oxygen (mg/L)	pH	Specific Conductance (µS/cm)	Water Temperature (°C)
Jordan Creek	JOR-DS-AQ31	03-Aug-2016	9.3	7.1	64	15.8
		26-Jul-2017	8.9*	7.1	105	14.9
		01-Aug-2018	7.7*	7.1	65	18.8
		July 30, 2019	**9.4**	**7.7**	**78**	**17.4**
Crabapple Creek	CRB-DS-AQ01	02-Aug-2016	9.4	7.6	218	12.7
		25-Jul-2017	11.6	7.4	336	12.0
		01-Aug-2018	7.5*	7.5	194	16.0
		July 30, 2019	**10.0**	**7.6**	**235**	**13.9**
21 Mile Creek	21M-DS-AQ21	03-Aug-2016	9.4	6.3*	40	12.0
		25-Jul-2017	11.3	7.1	40	11.6
		31-Jul-2018	14.6	6.2*	38	19.9
		July 30, 2019	**9.8**	**7.0**	**52**	**13.3**
River of Golden Dreams (Upper)	RGD-US-AQ11	03-Aug-2016	8.3*	7.3	64	11.7
		25-Jul-2017	11.0	7.1	50	10.5
		31-Jul-2018	7.5*	7.2	36	15.5
		July 30, 2019	**9.8**	**6.8**	**33**	**12.8**
River of Golden Dreams (Lower)	RGD-DS-AQ12	05-Aug-2016	9.9	7.8	69	15.2
		25-Jul-2017	9.8	7.0	73	13.0
		01-Aug-2018	8.2*	6.7	48	17.8
		July 31, 2019	**9.9**	**7.6**	**61**	**13.1**

*Notes: 2019 results are **bolded**; values below guideline are identified with an asterisk (*) next to the value.*

Dissolved oxygen ranged from 7.5 mg/L to 14.6 mg/L across all sites and years. The BC WQG for dissolved oxygen is an instantaneous minimum of 5 mg/L for all fish life stages other than buried embryo/alevin and 9 mg/L for buried embryo/alevin life stages (BC MOE, 1997). This guideline for dissolved oxygen is not specific to benthic invertebrates, however; low dissolved oxygen can result in reduced benthic invertebrate community diversity. *In situ* dissolved oxygen was above 5 mg/L at all sites in all years. Recorded dissolved oxygen levels in 2019 ranged between 9.4 mg/L and 10.0 mg/L and were thus all above the upper guideline. PH ranged from 6.2 to 7.8 across all sites and years. The BC water quality guideline for pH is 6.5 to 9.0. Readings below 6.5 were recorded at 21 Mile Creek in 2016 and 2018. pH values recorded in 2019 ranged between 6.8 and 7.7 and were thus above the lower guideline.

Specific conductance ranged from 33.3 µS/cm to 336.3 µS/cm across all sites and years. The lowest value of 33.3 µS/cm was recorded at the upper River of Golden Dreams site in 2019. There is no BC guideline for specific conductance. High specific conductance is associated with high dissolved ions. Crabapple Creek had notably higher specific conductance (194.4 to 336.3) than all other sites. Conductance values recorded in 2019 ranged from 33.3 µS/cm to 234.9 µS/cm. Further monitoring will be required to determine if there are trends present in these parameters.

2.3.1.2 Laboratory Parameters

Laboratory water chemistry data were provided by the RMOW and were reviewed alongside the CABIN sampling results (Table 2-4). The RMOW's water and sediment quality monitoring program rotates streams on an annual basis to achieve a larger coverage of streams in the area.

Table 2-4. Summary of overlap of benthic and water/sediment sampling, 2016-2019.

Stream	**Sample Year**	**RMOW Water/Sediment Sampling**			**Palmer Benthic invertebrate sampling**		
		Sample Date	Water	Sediment	Benthic site	Location relative to water/sediment site	Sample Date
Jordan Creek (upstream)	2016	Oct 12	x		JOR-DS-AQ31	100 m DS	Aug 03
Jordan Creek (downstream)	2016	Oct 12	x		JOR-DS-AQ31	250 m US	Aug 03
River of Golden Dreams (downstream)*	2016	Oct 12	x		RGD-US-AQ11, RGD-DS-AQ12	100 m US from AQ11, 3.5 km DS from AQ12	Aug 05
21 Mile Creek	2017	Sept 21	x	x	21M-DS-AQ21	4 km DS	Jul 25
Crabapple Creek	2018	Sept 11	x	x	CRB-DS-AQ01	Co-located	Aug 01
Millar Creek	2018	Sept 10	x	x	MIL-DS-001	Co-located	Aug 01
Crabapple Creek	**2019**	**Sept 17**	**x**	**x**	**CRB-DS-AQ01**	**Co-located**	**Jul 30**
Jordan Creek (upstream)	**2019**	**Sept 17**	**x**	**x**	**JOR-DS-AQ31**	**100 m DS**	**Jul 30**
Jordan Creek (downstream)	**2019**	**Sept 17**	**x**	**x**	**JOR-DS-AQ31**	**250 m US**	**Jul 30**

*Notes: DS = downstream, US = upstream; * indicates that there is another water quality sampling site on the River of Golden Dreams not listed in this table as it is upstream of the confluence with 21 Mile Creek.*

Water quality and sediment sampling was conducted by RMOW at the following sites in 2019: Jordan Creek (two locations) and Crabapple Creek. Results were screened against guidelines:

- BC Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (ENV 2018).

- The Canadian Council of Ministers of Environment (CCME) Canadian Water Quality Guidelines (WQG) for the Protection of Aquatic Life

The CCME WQG, and the BC Approved WQG cover protection of freshwater aquatic life by providing scientifically derived benchmarks for evaluating the potential for observing adverse biological effects in aquatic systems. The BC guidelines are used where BC and CCME guidelines differ, as the BC guidelines are intended to represent more closely the conditions in BC waters, while the CCME (federal) guidelines are more general. In BC, the definition of water quality include the sediments, therefore WQGs include sediment quality values.

Jordan Creek was sampled for both water and sediment quality in 2019. A water quality exceedance for a single metal (calcium) was detected at both upstream and downstream sampling sites as per the BC WQG (BC MOE 1997). A sediment exceedance for a single metal (copper) was detected at the upstream sample site. Sediment copper concentration was 35.9 mg/kg (dry weight) and the BC Interim Sediment Quality Guideline (ISQG) is 35.7 mg/kg.

Crabapple Creek was sampled for both water and sediment quality in 2019. Water quality exceedances in aluminum were detected as per the BC WQG (BC MOE 1997). Concentrations of 0.174 and 0.207 mg/kg were detected, compared to the maximum guideline of 0.1 mg/kg. Sediment exceedances in the following metals were detected as per CCME 2014: arsenic and copper. Sediment arsenic concentration was 6.45 mg/kg (dry weight) and the ISQG is 5.9 mg/kg. Sediment copper concentration was 42.9 mg/kg (dry weight) and the ISQG is 35.7 mg/kg.

The exceedances noted above represent single sampling events and further monitoring is required to assess if there are trends that point to deterioration in sediment or water quality.

2.3.2 Stream Temperature

Stream temperatures were downloaded from five sites within the RMOW in 2019. Crabapple Creek (at Sunridge Drive) and 21 Mile Creek (21M-DS-AQ21) loggers were not downloaded. At 21M-DS-AQ21, water levels prevented the crew from determining if the temperature logger was stuck in the standpipe or lost. Mean monthly stream temperatures in the study streams ranged from -3.86 °C in February (Scotia Creek) to 18.61 °C (Jordan Creek) in August (Figure 2-2). Consistent with previous years, highest temperatures were observed during July and August in all five creeks. Jordan Creek was the warmest creek throughout the year, in keeping with previous years.

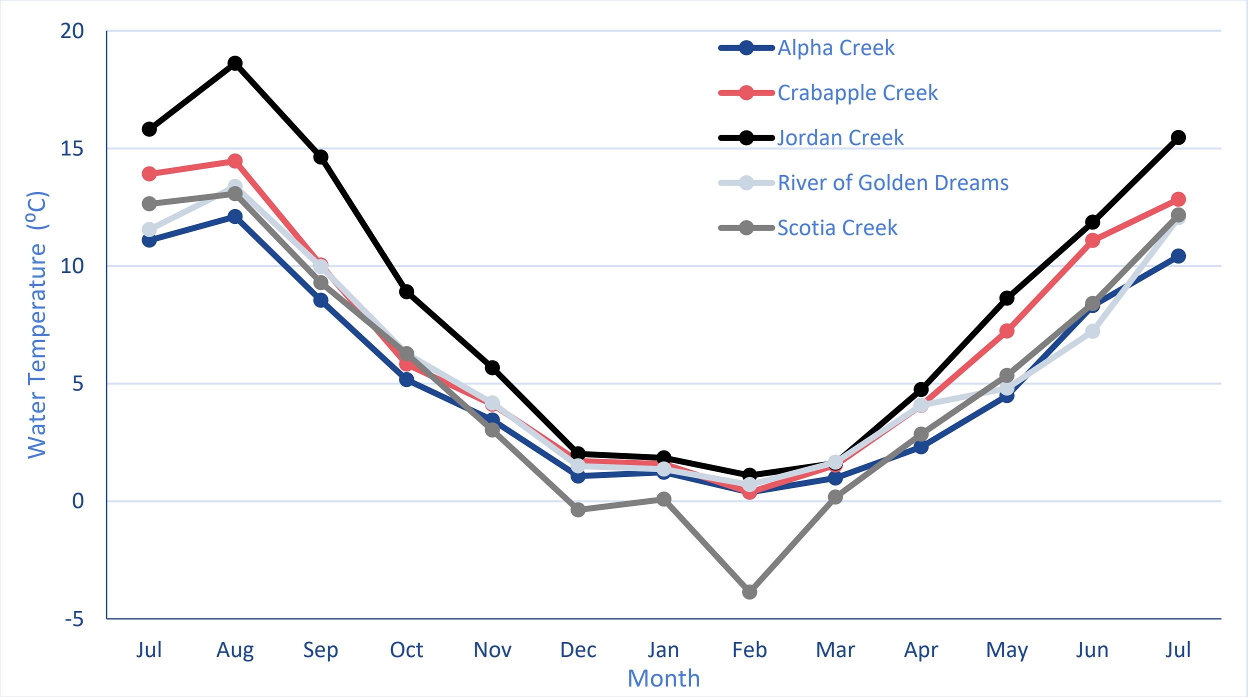


Figure 2-2. Mean monthly stream temperatures, July 2018 – July 2019.

3. Benthic Invertebrates

3.1 Introduction

Benthic invertebrates have been of central importance in biomonitoring studies for many years (Barbour et al. 1999). Advantages of using benthic invertebrates include the following;

- Many have limited migration patterns or a sessile life cycle during their aquatic phase, which means they provide a solid integrated understanding of localized, site-specific conditions.
- Many have a terrestrial winged phase to their life cycle, which means that every year to every few years an entire watershed is recolonized.
- Benthic invertebrates have a complex life-cycle that lasts approximately one year or longer, which means the community integrates the effects of transient, short-term, and seasonal variations.
- Most are relatively easy to identify to family and many taxa can be readily identified to genus or even species, which provides an in depth understanding of community structure.
- Benthic invertebrate communities are diverse and are composed of species that included a range of trophic levels, feeding strategies and pollution tolerances, which provides a comprehensive basis for interpreting community status and environmental effects.
- Sampling protocols are well established and field tested and have minimal detrimental effects on stream communities.
- Benthic invertebrates are abundant in most streams, which means that adequate numbers of organisms for a robust analysis can be easily collected.

Due to their sedentary nature, relatively long lifecycles, abundance, and high community diversity, benthic invertebrate communities provide insight into the long-term health of aquatic ecosystems within a small spatial area (i.e. site).

Benthic invertebrates have been monitored annually in the RMOW study area since 2016 (PALMER and Snowline 2017, 2018, 2019) in four streams: Jordan Creek (JOR-DS-AQ31), Crabapple Creek (CRB-DS-AQ01), River of Golden Dreams (2 sites: RGD-AQ11 and RGD-DS-AQ12), and 21 Mile Creek (21M-DS-AQ21).

3.2 Methods

3.2.1 Benthic Invertebrate Sample Collection

Rapid Bioassessment Protocols (RBP) for streams and wadeable rivers were developed decades ago in response to a need for rapid, cost-effective survey techniques that were nevertheless scientifically valid, easily translatable, and environmentally benign (Barbour et al. 1999). Integral components of an RBP include large composited samples, coordinated habitat characterization, and either multimetric analyses with performance-based evaluation or development of regional reference conditions for benthic invertebrate communities using multivariate ordination (Barbour et al. 1999).

In Canada, Environment and Climate Change Canada has developed a national RBP called the Canadian Aquatic Biomonitoring Network (CABIN) that provides a standardized sampling protocol and a multivariate Reference Condition Approach (RCA) for assessment of benthic invertebrate communities (Barbour et al.

1999, ECCC 2011). As with other RBPs, CABIN includes collection of a composited sample of benthic invertebrates, coordinated habitat characterization, and assessment of the benthic invertebrate community using the RCA.

The Canadian Aquatic Biomonitoring Network (CABIN, ECCC 2011) protocol was performed at five test sites in 2019 (Table 2-1) to collect habitat information and benthic invertebrate samples. The five sites were the same as those used in 2016, 2017 and 2018. Benthic invertebrate sampling was completed prior to fish sampling, to avoid disturbance of the substrate. At each site, a CABIN field sheet was completed, and a benthic invertebrate sample was collected using a kick-net. The CABIN method entails kick-net sampling for benthic invertebrates in the erosional zone (riffle, straight run, or rapid) of a representative watercourse reach. A triangular kick-net sampler with 400-micron mesh and detachable collection cup was employed for each kick-net sample. To collect a sample, one collector walked backward in the upstream direction, tracing a zig-zag pattern, and dragging the net along the bottom. The collector kicked the substrate in front of the net while moving upstream for three minutes. All invertebrates were removed from the net, placed in a clean 500 mL sampling jar, preserved using 85% ethanol and submitted to Cordillera Consulting (Summerland, BC) for taxonomic analysis. In the laboratory, benthic invertebrates were identified to the lowest possible taxonomic group by Cordillera.

Samples from site RGD-US-AQ11 were sieved using the bucket swirling method to remove excess debris from the samples (ECCC 2011). A QA/QC sample was collected from the remaining debris at this location. The sample of excess debris was processed in the laboratory to ensure that the method was effective in removing benthic invertebrates.

Once the kick-sample was collected, habitat characteristics were recorded at each site including canopy coverage, macrophyte coverage, riparian vegetation, periphyton coverage, substrate composition (pebble count) and slope (Appendix C). Average and maximum velocity were determined by measuring velocity at 6 points along a transect of the stream using the Velocity Head Rod technique, according to CABIN protocol (ECCC 2011).

3.2.2 Laboratory Analysis

Cordillera Consulting identified and enumerated organisms to the genus-species level, where possible. Enumeration was undertaken using a Marchant box: cells were extracted and enumerated in the order indicated by a random number table. Sorting and counting continued until the 300th organism was identified. If the 300th organism was found part way into sorting a cell, then the balance of the cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted (Appendix B). Organisms were identified to the lowest practical level using Standard Taxonomic Effort lists compiled by the CABIN manual (McDermott et al. 2014, SAFIT 2015 and PNAMP 2015).

The 2019 benthic invertebrate taxonomic richness was reported as number of families, the standard protocol for CABIN reports that accounts for potential misidentification of invertebrates at lower taxonomic levels (e.g. genus or species level). Organisms were grouped as follows: Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies), Diptera (true flies) +non-insects, and other. The grouping of Diptera+non-insects includes true flies, bivalves, molluscs, mites and worms.

3.2.2.1 *Quality Assurance/Quality Control*

Cordillera Consulting has over ten years' experience in taxonomic analysis of benthic invertebrates from streams, rivers and lakes of western Canada. The following QA/QC procedures were followed by Cordillera Consulting:

- Complete, blind re-identification and re-enumeration was completed in-house by a second taxonomist (*i.e.* not the taxonomist who originally processed the samples)
- Samples for taxonomic quality control were randomly selected and quality control procedures were conducted as the samples progressed through the laboratories.
- The second taxonomist calculated and recorded four types of errors:
  - Misidentification error;
  - Enumeration error;
  - Questionable taxonomic resolution error; and
  - Insufficient taxonomic resolution error.

The percent total identification error rate was calculated as:

$$(Sum\ of\ incorrect\ identifications \div\ total\ organisms\ counted\ in\ audit)\ \times 100$$

The average identification error rate of audited samples did not exceed 5%. All samples that exceeded a 5% error rate were re-evaluated to determine whether repeated errors or patterns in error contributed (Appendix B).

3.2.3 Data Analysis

3.2.3.1 *CABIN Multivariate Reference Condition Approach and Assessment*

The 2019 benthic invertebrate sampling results (habitat and taxonomy data) were entered into the online CABIN database. Data from 2016 to 2019 sampling are stored in the database for ease of access, data security and to allow CABIN analyses to be performed. The benthic invertebrate data were analysed using the Reference Condition Approach (RCA) adopted from Environment Canada's CABIN protocols (ECCC 2011; Palmer and Snowline 2017, 2018). In 2016 and 2017, the benthic invertebrate data were compared with the Fraser River-Georgia Basin Reference Model (2005) to make this assessment. However, in 2018 the Fraser River-Georgia Basin Reference Model error rates of correctly assigning a site to the appropriate reference group were noted to be unacceptably high. Environment Canada recommended conducting the RCA analysis (for all years and sites) using the updated Fraser River Reference Model (2014) to provide more reliable results. Accordingly, for this report, the data (all years) were compared with the Fraser Basin Reference Model, a long-standing reference model first developed in 1999 (Rosenberg et al. 1999), updated in 2005 (Sylvestre et al. 2005), and updated again in 2014 (Strachan et al. 2014).

The model assigned each site to a reference group based on habitat variables as well as the type and proportion of taxa present (Sylvestre *et al*. 2005). The samples from the five sites and four years were assigned to one of a total of four reference groups (Table 3-1).

The multivariate ordination (Appendix B) used in the RCA was developed using Bray-Curtis Index (BCI) data calculated for the RCA as a complete data matrix. For the test sites, the Bray-Curtis Index (BCI) was then calculated based on the expected relative abundance of the taxa present for that reference group; these BCI data were then used to locate each site on the ordination.

For the BCI, a value of 0 indicates that a site is identical in community structure to the reference condition and a value of 1 indicates a site is entirely different from the reference condition with no species in common. Within that range, between site variability is considered low if BCI values are less than 0.40 moderate if BCI values are between 0.40 and 0.80, and high if BCI values are greater than 0.80. The latter category is also problematic because the correlation between BCI values and ecological 'distance' becomes sharply non-linear above approximately 0.80. (Beals 1984). Site comparisons with BCI values greater than 0.80 should therefore be interpreted with caution. For the reference sites, the mean BCI values ranged from 0.41 to 0.55 and were therefore considered moderately variable on average (Table 3-1).

The CABIN analysis provided an assessment of whether test sites were in reference condition, mildly divergent from reference condition, or divergent from reference condition. The assessment was further developed through comparison of test sites with reference sites using the River Invertebrate Prediction and Classification System (RIVPACS). The RIVPACS compares the observed taxon richness with the taxon richness predicted from the reference model, reported as an Observed:Expected (O:E) ratio. A ratio less than one indicates fewer taxa than expected and a ratio greater than one indicates more taxa than expected. From an assessment perspective, it is considered that impairment would result in a loss of taxa richness and therefore O:E ratios less than one. For the CABIN assessment, however, divergence would result from either a high or low O:E ratio.

3.2.3.2 Benthic Invertebrate Community Characterization

To further characterize the benthic invertebrate community, the following metrics were calculated:

- Abundance, calculated as the total number of individuals per kick-net per site;
- EPT relative abundance, calculated by dividing the abundance of mayfly (Ephemeroptera), stonefly (Plecoptera) and caddisfly (Trichoptera) by the total abundance. These three orders of aquatic insects are typically most sensitive to habitat disturbance;
- Taxa richness, calculated as the total number of families present at each site;
- EPT taxa richness, defined as the total number of mayfly (Ephemeroptera), stonefly (Plecoptera) and caddisfly (Trichoptera) families per site;
- Percentage composition, calculated by dividing the abundance of the five most dominant groups by the total abundance; and
- Shannon-Wiener diversity index, defined as: $H' = \sum_{i=1}^{R} p_i \, (\ln p_i)$
- Where R is taxa richness and p_i is the total number of individuals in the i^{th} species divided by the total number of organisms in the sample. The Shannon-Wiener diversity index characterizes taxa diversity in a community and accounts for taxa richness as well as the proportion of each taxa (evenness).

3.2.3.3 Multimetric Performance-Based Assessment

There are two approaches to development of Rapid Bioassessment Protocols; the multivariate approach used in Canada, and the multimetric approach used in the United States (Barbour 1999). The advantage of the multivariate approach is that it uses all the data to provide a comprehensive assessment. The disadvantage is that the multivariate approach assesses whether a test site is divergent from reference, but not how it is divergent. In contrast, the multimetric performance-based approach uses only a fraction of the available data, but if the metrics are chosen with care, provides a solid understanding of how sites are divergent. For the test sites at Whistler, use of the multimetric approach in addition to the multivariate approach was considered useful in providing a weight-of-evidence to test site classification. There are five steps to the multimetric approach (Barbour 1999);

1. Use biological information and habitat data to group reference sites into homogenous classes. This step is identical for both the multivariate and multimetric approaches.
2. Identify candidate attributes of the benthic invertebrate community that are ecologically relevant.
3. Select core metrics that are sensitive to watershed stressors and are informative of the relationship of the benthic community to specific stressors or cumulative impacts. The six core metrics selected for this report were taxon richness, EPT richness, EPT relative abundance, total abundance, dominant taxa (%), and the Shannon-Wiener Diversity Index (Table 3-1).
4. Transform the core metrics to dimensionless numbers for aggregation. For this study, transformation was undertaken by dividing the test site metric value by the mean of the reference site metric. This resulted in each metric score being expressed as a fraction.
5. Establish thresholds of impairment. For the purposes of this assessment, it was considered that the final average assessment values were within reference condition (i.e. unimpaired) if the calculated metric score was greater than 0.75. This was based on the median coefficient of variation (standard deviation/mean) of the reference metrics, which was calculated as 25% (Appendix B). It is noted, however, that the coefficient of variation was variable amongst the six metrics, with Shannon-Wiener Diversity having the lowest variability and total abundance having the highest variability (Table 3-1). Consequently, it was considered that the individual metrics were considered within reference if the metric score was within one standard deviation of the mean and mildly divergent if outside of one standard deviation. Similarly, individual metrics were considered divergent from reference if the metric score was greater than two standard deviations from the reference mean. This latter threshold is consistent with the Critical Effect Size as defined in the Environmental Effects Monitoring program within the Metal and Diamond Mining Effluent Regulations under the *Fisheries Act*, and is a de facto standard for benthic invertebrate analyses within Canada.

Table 3-1. Characteristics of the Groups within the Fraser River Basin Model (Strachan et al. 2014)

Parameter	**Group**			
	1	3*	4	5*
Number of Sites	64	19	103	13
Bray-Curtis Index	0.48 ± 0.15 (31%)	0.41 ± 0.17 (42%)	0.53 ± 0.14 (26%)	0.55 ± 0.22 (40%)
Total Abundance	5011 ± 6542 (131%)	3776 ± 2948 (78%)	2647 ± 2773 (105%)	13707 ± 8626 (63%)
EPT Relative Abundance (%)	79.0 ± 14.8 (19%)	78.2 ± 17.8 (23%)	66.1 ± 26.2 (40%)	49.6 ± 26.3 (53%)
Taxon Richness	16.8 ± 4.7 (28%)	14.8 ± 4.3 (29%)	18.0 ± 4.5 (25%)	16.0 ± 4.0 (25%)
EPT Richness	11.0 ± 2.8 (25%)	9.8 ± 2.6 (27%)	10.8 ± 3.5 (32%)	9.3 ±3.6 (39%)
Five Dominant (%)	83.1 ± 9.3 (11%)	86.1 ± 8.2 (10%)	82.2 ± 8.7 (11%)	86.1 ± 8.4 (10%)
Shannon-Wiener Diversity	1.9 ± 0.4 (21%)	1.8 ± 0.4 (22%)	1.9 ± 0.4 (21%)	1.7 ± 0.4 (24%)

(Coefficient of Variation)

**The minimum recommended number of sites (20) for the RCA is not satisfied for Group 3 or Group 5 (Bowman and Somers 2005).*

3.2.3.4 Hilsenhoff Index of Biotic Integrity

As a further test of the benthic invertebrate community, the Hilsenhoff Index of Biotic Integrity (HIBI) was calculated and assessed for the 2018 and 2019 benthic invertebrate data.

The HIBI is calculated using tolerance scores and relative abundance data for the benthic invertebrate community. The tolerance scores have been developed over time by experts and relate to the response of benthic invertebrates to organic pollution (Mandeville 2002). The HIBI scores range from 0 to 10, with a score of 0 indicating that a site is dominated by pollution-sensitive organisms and that there is no apparent organic pollution at the site (Table 3-2).

The HIBI is of interest because of the potential for organic pollution in an urban setting, including from stormwater runoff, septic tank leakage, industrial activity, and/or wildlife waste.

Table 3-2. Hilsenhoff Index of Biotic Integrity (Mandaville 2002)

Assessment	Extent of Organic Pollution	Low HIBI Score	High HIBI Score
Excellent	None apparent	0	3.5
Very Good	Possible	3.51	4.5
Good	Some	4.51	5.5
Fair	Fairly significant	5.51	6.5
Fairly Poor	Significant	6.51	7.5
Poor	Very significant	7.51	8.5
Very Poor	Severe	8.51	10

3.2.3.5 Temporal Trends Analysis

There are currently four years of benthic invertebrate data, which provides a sample size of only six temporal comparisons. These are too few for a robust analysis and so trends analysis was not undertaken this year. However, five years of data will provide a sample size of ten temporal comparisons. Temporal trends analysis using the non-parametric Mann-Kendall temporal trends test will therefore be undertaken starting after year 5 of the monitoring program.

3.3 Results and Discussion

3.3.1 Group Assignment

Based on the habitat and the type and proportion of taxa present at each site there were three sites/years assigned to Group 1, six to Group 3, five to Group 4, and six to Group 5 (Table 3-3). Confidence in the Group assignments, however, was low for the following reasons;

- Only site JOR-DS-AQ31 (Jordan Creek) was consistently classified through all four years of monitoring with the other three sites assigned to two different Groups each (Table 3-3).
- The probability of group membership was less than 50% for all but six sites/years (Table 3-3), with the lowest probability estimated at only 26%.
- Group 3 and Group 5, which were assigned to 12 of the 20 year/site combinations, are currently defined by less than 20 reference sites (Table 3-1). This is less than recommended for development of a robust understanding of reference condition (Bowman and Somers 2005).

Table 3-3. Probabilities of sorting into each reference model group (based on habitat), for aquatic sampling sites, Whistler, 2016 - 2019

Site	Year	Group	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Twenty-one Mile Creek (21M-DS-AQ21)	2016	3	6%	4%	***29%***	29%	21%	12%
	2017	3	10%	5%	***33%***	24%	17%	10%
	2018	5	10%	5%	22%	17%	***39%***	6%
	2019	3	10%	5%	***33%***	24%	17%	10%
Crabapple Creek (CRB-DS-AQ01)	2016	1	***44%***	27%	0%	19%	9%	2%
	2017	1	***44%***	27%	0%	19%	8%	2%
	2018	1	***44%***	27%	0%	19%	8%	2%
	2019	5	0%	0%	0%	16%	***82%***	1%
Jordan Creek (JOR-DS-AQ31)	2016	4	14%	8%	0%	***55%***	2%	20%
	2017	4	18%	10%	0%	***51%***	2%	18%
	2018	4	10%	7%	0%	***57%***	7%	18%
	2019	4	8%	6%	0%	***62%***	3%	21%
River of Golden Dreams (RGD-US-AQ11)	2016	3	9%	5%	***38%***	22%	17%	10%
	2017	3	8%	4%	***41%***	21%	16%	10%
	2018	5	9%	4%	27%	16%	***38%***	7%
	2019	3	9%	5%	***39%***	22%	17%	10%
River of Golden Dreams (RGD-DS-AQ12)	2016	4	17%	8%	16%	***27%***	23%	9%
	2017	5	16%	7%	10%	17%	***46%***	5%
	2018	5	12%	4%	5%	8%	***68%***	2%
	2019	5	18%	7%	10%	16%	***44%***	5%

3.3.2 Multivariate Site Assessment

The test site BCI values ranged from 0.37 to 0.94 with a first quartile of 0.57 and a median value of 0.72 (Table 3-4). The BCI values for most of the test sites were therefore greater than the highest value of 0.55 for the reference sites (Table 3-1). These data indicate that the benthic invertebrate communities at test sites were moderately dissimilar to reference sites.

Based on the reference and test site BCI values, Twenty-one Mile Creek (21M-DS-AQ21) was assessed as being mildly divergent to divergent with the difference between reference and test site BCI of between 0.32 and 0.37, Crabapple Creek (CRB-DS-AQ01) was assessed as being in reference condition to mildly divergent with the difference between reference and test site BCI of between 0.05 and 0.23, Jordan Creek (JOR-DS-AQ31)was assessed as being in reference condition to divergent with the difference between reference and test site BCI of between 0.04 and 0.25, River of Golden Dreams upstream site (RGD-US-AQ11) was assessed as being mildly divergent to divergent with the difference between reference and test site BCI of between 0.29 and 0.39, and River of Golden Dreams downstream site (RGD- DS-AQ12) was assessed as being in reference condition with the difference between reference and test site BCI of between 0.04 and 0.17 (Table 3-4).

Correlation of the difference in BCI between test site and reference site and the subsequent assessment indicated that the difference between the reference and test BCI values was <0.18 for test sites in reference condition, between 0.17 and 0.34 for sites considered mildly divergent, and >0.25 for test sites considered divergent from reference condition (Table 3-4, Appendix B).

Table 3-4. Bray - Curtis Index for aquatic sampling sites, Whistler, 2016 -2019

Site	Year	Test Site Bray-Curtis Index	Reference Bray-Curtis Index (Mean ± SD)	RIVPACS O:E (p>0.7)	Group (Probability)	CABIN Classification
21M-DS-AQ21	2016	0.74	0.41 ± 0.17	1.17	3 (29%)	Mildly Divergent
	2017	0.78	0.41 ± 0.17	0.93	3 (33%)	Divergent
	2018	0.87	0.55 ± 0.22	1.20	5 (39%)	Mildly Divergent
	2019	0.75	0.41 ± 0.17	1.16	3 (33%)	Mildly Divergent
CRB-DS-AQ01	2016	0.71	0.48 ± 0.15	0.96	1 (44%)	Mildly Divergent
	2017	0.37	0.48 ± 0.15	0.96	1 (44%)	Reference
	2018	0.43	0.48 ± 0.15	1.15	1 (44%)	Reference
	2019	0.72	0.55 ± 0.22	0.56	5 (82%)	Mildly Divergent
JOR-DS-AQ31	2016	0.78	0.53 ± 0.14	0.82	4 (55%)	Divergent
	2017	0.76	0.53 ± 0.14	0.82	4 (52%)	Mildly Divergent
	2018	0.73	0.53 ± 0.14	0.95	4 (57%)	Mildly Divergent
	2019	0.57	0.53 ± 0.14	0.82	4 (62%)	Reference
RGD-AQ11	2016	0.70	0.41 ± 0.17	1.16	3 (38%)	Mildly Divergent
	2017	0.70	0.41 ± 0.17	1.16	3 (41%)	Mildly Divergent
	2018	0.94	0.55 ± 0.22	1.20	5 (38%)	Divergent
	2019	0.71	0.41 ± 0.17	1.16	3 (39%)	Mildly Divergent
RGD-DS-AQ12	2016	0.57	0.53 ± 0.14	1.18	4 (26%)	Reference
	2017	0.72	0.55 ± 0.22	1.22	5 (46%)	Reference
	2018	0.59	0.55 ± 0.22	1.17	5 (68%)	Reference
	2019	0.39	0.55 ± 0.22	1.21	5 (44%)	Reference

The RIVPACS O:E ratios ranged from 0.56 for Crabapple Creek (CRB-DS-AQ01) to 1.22 for River of Golden Dreams downstream site (RGD- DS-AQ12) (Table 3-4). The only site with an O:E ratio consistently less than 1.0 was Jordan Creek (JOR-DS-AQ31), where the ratio ranged from 0.82 to 0.95 (Table 3-4). For the other sites, the O:E ratio was greater than 1.0 for at least one year, and was greater than 1.0 for all four years at both sites on the River of Golden Dreams. The O:E data were also variable in relation to the multivariate assessment, with some sites assessed as within reference with a relatively low O:E ratio and other sites assessed as divergent with a relatively high O:E ratio (Table 3-4)

These data indicate that taxon richness at the test sites was on average comparable to what was expected based on the richness of reference sites. The divergence from reference condition identified through the CABIN multivariate assessment therefore was not primarily based on taxon richness.

3.3.3 Multimetric Site Characterization and Assessment

3.3.3.1 Total Abundance

Total abundance is a highly variable metric; for reference sites the CV ranged from 63% to 131% (Table 3-1). What this means is that abundance is an insensitive metric of only limited value in a site assessment. However, it is commonly reported and so is included within the analysis below.

As with the reference sites, abundance was also highly variable for the test sites, both among years and among sites. The highest abundance was recorded at Crabapple Creek (CRB-DS-AQ01), which ranged from approximately 2500 organisms to 3500 organisms per sample (Figure 3-1). The lowest abundance was recorded in the River of Golden Dreams (RGD-US-AQ11), which ranged from approximately 850 organisms to almost 1200 organisms per sample (Figure 3-1). The highest temporal variability was recorded at Jordan Creek (JOR-DS-AQ31), which ranged from just over 900 organisms to just over 2500 organisms per sample (Figure 3-1).

Despite the high spatial and temporal variability, abundance values for all sites in all years were considerably less than in the associated reference site: average site metric scores ranged from 0.21 to 0.73 among the five sites (Table 3-5). However, because of the high variability of the abundance metric, all sites were within the average metric threshold value of 0.06 (Table 3-5). What this means is that even though the abundance metrics were low in comparison to the reference average, they were still within one standard deviation of the measured abundances recorded for the reference sites. Benthic invertebrate abundance at all sites in all years was therefore in reference condition and considered unimpaired.

Table 3-5. Multimetric Assessment Scores

Parameter	**AQ21**	**AQ01**	**AQ31**	**AQ12**	**AQ11**	**Threshold**
Abundance	0.36	0.51	0.73	0.21	0.24	**0.06**
EPT Relative Abundance	1.06	1.16	***0.53***	0.95	1.05	**0.66**
Total Taxon Richness	1.19	0.89	0.81	1.08	1.13	**0.73**
EPT Taxon Richness	1.01	0.73	0.81	0.90	1.01	**0.69**
% Dominant	1.03	0.92	***0.87***	0.98	0.99	**0.89**

Parameter	**AQ21**	**AQ01**	**AQ31**	**AQ12**	**AQ11**	**Threshold**
Shannon-Wiener Diversity	1.07	0.80	0.81	1.08	1.03	**0.78**
Average Metric Score	**0.95**	**0.84**	**0.76**	**0.87**	**0.91**	**0.75**

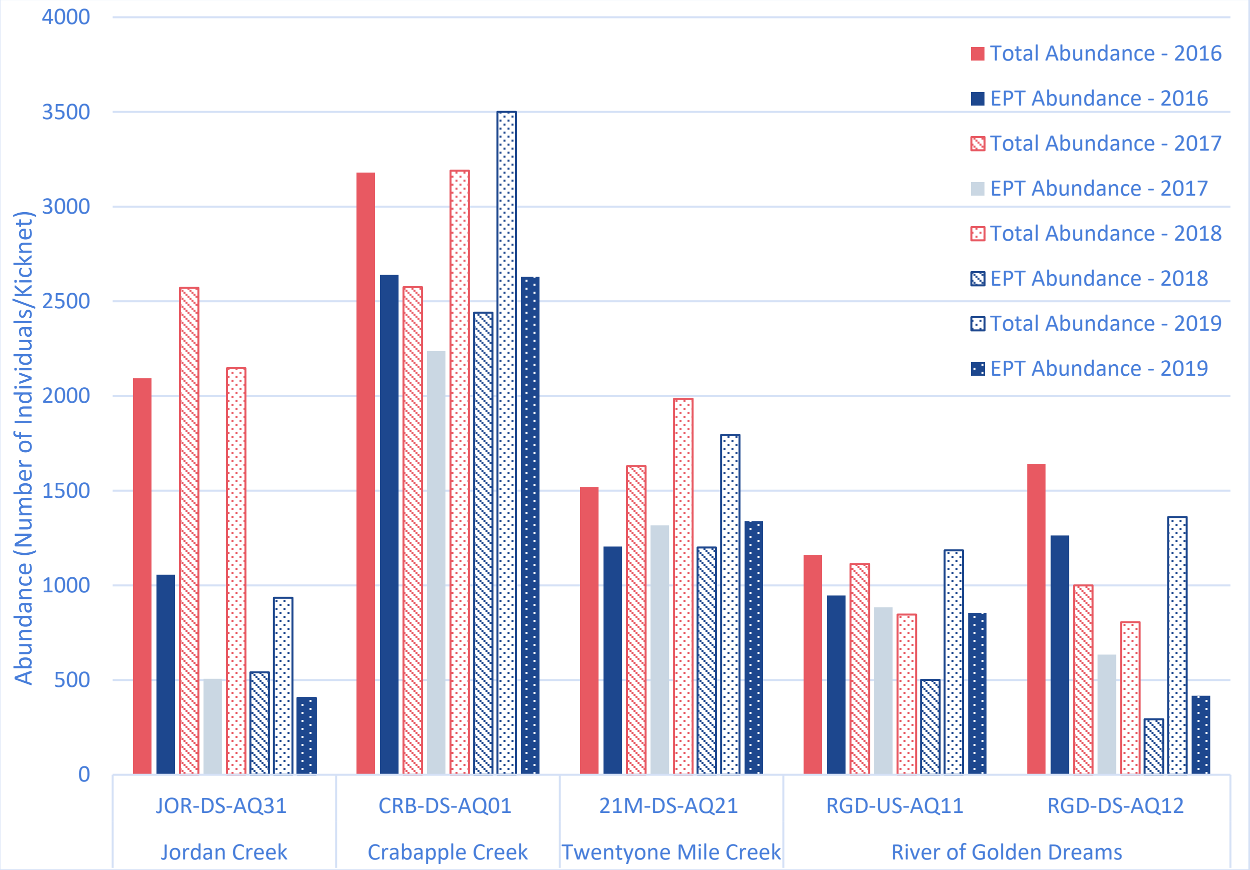


Figure 3-1. ***Benthic invertebrate total and Ephemeroptera, Plecoptera and Trichoptera (EPT) abundance by site and year, 2016-2019.***

3.3.3.2 EPT Relative Abundance

Ephemeroptera, Plecoptera and Trichoptera (EPT) relative abundance ranged from 20% to 87% among all sites and years (Figure 3-5). The relative abundance of EPT taxa was comparable among sites in Crabapple Creek, Twentyone Mile Creek and the River of Golden Dreams, and within these sites was relatively stable varying only from 60% to 87% (Figure 3-2). In Jordan Creek EPT abundance was relatively low and variable, ranging from 20% to 50% through the four years of sampling (Figure 3-2). Of interest is the continuing decline in EPT relative abundance at the downstream site on River of Golden Dreams (RGD-DS-AQ12): a trends test in 2021 will indicate whether the decline is significant.

Average metric scores ranged from 0.53 at the Jordan Creek site (JOR-DS-AQ31) to 1.16 at the Crabapple Creek site (CRB-DS-AQ01), with three of the sites greater than 1.0 (Table 3-5). Comparison with the reference threshold of 0.66 indicates that Jordan Creek (JOR-DS-AQ31) was below the threshold, but that the other four sites were above the threshold. Benthic invertebrate EPT relative abundance at sites CRB-DS-AQ01, 21M-DS-AQ21, RGD-US-AQ11 and RGD-DS-AQ12 was therefore in reference condition and considered unimpaired, while EPT relative abundance at site JOR-DS-AQ31 was considered mildly divergent.

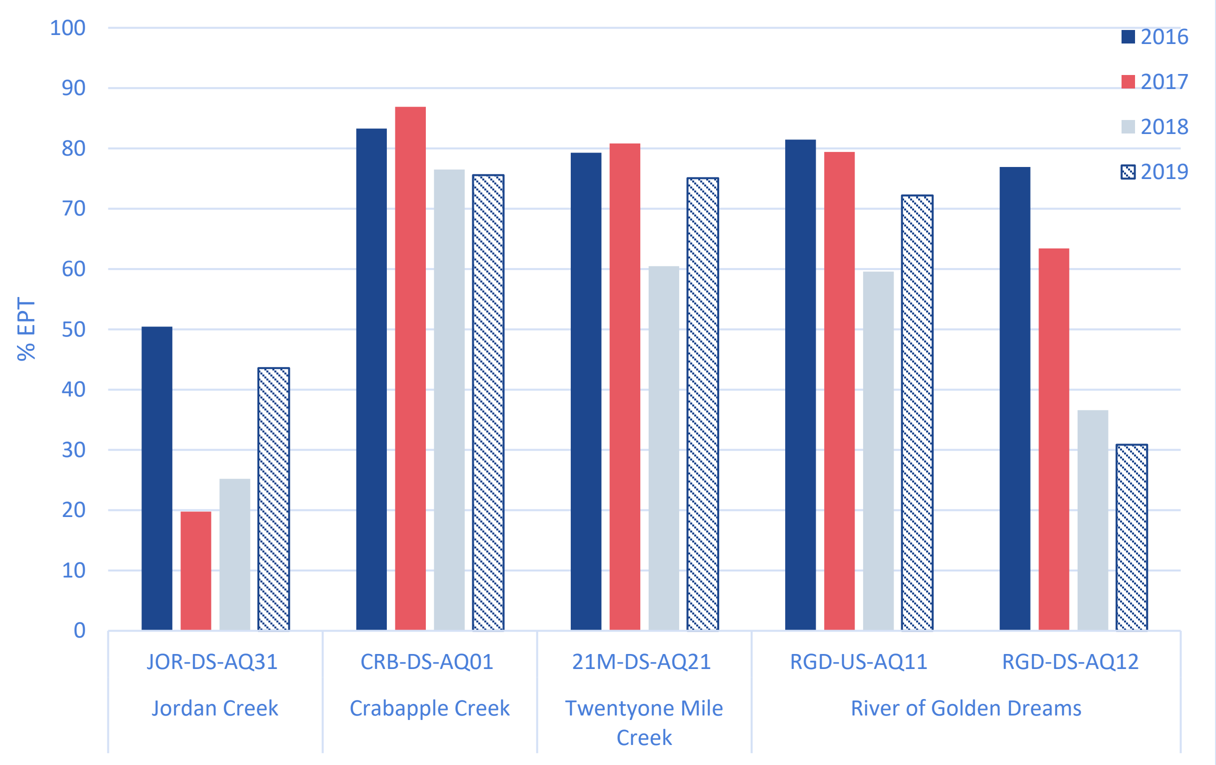


Figure 3-2. Benthic invertebrate community % EPT, 2016-2019.

3.3.3.3 Taxonomic Richness

Taxonomic richness varied from a low of 10 at site CRB-DS-AQ01 in 2017, to a high of 25 at site RGD-US-AQ11 in 2018 (Figure 3-3), but there were no consistent differences among sites. For all sites, taxonomic richness was higher in 2018 and 2019 than recorded in 2016 and 2017, ranging from 15 to 25 taxa in 2018 and 2019 and 10 to 16 taxa in 2016 and 2017 (Figure 3-3). Of interest is the continuing increase in taxa richness at site JOR-DS-AQ31 in Jordan Creek: a trends test in 2021 will indicate whether the increase is significant.

Average metric scores ranged from 0.81 at JOR-DS-AQ31 to 1.19 at 21M-DS-AQ21, with three of the sites greater than 1.0 (Table 3-4). Comparison with the reference threshold of 0.73 indicates that all sites were above the threshold. Benthic invertebrate taxon richness at all sites in all years was therefore in reference condition and considered unimpaired.

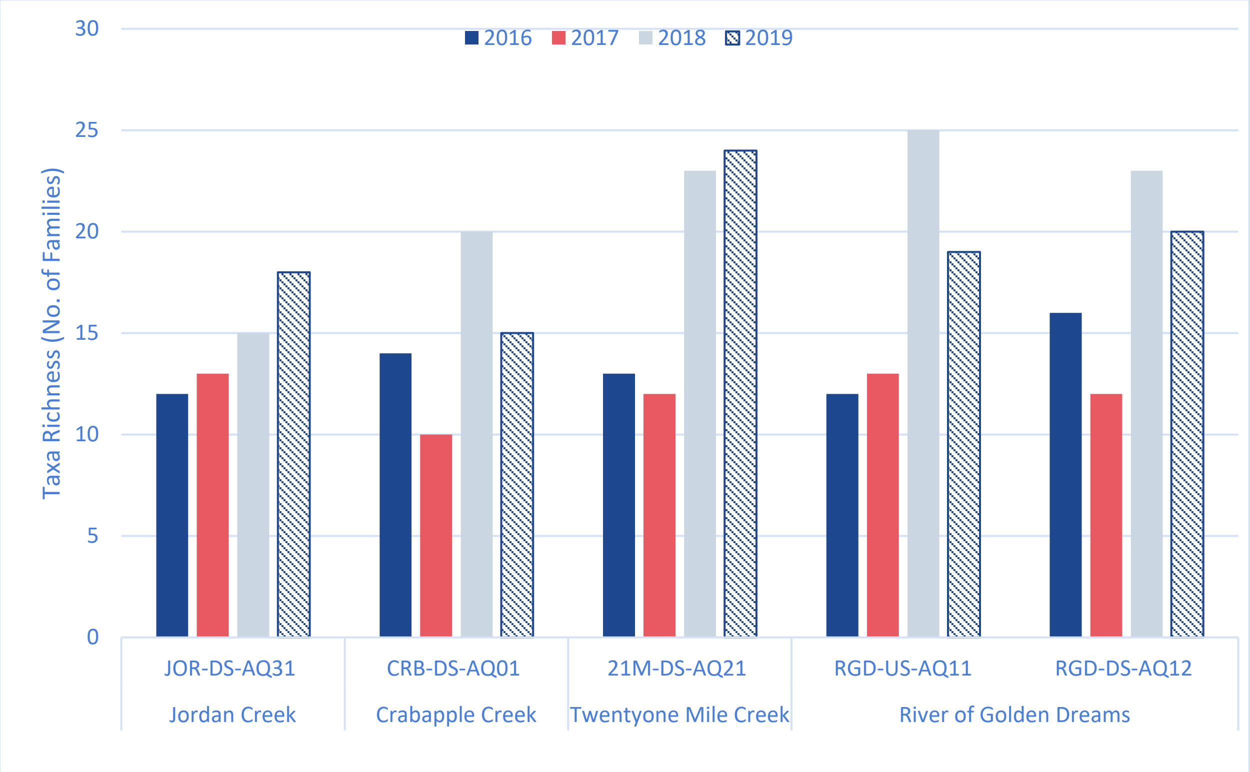


Figure 3-3. Benthic invertebrate community taxa richness, 2016-2019.

3.3.3.4 EPT Taxon Richness

The EPT richness ranged from 6 to 13 among the sites and years, but as with total richness, there were no consistent differences among sites (Figure 3-4). In 2019, richness of EPT taxa ranged from seven families at Crabapple Creek to 13 families at the 21 Mile Creek site (Figure 3-4). The 2019 EPT taxa richness was consistent with 2018 for the following sites: Jordan Creek, 21 Mile Creek, and the downstream River of Golden Dreams site (RGD-DS-AQ12). Overall, an increase in EPT taxa richness was recorded in 2018 and 2019, compared with 2016 and 2017.

Average metric scores ranged from 0.73 at CRB-DS-AQ01 to 1.01 at 21M-DS-AQ21 and RGD-US-AQ11, with two of the sites greater than 1.0 (Table 3-5). Comparison with the reference threshold of 0.69 indicates that all sites were above the threshold. Benthic invertebrate EPT taxon richness at all sites in all years was therefore in reference condition and considered unimpaired, which means that EPT taxa are present and persisting at all five of the study sites.

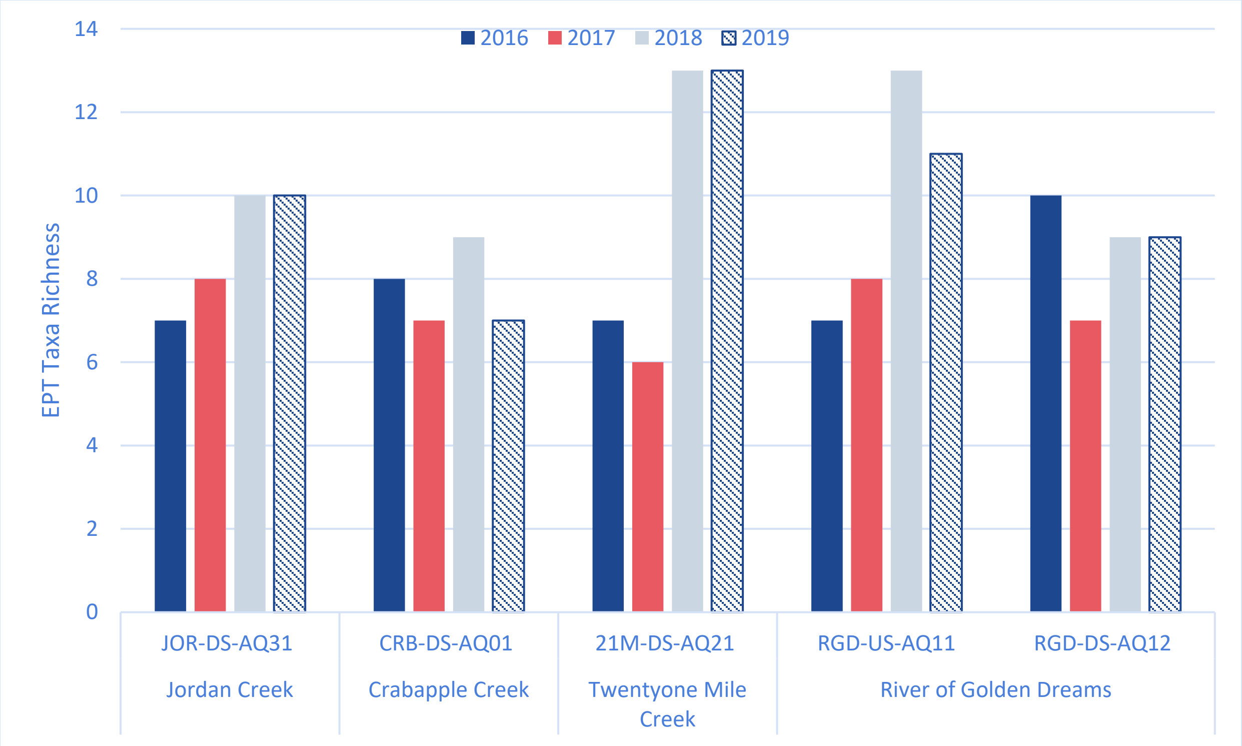


Figure 3-4. Benthic invertebrate community EPT taxa richness, 2016-2019.

3.3.3.5 Community Composition

Sites in Crabapple Creek, 21 Mile Creek and the upper River of Golden Dreams site AQ11, which are all clustered in the upper River of Golden Dreams system, had similar community structure, with 27% or less of Diptera+non-insects and greater than 50% of EPT taxa (Figure 3-5).

The downstream site on the River of Golden Dreams (RGD-DS-AQ12) had a higher proportion of Diptera+non-insects (57%) relative to the upstream sites (Crabapple Creek, 21 Mile Creek and River of Golden Dreams upstream site) and a lower proportion of Ephemeroptera (28%). The site also had the highest proportion of invertebrates in the 'other' category (12%).

Diptera+non-insects comprised just over half (56%) of the benthic community at the Jordan Creek site (Figure 3-5). This proportion was similar to that recorded in 2016 (50%). Notably, in 2017 and 2018 a shift to higher proportions of Diptera+non-insects were recorded and suggested a decline in overall community health potentially caused by organic pollution.

Compilation of the five dominant species for each site resulted in average metric scores that ranged from 0.87 at JOR-DS-AQ31 in Jordan Creek to 1.03 at 21M-DS-AQ21 in Twentyone Mile Creek (Table 3-5). Comparison with the reference threshold of 0.89 indicates that site JOR-DS-AQ31 in Jordan Creek was below the threshold, but that the other four sites were above the threshold. Benthic invertebrate dominance at sites CRB-DS-AQ01, 21M-DS-AQ21, RGD-US-AQ11 and RGD-DS-AQ12 was therefore in reference condition and considered unimpaired, while dominance at site AQ31 was considered mildly divergent.

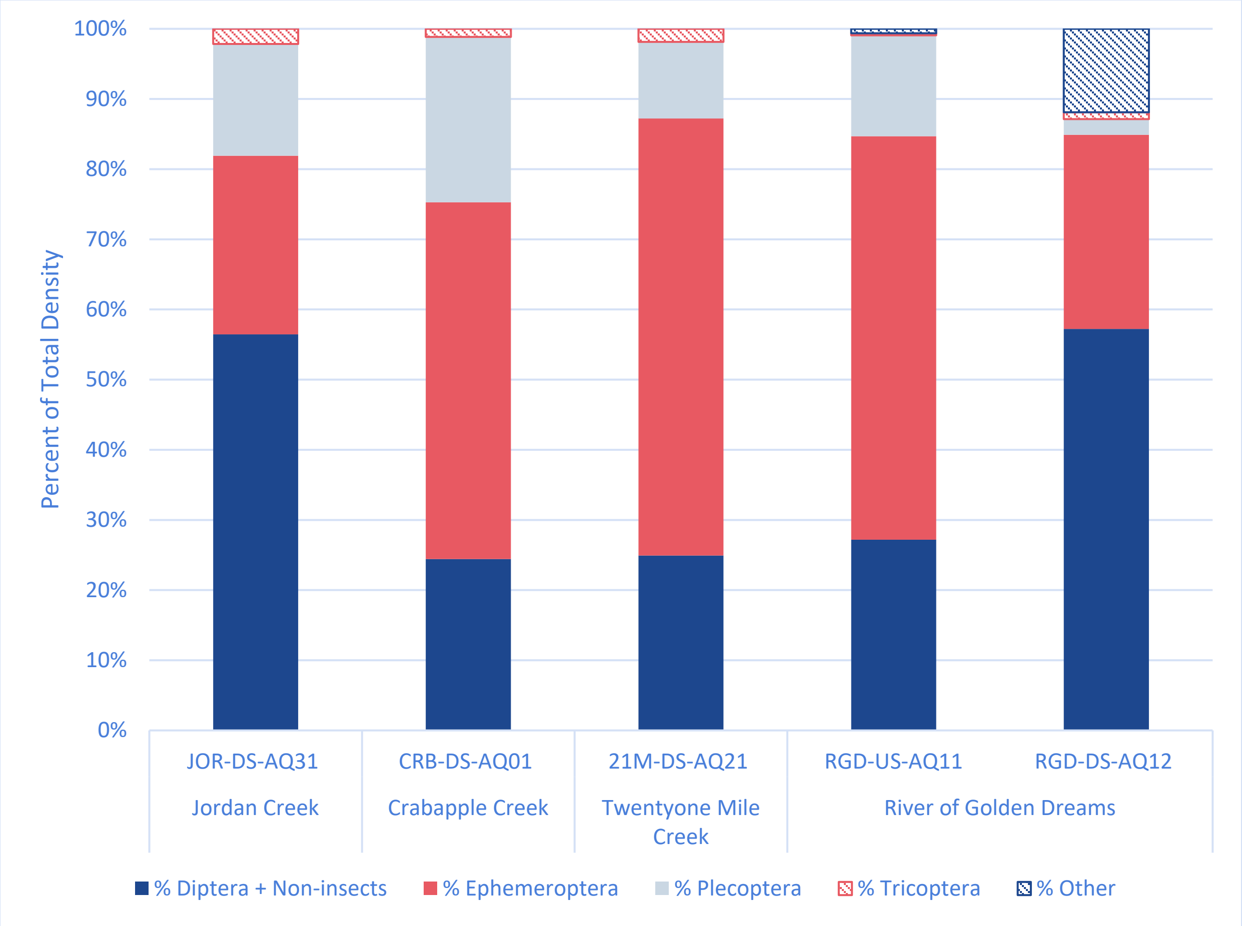


Figure 3-5. Relative densities of benthic invertebrate communities by site, 2019.

3.3.3.6 Shannon-Wiener Diversity

Diversity ranged from 1.07 at CRB-DS-AQ01 in 2017 to 2.32 at RGD-DS-AQ12 in 2018 (Figure 3-6). On average, the lowest diversity was recorded at site JOR-DS-AQ31 in Jordan Creek and the highest diversity was recorded at Site RGD-DS-AQ12 in the River of Golden Dreams. Diversity was relatively stable through the period of record, but it did appear that diversity was slightly higher in 2018 and 2019 than in 2016 and 2017 (Figure 3-6).

Average metric scores for diversity ranged from 0.80 at CRB-DS-AQ01 to 1.08 at RGD-DS-AQ12, with three of the sites greater than 1.0 (Table 3-5). Comparison with the reference threshold of 0.78 indicates that all sites were above the threshold. Benthic invertebrate diversity at all sites in all years was therefore in reference condition and considered unimpaired.

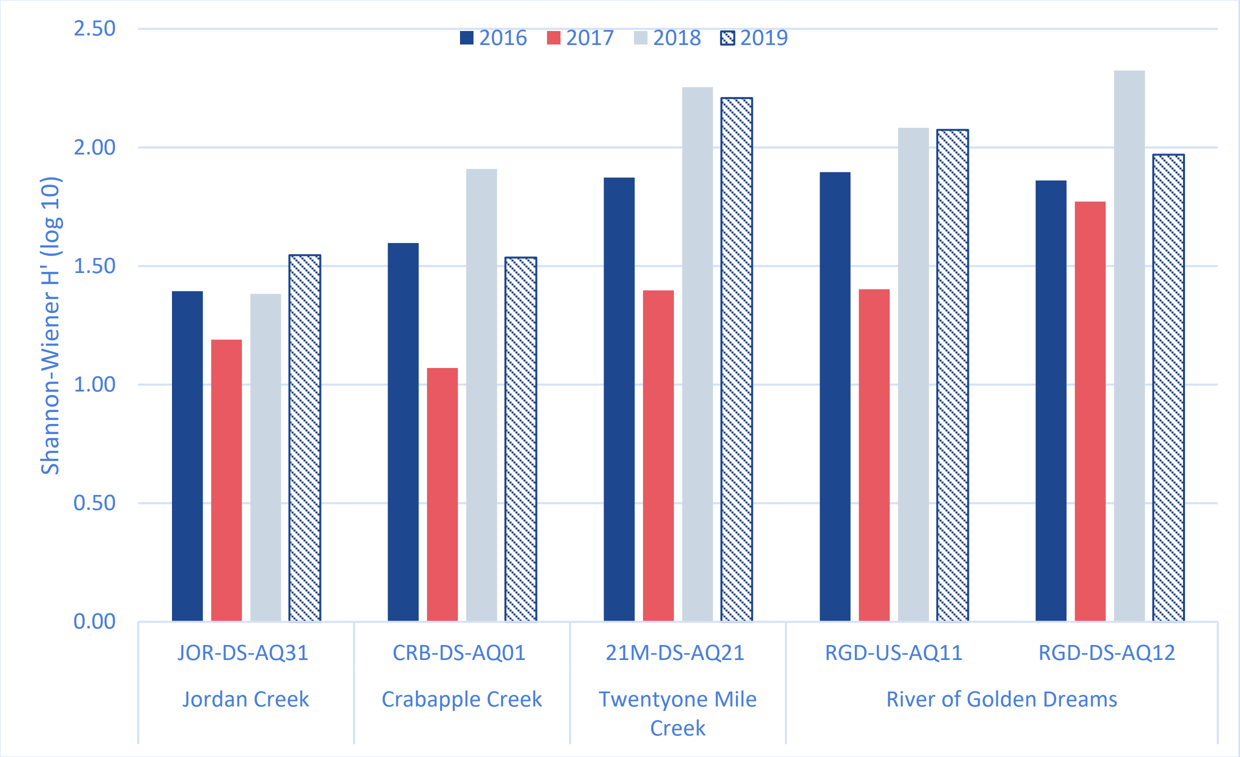


Figure 3-6. Shannon-Weiner indices, 2016-2019.

3.3.4 Hilsenhoff Index of Biotic Integrity

Compilation of the HIBI scores was undertaken and indicated that the scores varied from 3.58 at site 21M-DS-AQ21 to 5.43 at site RGD-DS-AQ12 (Table 3-6). Based on these scores, classification ranged from good to very good, indicating that the potential for some organic pollution existed at site RGD-DS-AQ12 and site JOR-DS-AQ31, but that there was only the possibility of slight organic pollution at the rest of the sites (Table 3-6). These results indicate that significant input of organic pollutants has not occurred to date within the test streams.

Table 3-6. Hilsenhoff Index of Biotic Integrity Assessment Scores

Site	Stream Order	2018	2019	Classification*
AQ01 – Crabapple Creek	2	3.93	4.25	Very Good
AQ11 – River of Golden Dreams Upstream	3	3.93	3.98	Very Good
AQ12 – River of Golden Dreams Downstream	3	5.14	5.43	Good
AQ21 – Twentyone Mile Creek	3	3.75	3.58	Very Good
AQ31 – Jordan Creek	2	5.21	4.66	Good

**See Table 3-2*

3.4 Assessment Conclusions

Conclusions regarding the condition of the four creeks are provided below for each site.

3.4.1 Crabapple Creek Site CRB-DS-AQ01

Crabapple Creek was assessed as in reference condition to mildly divergent using the CABIN assessment and was assessed within reference condition for all six core metrics with an average metric score of 0.84. The site was also assessed as in very good condition using the HIBI. These results suggest that Crabapple Creek through the period of record was generally in reference condition and unimpaired through the period of record.

3.4.2 River of Golden Dreams Upstream Site RGD-US-AQ11

The upstream site in the River of Golden Dreams was assessed as mildly divergent to divergent using the CABIN assessment. In contrast, the site was assessed as within reference condition for all six core metrics with an average metric score of 0.91 and in very good condition using the HIBI. The site also had a greater number of taxa than expected. The weight-of-evidence therefore suggests that the upstream reach of the River of Golden Dreams was in reference condition and unimpaired through the period of record.

3.4.3 River of Golden Dreams Downstream Site RGD-DS-AQ12

The down stream site in the River of Golden Dreams was assessed as in reference condition for all four years using the CABIN assessment. The site was also assessed as within reference condition for all six core metrics with an average metric score of 0.87 and in good condition using the HIBI. The site also had a greater number of taxa than expected. The weight-of-evidence therefore suggests that the downstream reach of the River of Golden Dreams was in reference condition and unimpaired through the period of record.

3.4.4 Twentyone Mile Creek Downstream Site 21M-DS-AQ21

The downstream site in Twentyone Mile Creek was assessed as mildly divergent to divergent using the CABIN assessment. In contrast, the site was assessed as within reference condition for all six core metrics with an average metric score of 0.95 and in very good condition using the HIBI. The site also had a greater number of taxa than expected. The weight-of-evidence therefore suggests that the downstream reach of Twentyone Mile Creek was in reference condition and unimpaired through the period of record.

3.4.5 Jordan Creek Downstream Site JOR-DS-AQ31

The downstream site in Jordan Creek was assessed as ranging from reference to divergent using the CABIN assessment. The site was also assessed as within reference condition for only four of the six core metrics with an average metric score of 0.76, which was the lowest of all the sites. The site also consistently had a fewer number of taxa than expected. The site was, however, assessed as in good condition using the HIBI. The weight-of-evidence therefore suggests that the downstream reach of Jordan Creek is likely mildly divergent from reference condition and may be slightly impaired at present.

4. Fish Community

4.1 Introduction

The objective of the aquatic species monitoring program was to assess relative aquatic health of local watercourses using important indicator species such as Kokanee Salmon (*Oncorhynchus nerka*), Bull Trout (*Salvelinus confluentus)*, Rainbow Trout (*O. mykiss)* and Coastal Cutthroat Trout (*O. clarkii clarkii).* The 2019 fisheries program remained consistent with previous years. In 2018 minnow trapping was added as a sampling method to augment data collected via electrofishing and facilitate fish sampling in the River of Golden Dreams.

Kokanee Salmon are present in the study streams, with known spawning areas in the River of Golden Dreams. Bull Trout*,* as well as Cutthroat Trout, are native to the Whistler area, but observations of these species are rare. Both species are blue-listed, indicating that they are considered vulnerable in BC. The Lower Mainland populations of Coastal Cutthroat Trout are in serious decline (BC MoFLNRO 2017a). Within the Whistler area, Cutthroat Trout are believed to have hybridized with Rainbow Trout. Populations of Bull Trout are also in decline in BC and throughout the global range of this species (BC MoFLNRO 2017b). Bull Trout are very similar in shape and coloration to Dolly Varden (*Salvelinus malma*) and genetic analysis is required to definitively differentiate individuals of these species. Rainbow Trout are ubiquitous in the study streams and were stocked in Rainbow Lake (the headwater lake of 21 Mile Creek) in the late 1970s or early 1980s (Eric Crowe, pers. comm). Sculpin (*Cottus sp.*) and Threespine Stickleback (*Gasterosteus aculeatus*) are also common.

4.2 Methods

Streams were sampled for fish between July 31st and August 2nd, 2019.Table 4-1 provides a complete list of 2018 fish sampling sites.

The fish community within RMOW streams were sampled in 2019 under the Scientific Fish Collection Permit SU19-524197 issued by the BC Ministry of Forests Lands and Natural Resource Operations (BC MoFLNRO). The fish community was sampled using a combination of backpack electrofishing and minnow traps. Electrofishing was not completed in The River of Golden Dreams due to human safety concerns; only minnow traps were used at these locations. Electrofishing was completed at stream sites by a two-person crew using a Smith-Root LR-24 backpack electrofisher following methods outlined in Johnston et al. (2007). Only one electrofishing pass was made at each site; no stop nets were used. Electrofisher voltage, duty cycle and frequency settings were adjusted based on site conditions in order to maximize efficiency and minimize the risk of injury to fish. Electrofisher settings are summarized in Table 4-1.The electrofishing effort was recorded for each site.

Minnow traps were set at each stream site after electrofishing was completed as well as at the River of Golden Dreams where no electrofishing could be conducted. Traps consisted of two cylinders made of 6.35 mm galvanized steel wire mesh with a conical entrance, measuring 42 cm long and 23 cm in diameter. The cylinders were clipped together, baited with cat food and set overnight. Table 4-1 provides a summary of total fishing effort for gear used at each stream site.

All fish captured were identified to species, enumerated and measured for length (to the nearest 1 mm) and wet weight (to the nearest 0.1 g using a Scout Pro 400 g scale). Fork length was measured for salmonid fish species and total length was measured for other species. Any lesions, parasites, or other anomalies on fish were recorded before the fish were released live back at the site of capture.

Table 4-1. Fish sampling methods and effort at stream sites in the RMOW areas, 2019

Creek	Site ID	Gear Type	Date Sampled/Set	Minnow Trapping			Electrofishing			
				Date Retrieved	Number of Traps	Total Effort (hrs)	Voltage (V)	Frequency (Hz)	Duty Cycle (%)	Total Effort (sec)
Jordan Creek	JOR-DS-AQ31	EF	01-Aug-19	-	-	-	220	30	15	402
		MT	31-Jul-19	01-Aug-19	5	122.5	-	-	-	-
Crabapple Creek	CRB-DS-AQ01	EF	01-Aug-19	-	-	-	225	30	12	1558
		MT	01-Aug-19	02-Aug-19	5	130	-	-	-	-
River of Golden Dreams (Upper)	RGD-US-AQ11	MT	01-Aug-19	02-Aug-19	5	119.01	-	-	-	-
River of Golden Dreams (Lower)	RGD-DS-AQ12	MT	31-Jul-19	01-Aug-19	5	127.5	-	-	-	-
21 Mile Creek	21M-DS-AQ21	EF	31-Jul-19	-	-	-	450	35	20	844
		MT	31-Jul-19	02-Aug-19	5	222.5	-	-	-	-

4.2.1 Data Analysis

Field identification of juvenile trout can be confounded where Rainbow Trout occur in the same geographic area and frequently encounter on another (sympatry) with Coastal Cutthroat Trout, in part because hybridization commonly occurs between the two species and because hybrids themselves are difficult to differentiate (Baumsteiger 2005). Visual identification error rates for juvenile trout (sympatric Coastal Cutthroat and Rainbow Trout populations) can be quite high without genetic analyses to corroborate genotypes. Similar to 2018 (Palmer and Snowline 2019), 2019 field crews did not identify any suspected hybrid offspring of Coastal Cutthroat and Rainbow Trout (Photo 4-1). In the absence of genetic analyses to provide accurate identification of individual fish and the fact that a suspected hybrid was identified in 2016 within the Ecosystem Monitoring Program study area (Photo 4-2); Palmer and Snowline 2017), results are discussed in terms of 'unknown' trout within this report.

Photo 4-1. Rainbow Trout (fork length 136 mm) captured in Crabapple Creek (CRB-DS-AQ01) during 2018 electrofishing efforts. Date: August 1, 2019.

Photo 4-2. Suspected hybrid trout (fork length 84 mm) captured in 21 Mile Creek in 2016 (21M-DS-AQ21). Date: August 6, 2016.

<u>*Fish Abundance*</u>

Fish community data was summarized by calculating catch-per-unit-effort (CPUE) for each individual fishing effort, gear type and fish species captured. CPUE is an index of relative abundance that can be used to compare fish populations among different areas with the assumption that catch is proportional to the amount of effort for each gear-type used. CPUE is defined as the number of fish captured per sampling device per unit time. CPUE is summarized for each gear type and by species.

Electrofishing:
*CPUE=number of fish caught * [100/(electrofishing effort, hr)]*

Minnow Traps:
*CPUE=number of fish caught per trap * [24 hr/(set time, hr)]*

Length, Weight and Condition

Mean length and weight were calculated for each fish species; further analyses were only completed on trout, as this species was proposed as an indicator species in the past and the focus of analysis in previous Whistler Ecosystem Monitoring reports (Palmer and Snowline 2017-2019).

Site-specific length-age regressions for trout were calculated as:

$$log_{10}(W) = a + b \times log_{10}(L) \qquad (1)$$

where *W* = weight (g), *L* = length (mm), *a* = the intercept of the regression and *b* = the slope of the regression.

One sample t-tests were performed on estimated weight-length slope coefficients to determine if slopes significantly differed from the isometric growth value of three. Isometric fish growth occurs when length and weight increase at the same rate as the fish grows, whereas allometric growth occurs when length and weight increase at different rates during fish growth. Isometric and allometric growth are used to understand length-weight relationships in organisms. Slope coefficients of the estimated weight-length slope used in t-tests were estimated using species-specific linear regressions. Isometric growth is a requirement for calculating fish condition using the Fulton condition factor (K), as it assumes that fish shape does not change with increasing length. Trout condition could not be assessed using the Fulton condition factor, due to allometric growth. Instead, the relative condition factor (K_n) was used to characterize fish condition:

$$K_n = \frac{W}{W'} \qquad (2)$$

where *W* = fish actual weight (g) and *W'* = predicted length-specific weight using the length-weight regression outlined in Equation 1.

4.2.2 Quality Assurance/Quality Control

Field equipment was calibrated prior to the start of the field season, properly maintained and kept clean and free of excess water. The YSI meter was re-calibrated multiple times while in the field. All scales were regularly tared to maintain accuracy while in use. Care was taken to clean equipment between samples to prevent cross contamination.

All data was recorded on waterproof paper and examined for completeness and accuracy. All captured fish were identified to the lowest possible taxonomic level and a subset were photographed for verification of species identification.

All fisheries field data were transferred to electronic spreadsheets in the office. The spreadsheets were compared with the field notes to identify and correct transcription errors. A variety of other measures were taken to further ensure the validity of the data. For example, fish weights were plotted against fish lengths for each species separately to identify outliers that may have been due to errors in recording or transcription. Outliers were excluded from the analyzed dataset.

4.3 Results and Discussion

In 2019, fish community assessments were completed at five stream sites within the RMOW study area (Figure 2-1). Fish catch-per-unit-effort (CPUE) by species and sampling gear are presented in Table 4-2 and Table 4-3. Biological data for fish sampled in the RMOW study area are presented in Appendix D.

A total of 179 fish were captured during 2019 electrofishing and minnow trap efforts. Similar to 2018 only three fish species were identified in streams sampled in 2019, including unidentified trout, Sculpin and Threespine Stickleback. No Bull Trout or Dolly Varden were observed. Sculpin represented the overall dominant fish species captured during 2019 electrofishing efforts, comprising over 67% of the capture in b Jordan Creek, Crabapple Creek and 21 Mile Creek (Figure 4-1). Threespine Stickleback composed 50% or more of the catch using minnow trapping at all five sampling locations (Figure 4-2). Overall, trout have shown a decline in capture since 2016. Similar to 2018 no trout were captured at the upstream site of the River of Golden Dreams where only minnow traps were deployed (Palmer and Snowline 2019).

Table 4-2. *Electrofishing effort and fish caught in surveys conducted in the RMOW study area, 2019.*

Site	Creek	Date	Effort (seconds)	Catch (number of individuals)				CPUE (#/100s)			
				CC	TR	TSB	Total	CC	TR	TSB	Total
CRB-DS-AQ01	Crabapple Creek	01-Aug-19	1558	4	1	1	6	0.26	0.06	0.06	0.39
JOR-DS-AQ31	Jordan Creek	01-Aug-19	402	26	4	1	31	6.47	1.00	0.25	7.71
21M-DS-AQ21	21-Mile Creek	31-Jul-19	844	30	11	0	41	3.55	1.30	0.00	4.86

Notes: CPUE = catch-per-unit-effort, CC = Sculpin (General), TR = trout, TSB = Threespine Stickleback

Table 4-3. *Minnow trap effort and fish caught in surveys conducted in the RMOW study area, 2019.*

Site	Creek	Date Traps Set	Date Retrieved	Number of Traps	Effort (hrs)	CC	TR	TSB	Total	CC	TR	TSB	Total
CRB-DS-AQ01	Crabapple Creek	01-Aug-19	02-Aug-19	5	130	0	4	4	8	0.00	0.15	0.15	0.30
JOR-DS-AQ31	Jordan Creek	31-Jul-19	01-Aug-19	5	122.5	1	5	9	15	0.04	0.20	0.35	0.59
RGD-DS-AQ12	River of Golden Dreams	31-Jul-19	01-Aug-19	5	136.65	6	2	55	63	0.23	0.08	2.07	2.37
21M-DS-AQ21	21-Mile Creek	31-Jul-19	02-Aug-19	5	222.5	0	4	6	10	0.00	0.09	0.13	0.22
RGD-AQ11	River of Golden Dreams	01-Aug-19	02-Aug-19	5	127.5	0	0	6	6	0.00	0.00	0.23	0.23

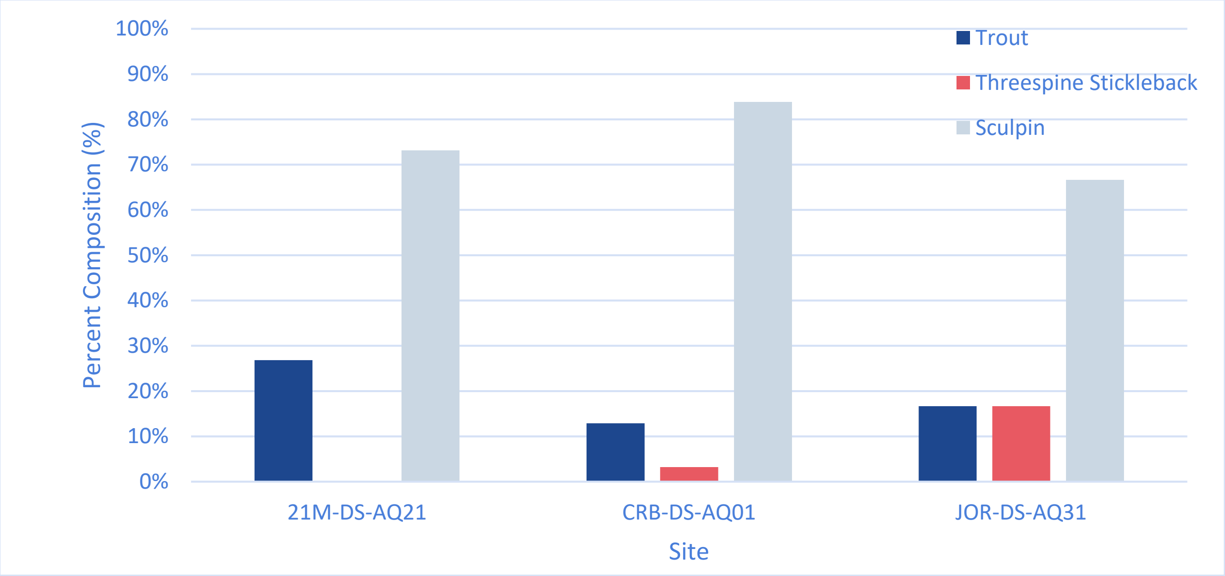


Figure 4-1. Percent composition of fish species captured electrofishing streams in RMOW study area, 2019.

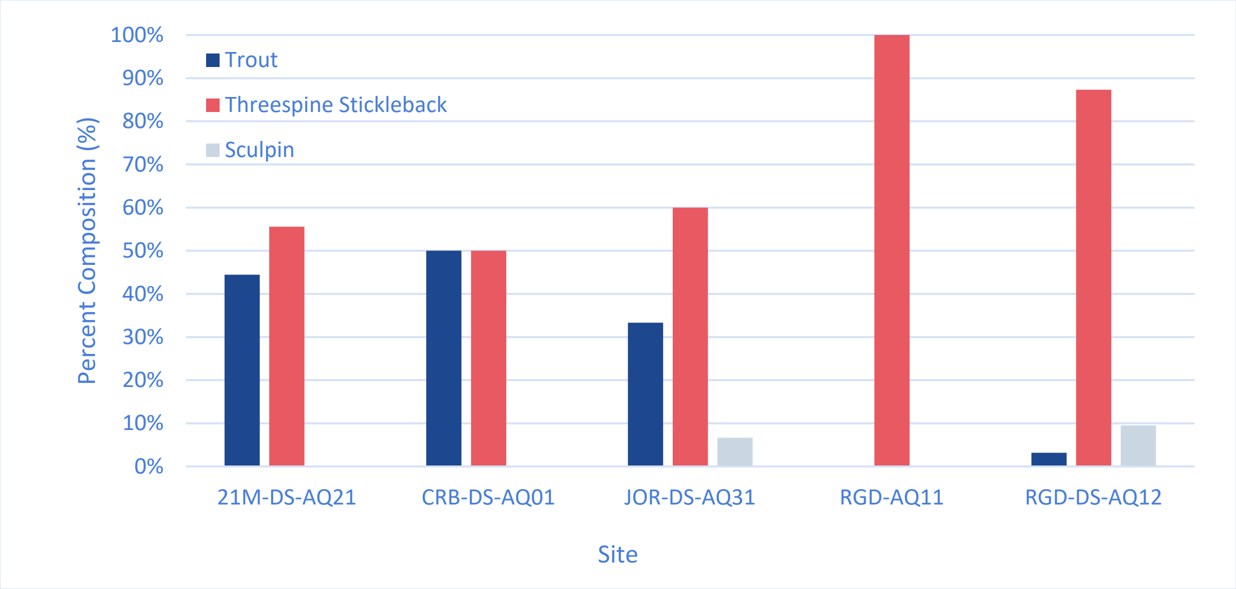


Figure 4-2. Percent composition of fish species captured in streams using minnow traps, 2019.

4.3.1.1 *Lengths, Weights and Condition*

The mean length and weight of each fish sampled in 2019 is presented in Table 4-4. A length-frequency analysis for trout sampled in 2016 – 2019 is presented in Figure 4-3. Note that the larger numbers of fish captured in 2016 (n=102) relative to 2017 (n=9), 2018 (n=20) and 2019 (n=31) is most likely due to the multiple pass depletion electrofishing method used in that year (Palmer and Snowline 2017).

In 2019, trout were consistently the largest fish species captured in the study area. Amongst all sites, trout ranged in length from 27 mm to 136 mm and in weight from less than 0.1 g to 48.0 g (Table 4-4). The largest trout were captured in Crabapple Creek and Jordan Creek.

Table 4-4. Length and weights of fish captured in the RMOW study area, 2018.

Creek	Site ID	Species	Number	Length (mm)				Weight (g)			
				Min	Mean	Max	SD	Min	Mean	Max	SD
Jordan Creek	JOR-DS-AQ03	CC	5	58.0	74.2	94.0	14.8	2.2	14.2	48.0	19.3
		TR	6	46.0	81.7	128.0	32.1	1.3	8.7	21.6	7.7
		TSB	10	47.0	51.9	59.0	4.2	1.1	1.6	2.0	0.3
Crabapple Creek	CRB-DS-AQ01	CC	8	28.0	86.1	136.0	36.8	0.6	2.4	8.3	1.7
		TR	8	28.0	86.1	136.0	36.8	0.1	9.1	23.3	8.0
		TSB	5	52.0	59.0	70.0	8.0	1.8	2.4	3.3	0.7
River of Golden Dreams (Upper)	RGD-AQ11	TSB	6	48.0	58.0	80.0	12.0	1.0	2.4	6.2	2.0
River of Golden Dreams (Lower)	RGD-DS-AQ12	CC	6	55.0	61.3	68.0	4.9	0.3	0.8	1.7	0.3
		TR	2	73.0	78.5	84.0	7.8	3.6	4.7	5.8	1.6
		TSB	55	33.0	42.9	55.0	4.2	1.7	2.5	3.3	0.6
21 Mile Creek	21M-DS-AQ21	CC	30	39.0	50.6	76.0	9.1	0.4	2.4	13.0	2.8
		TR	15	27.0	50.9	87.0	23.3	0.1	2.4	7.0	2.8
		TSB	5	46.0	49.4	52.0	3.1	0.6	1.3	1.8	0.6
All Sites		CC	67	39.0	56.4	94.0	12.0	0.4	3.3	48.0	6.1
		TR	31	27.0	67.7	136.0	32.0	0.1	5.5	23.3	6.2
		TSB	81	33.0	46.6	80.0	7.7	0.3	1.1	6.2	0.8

Notes: CC = Sculpin (General), TR = trout, TSB = Threespine Stickleback

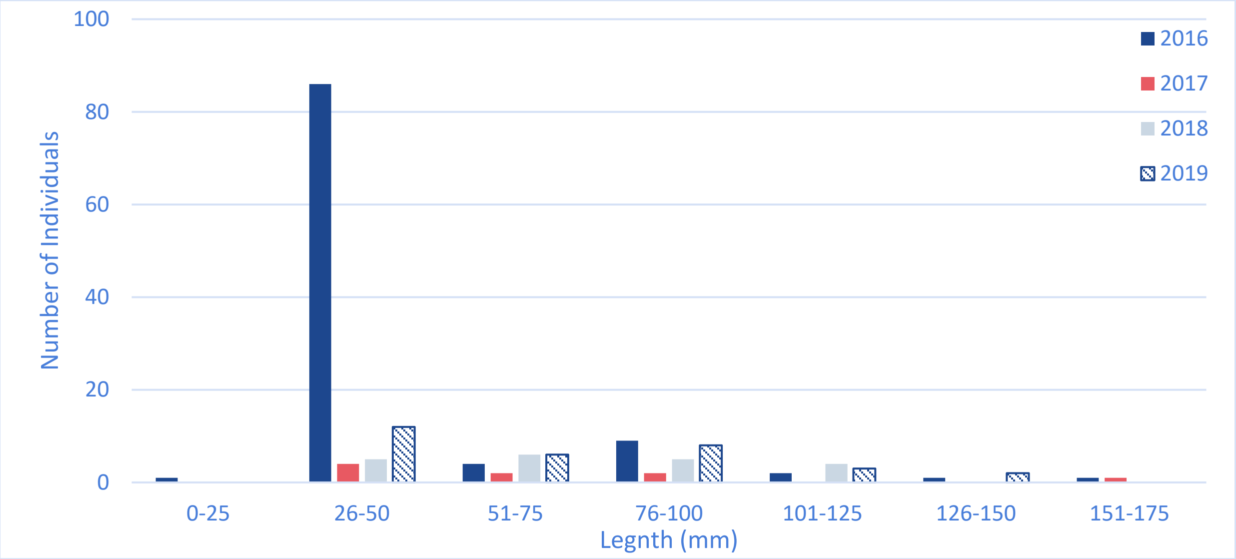


Figure 4-3. Length-frequency analysis for sampled trout (electrofishing and minnow trap collection methods) in study streams, August 2016, 2017, 2018 and 2019.

<u>Condition</u>

The length to weight relationship of all the trout sampled in 2016 - 2019 are presented in Figure 4-4. The length-weight linear regression for juvenile trout collected in 2019 was significant (Linear regression, slope = 3.54, $R^2 = 0.97$, df = 29, $p < 0.05$). Due to a slope value greater than 3.0 (3.54), trout growth was shown to be positively allometric (t-test, t = 2.74, df = 29, $p < 0.05$), that is, fish length increased more quickly relative to weight. This positive allometric growth was also in juvenile trout captured in 2018 (Palmer and Snowline, 2019). Conversely, in 2017 trout growth was shown to be isometric (t-test, t = 0.76, df = 7, P = 0.47) with fish having relatively similar ratios between growth in length and weight (Palmer and Snowline 2018). In 2016, trout growth was also allometric but in this year was negatively allometric (slope value less than 3.0), thus showing weight increasing quickly relative to length (Palmer and Snowline, 2017).

Due to the low sample size of trout in 2017 and 2018, statistics derived from this data have limited power and therefore results should be interpreted with caution. For example, even though the length-weight relationships of 2016 - 2019 trout appear similar (Figure 4-4), statistical analysis showed significant differences in trout growth relationships (isometric vs. allometric). As trout captured in 2018 and 2019 show allometric growth, relative condition was used to assess fish condition. Refer to Section 4.2.2 for detailed analyses.

Mean relative condition (Kn) for trout captured in RMOW from 2016 -2019 is presented in Figure 4-5. In salmonids, a condition of 1 is considered normal for a healthy fish. Therefore, all trout sampled within the RMOW in 2019 were considered healthy based on the relative condition index. Within the four sites where trout were captured, all showed similar condition values for 2019.

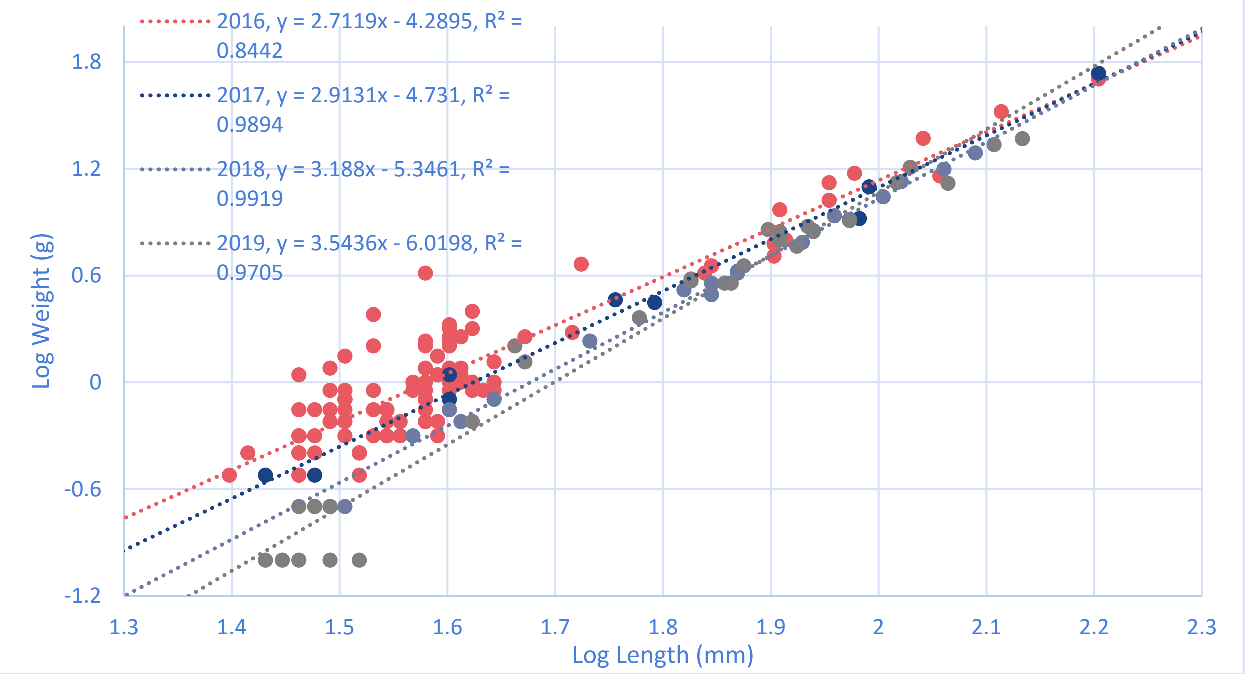


Figure 4-4. Weight-length relationship for juvenile trout captured in the RMOW study streams, 2016 - 2019.

The purpose of the fish sampling program was to develop a greater understanding of the fish communities in the streams within the study area and to help identify any potential impacts to these sites. The 2019 sampling program built upon the work completed in 2016 to 2018. Fish community health is a product of the environment in which they live in. As fish occupy a higher trophic level and are longer-lived compared to other aquatic organisms (*e.g.* benthic invertebrates), fish community data can provide information on the long-term health of a system.

The fish communities within the Ecosystems Monitoring Program study area are inhabited by 0+ year fry and juvenile trout, demonstrating the importance of the study reaches as rearing and feeding habitat. At present, trout collected could represent either cutthroat or rainbow trout. As recommended in previous years, the collection of aging structures and the collection of fin clips to conduct genetic analysis from trout captured within the study area would contribute to a greater understanding of the trout community inhabiting these systems within the RMOW.

Changes in length weight relationship between years is not a currently a concern. The specific species of trout captured remains unknown and mixed catch can affect the length/weight relationship between years and sites. Trout have been captured from several distinct streams and habitats; the proportion of trout captured from each stream changes from year to year. This proportional difference in sampled fish can effect the length weight relationship.

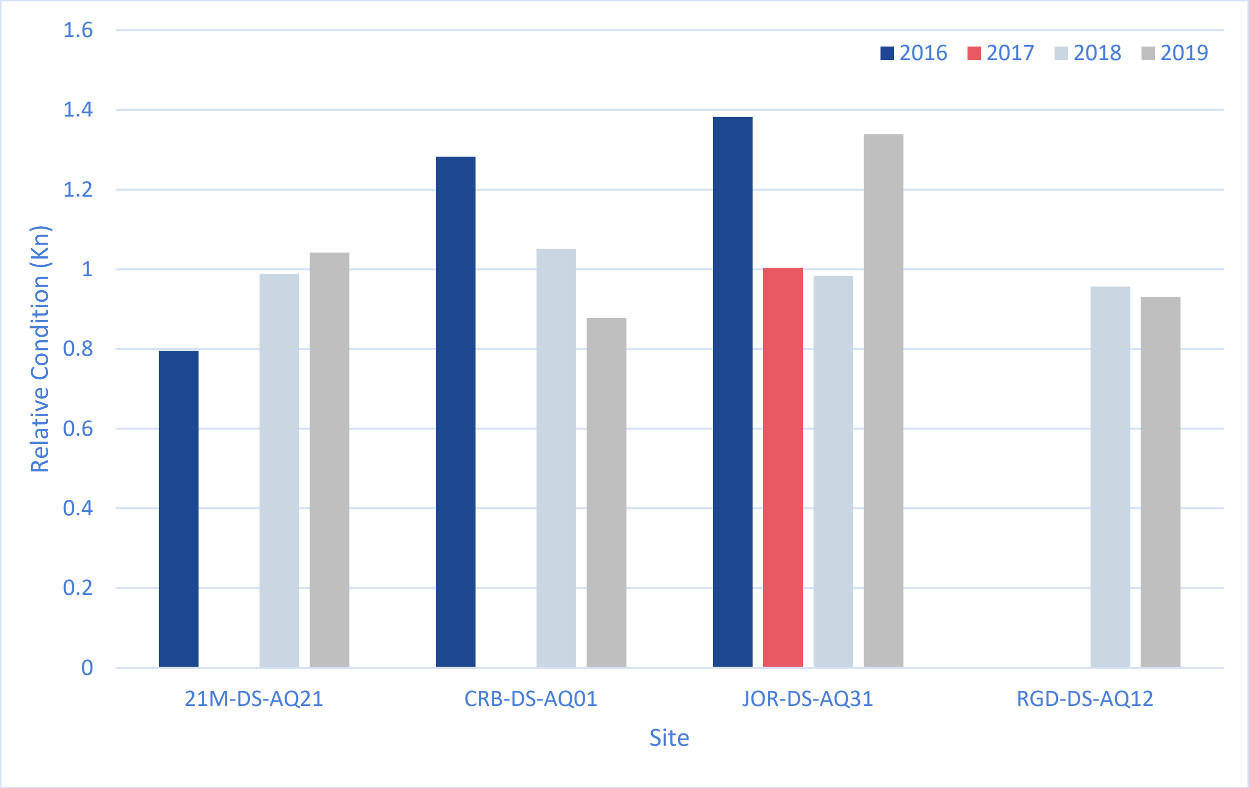


Figure 4-5. Relative condition of trout captured in the RMOW study area, 2016 - 2019.

5. Coastal Tailed Frogs

Lead Biologist and Author: Bob Brett
Additional Surveyors: Jagoda Kozikowska and Hillary Williamson

5.1 Introduction

Amphibians have long been used as indicators of ecosystem health. They have physiological constraints and sensitivities due to subcutaneous respiration, specialized adaptations and microhabitat requirements, as well as a dual life cycle that utilizes aquatic and terrestrial habitats. These characteristics make them susceptible to perturbations in both habitat types and suitable indicator species of ecosystem health.

Stream-dwelling amphibians such as the Coastal Tailed Frog (*Ascaphus truei*) serve a vital role as indicators of stream health as they require flowing, clear, cold water throughout their lifecycle (Matsuda et al. 2006) and are vulnerable to habitat alteration and degradation such as siltation and algal growth. They are also highly philopatric,[3] long-lived and maintain relatively stable populations. These attributes make them more trackable and reliable as indicators of potential biotic diversity in stream ecosystems than anadromous fish and their relative abundance can be a useful indicator of stream condition (Welsh and Ollivier 1998).

Ideal habitats for tailed frogs are smaller, fast-flowing (gradients usually >10%) mountainside streams that are cool (typically 10 to 15ºC in late summer, but at least 5º C for egg development), have a cobble-boulder substrate with rounded to subangular-shaped rocks, and a cascade or step pool morphology (Matsuda et al. 2006; BC MOE 2015). These characteristics describe many of the streams that drain into the Whistler Valley. Tadpoles have been detected in most Whistler streams surveyed to date (Wind 2005-2009; Cascade 2014-2016; Palmer and Snowline 2017-2019).

As of 2004, the only public documentation of Coastal Tailed Frogs near the RMOW was in Brandywine Creek (Leigh-Spencer 2004), presumably from surveys before the construction of the Independent Power Project (IPP) built on that creek. In late 2004, the Whistler Biodiversity Project began the first valley-wide survey of breeding populations (tadpoles) in 16 creeks in the area (Wind 2005-2009; Brett 2007). Surveys conducted since then, as part of the Environmental Monitoring Program (Cascade 2013-2015; Palmer and Snowline 2017-2019), have continued to expand our understanding of the distribution and abundance of this species. In 2017, Coastal Tailed Frogs were meanwhile down-listed in BC from Blue (Special Concern) to Yellow (Secure; CDC 2020). It remains a species of Special Concern under the Species at Risk Act (Government of Canada 2020).

---

[3] *Adults typically breed in the stream in which they hatched.*

5.2 Methods

5.2.1 Site Selection

Most creeks surveyed since 2013 have been surveyed in at least two successive years; others have been surveyed three or more times. Sites since 2016 have been selected to: (a) allow results to be compared from year to year; (b) have the greatest geographic coverage that includes both east-side and west-side creeks; and/or (c) because adjacent developments could potentially affect them. It is important to include creeks on both sides of Whistler Valley since creeks on the east side of the valley are more likely to be glacier fed than those on the west side. Creeks with a glacial source typically have higher and more sustained flows. They are also more sensitive to climate change since glacier melt has and will reduce the volume and timing of water flows. Sites were again selected in 2019 to achieve the best balance between these three objectives.

Since it began in 2013, the Ecosystems Monitoring Program has surveyed for tailed frogs in 11 creeks, five of which are on the east side of Whistler Valley and six of which are on the west side (Table 5-1). More creeks on the east side of the valley pass through the ski area and suburban developments which make them easier to access and more susceptible to potential disturbance. For these reasons, more sites have been surveyed since 2013 on the east (47) than west (36) side of the valley. Surveys in 2018 and 2019 have begun to address this imbalance by sampling more creeks on the west side.

Table 5-1. Coastal Tailed Frog sampling sites, 2013 to 2015 (Cascade) and 2016 to 2018 (Palmer and Snowline)

Creek	Valley Side	2013	2014	2015	2016	2017	2018	2019	Total
Agnew Creek	West					3	3		6
Alpha Creek	East	3	3	3	3				12
Archibald Creek	East		3	3	3	3	3	3	18
Blackcomb Creek	East							1	1
FJ West Creek	West						2	3	5
Horstman Creek	East					3			3
Nineteen Mile Creek	West		2	2					4
Scotia Creek	West	3	3	3	3		1		13
Sproatt Creek	West						1	3	4
Van West Creek	West						2	2	4
Whistler Creek	East				4	3	3	3	13
	Total	6	11	11	13	12	15	15	83
	East	3	6	6	10	9	6	7	47
	West	3	5	5	3	3	9	8	36

The 2016 program expanded and standardized the elevational range of sites. The program continued the previous approach of surveying three reaches on each creek but changed some sampling sites to achieve a standardized range in which one site was near valley bottom, one at approx. 800 m and one at approx. 1000 m. This elevational range was meant to include one site within the development footprint, a second at the upper end of it and a third above the development footprint (as a control site). Due to access and/or topography of the area, it was not feasible to establish equivalent elevations on some creeks (Figure 5-1).

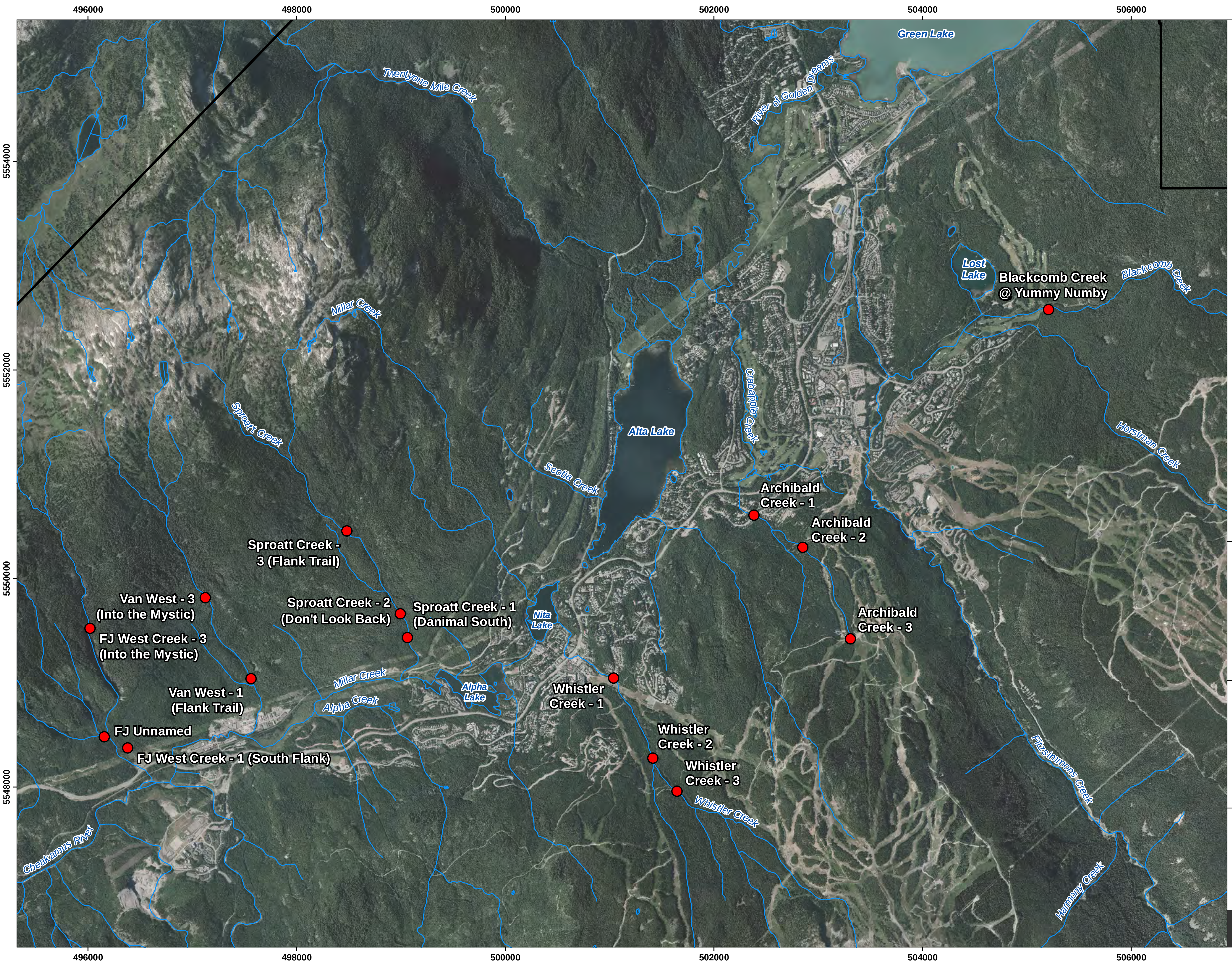
The 2017 program retained Archibald Creek and Whistler Creek to continue multi-year comparisons in these heavily used areas on Whistler Mountain. Two new creeks, Horstman Creek and Agnew Creek were added as replacements for Alpha and Scotia creeks). Alpha and Scotia creeks had been surveyed extensively in the past by the WBP and Cascade (Wind 2005-2009; Cascade 2014-2016) and detections of tailed frogs remained relatively similar in 2016. Horstman Creek was added in 2017 as it detected many tailed frogs in surveys conducted by the WBP in 2006 yet had not been surveyed since. This site was added to increase the spatial distribution of creeks northward, as well as to add another monitoring year to a creek within the ski area footprint. Agnew Creek was also added to the 2017 program to increase the representation of creeks on the west side of Whistler Valley. This area has relatively few creeks that are easily accessible and/or suitable for standard sampling methods. Prior to 2017, Agnew Creek had not previously been surveyed.

In 2018, 15 sites were surveyed on seven creeks; more than any year to date in the Ecosystem Monitoring Program. Whistler and Archibald creeks were again retained in the survey to allow multi-year comparisons, especially as the Whistler Bike Park continued to expand in those areas. Agnew Creek was retained for a second year to detect the presence of tailed frogs, while Horstman Creek was rotated out of the program to allow new creeks to be surveyed. Most notably, the 2018 survey included the sampling of three new creek sites on the west side of the valley: FJ West Creek (two sites), Sproatt Creek (one site), and Van West Creek (two sites).

As in 2018, the 2019 surveys included 15 sites on seven creeks. Archibald Creek has now been surveyed each year since 2013 to monitor impacts from the Whistler Bike Park and other potential disturbances. Whistler Creek was surveyed for the fourth straight year for the same reason. Agnew Creek was rotated out of the surveying program after two years of non-detections.

The main emphasis for the 2019 program was to establish three sites on each of the three west-side creeks newly surveyed in 2018. That goal was achieved on Sproatt Creek (two new sites) but not on the other two creeks. Chasms in the middle section of Van West Creek prevented establishing a third site, at least in 2019. Even more difficult terrain above the valleybottom break in slope on FJ West Creek likely precludes surveys in that area ever. Even below the break in slope, the streambeds for FJ West Creek and the adjacent creek to the west (FJ Unnamed) were significantly changed by a blowout during a fall 2017 storm (discussed in Section 5.3.3.3). The exact location of the lower streambeds for these two creeks no longer matches available mapping and prevented establishing a third site on FJ West Creek. Instead, a site was surveyed on FJ Unnamed Creek. These additions brought the number of west-side creeks surveyed in 2019 to eight.

A seventh east-side site, Blackcomb Creek was also surveyed in 2019. Blackcomb Creek was last surveyed in 2006 at four sites from valleybottom to 1377 m (Wind 2006) and no tadpoles were detected. This is the coldest creek surveyed to date: 4.0°C at 1377 m and only 6.3°C at 859 m (at the RMOW water intake). The goal of including a site on this creek was to test if current temperature regime could support a tailed frog population. Even if not, future climate change could melt the Blackcomb Glacier enough that the creek becomes warm enough to support tailed frogs which adds to the value of monitoring it.

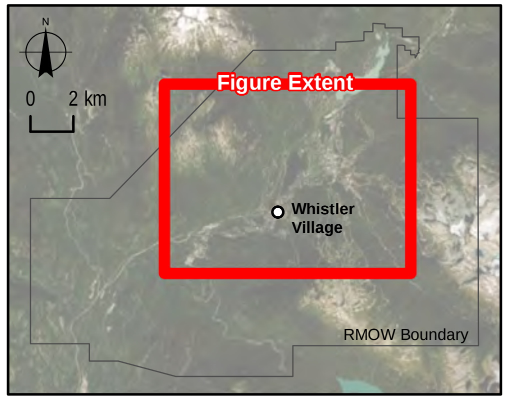


Legend

●	2019 Tailed Frog Site
—	Watercourse
▭	RMOW Boundary

Notes:
(1) Orthoimagery (2014) provided by RMOW.
(2) Watercourse data from BC Freshwater Atlas (accessed 2017).

Contains information licensed under the Open Government Licence - British Columbia. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



0 500 1,000 1,500
metres
N

DRAWN: B. Elder
CHECKED: B. Brett
PROJECT: 1602505
DATE: Jan 13, 2020

Scale 1:35000
UTM Zone 10N
NAD 1983

Palmer™

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2019

Coastal Tailed Frog Sampling Sites, 2019

FIGURE 5-1

Document Path: C:\Egnyte\Shared\Projects\Active\16025 - Resort Municipality of Whistler\1602505 - 2019 Annual Monitoring\Mapping\Figures\5_ArcGIS\1602505_Figure_TailedFrogs.mxd

5.2.2 Sampling Design

All previous surveys for tailed frog tadpoles in the RMOW study area by the WBP (Wind 2005-2009) and the RMOW's Environmental Monitoring Program (Cascade 2014-2016; Palmer and Snowline 2017-2019) have followed similar methodologies in conducting Coastal Tailed Frog surveys. The only variation in in sampling design since 2005 occurred in 2013 to 2015 surveys when Cascade used an area-constrained approach in contrast to the time-constrained approach used by the WBP (2005 to 2009) and surveys since 2016.

The area-constrained approach can be used to measure relative abundance as recommended by the BC Resource Inventory Committee (BC MELP 2000). Surveys from 2013 to 2015 therefore surveyed at fixed 5 m stream lengths for a total of 30 minutes (Cascade 2014-2016). Whistler-area streams, however typically have low tadpole densities and the area-constrained method had low detections result in a low number of detections,[4] and definitely lower than previous WBP results from time-constrained surveys (Wind 2005-2009). Surveys since 2016 have therefore returned to the time-constrained approach of 30 minutes total sampling time, regardless of area, which greatly increased detections and therefore statistical power (Malt et al. 2014a, 2014b) of the study.[5]

Both approaches measure total sampling area at each site and survey for the same amount of time (30 minutes per site) which allows direct comparisons between years, regardless of method (within some statistical limitations). In addition, the total area surveyed at each site since 2016 with the time-constrained approach remained remarkably similar to that surveyed using the area-constrained approach. This similarity should also increase the reliability of comparisons between the two approaches.

Data collection methods were otherwise the same for all tailed frog surveys since 2004 and followed recommendations of the BC Resource Inventory Committee (BC MELP 2000). The in-stream surveys consisted of overturning unembedded cover objects such as rocks with dipnets held immediately downstream to catch any dislodged animals (Photo 5-1, Photo 5-2). Rocks were also swept by hand to detect any clinging tailed frog larvae before being set back in their original positions, as were large anchored rocks and large woody debris. Data collected at each site included:

- Site characteristics such as location, weather, overhead cover and stand type;
- Stream characteristics such as morphology, substrate size and shape, slope and bankfull and wetted widths;
- Overhead canopy cover, forest type (coniferous, deciduous, or mixed) and forest successional stage;
- Water and air temperature; and
- Total survey area (measured with a cloth tape to the nearest 0.1 m).

---

[4] *Bruce Bury (in a 2016 email to Brent Matsuda and Bob Brett) recommends that detections should be >2 tadpoles/m^2 to ensure statistical power. Virtually all sites sampled to date in Whistler have revealed densities far lower.*

[5] *These increases are reported in a multi-year comparison included in the results section (Section 5.3).*

Photo 5-1. Hillary Williamson dipnetting for tadpoles in Whistler Creek.

Photo 5-2. Captured tadpoles are transferred to a bucket until they are measured, classified to cohort and development stage, and released upstream

Data collected for tadpole captures also followed standard methods, including a measurement of total length for tadpoles (snout to ventral length for later stages). From 2013 to 2015[6] and again in 2016, tadpoles were classed into cohorts defined by Malt et al (2014a,b) which served as proxies for age classes (e.g., first year - T1; second year - T2, etc.) as follows:

- T0 (hatchling <15 mm);[7]
- T1 (tadpole, no visible hind legs);
- T2 (tadpole, recognizable hind legs with knees that do not extend beyond the anal fold (Photo 5-3);
- T3 (tadpole, conspicuous hind legs with knees that extend out from body (Photo 5-4); and
- Non-tadpole – metamorph (tail plus front legs), juvenile (no tail, small, no nuptial pads); and adult (larger than juvenile, male has tail and nuptial pads, females larger than males).

Doubts about this classification scheme emerged in 2016 regarding how closely these classes reflected true and consistent age classes, especially in different streams. Tests conducted prior to 2017 surveys again revealed overlaps between length and developmental stages within and between streams. These observations intensified questions about whether developmental stages were reliable proxies for the number of years since hatching, especially between streams that have different growing conditions. This doubt was later strengthened by Pierre Friele[8] who emphasized that the link between developmental stage, length and age is even more tenuous when applied across large geographic gradients in which climate differs. As a result, surveys since 2017 measured the length of each tadpole and classified them by more detailed developmental stages as follows:

---

[6] *Candace Rose-Taylor, 2016 email to Bob Brett.*

[7] *No hatchlings have been reported to date in Whistler surveys conducted in late August and September.*

[8] *Pierre Friele email to B. Brett and follow-up phone conversation, December 2017.*

Table 5-2. Tadpole Developmental Stages and Classifications

Developmental Stage	**Cohort (Malt 2014a,b) Equivalent**
0 – Hatchling <15 mm	T0
1 - No visible hind legs	T1
2 - Bulge only, hind legs not defined	T1
3 - Hind legs visible but covered	T2
4 - Hind feet protruding	T2
5 - Hind knees protruding outside body	T3

Photo 5-3. Tadpole cohort 2 (T2). This individual's developmental stage is transitional between developmental stages 2 and 3 (hind legs covered but just starting to be defined).

Photo 5-4. Tadpole cohort 3 (T3); and developmental stage 5 (hind knees protruding outside body).

For consistency with past reports, the classes above were grouped according to Malt et al's (2014a, 2014b) cohorts. That is, Developmental Stages 1 and 2 were grouped into Malt's T1 cohort, and Developmental Stages 3 and 4 were grouped into Malts' T2 cohort. Future analyses may be able to use these detailed classifications to calibrate a reliable relationship between age and developmental stage in Whistler-area creeks. For the purposes of this report, most of the analysis and discussion is based on Malt's cohorts.

To prevent recaptures, all tadpoles were placed in buckets and released upon completion of the site survey (BC MELP 2000). Non-tadpoles, or post metamorphosis individuals, were classed as metamorphs (non-resorbed tail), juveniles (no tail, smaller than adults, no nuptial pads on males) or adults (larger than juveniles, males have a cloacal "tail," nuptial pads and are smaller than females; Corkran and Thoms 1996; Jones et al. 2005). Early September was the targetted survey window, late enough in the season that low streamflow would increase the detectability of tadpoles.

5.2.3 Data Analysis

The total number of tadpoles per site (reach) detected in 2019 was compared to surveys since 2015 (the last year of the time-constrained approach). Results were also reported as detections per unit area (per 100 m^2) to permit comparisons between the 2015 area-constrained method and the time-constrained method used for the past four surveys.

5.2.4 Quality Assurance/Quality Control

Although the ideal way to ensure consistency between sites and years would be to use the same surveyor(s), that is seldom achievable due to changes in available personnel. To maximize consistency in 2019, the two main surveyors from 2018 were again used for all but two sites at which one of the surveyors was unavailable and replaced by another who had participated in 2017. A trial survey was first used to ensure that measurements were consistent between surveyors. Special care was taken to ensure that cohort classes and developmental stages (see above) were recorded consistently. Photos of representative tadpoles in each class were used as guides to improve consistency between surveyors (e.g. Photo 5-3 and Photo 5-4).

5.3 Results and Discussion

5.3.1 Tadpole Surveys

Fifteen sites were surveyed from September 3 to 6, 2019 (Figure 5-1, Table 5-4; Appendix E). Seven sites on three creeks were on the east side of the valley and eight sites on four creeks were on the west side of the valley. As expected, Blackcomb Creek was the coldest creek surveyed. While surveys during warm, sunny weather are preferable to maximize detections, weather changes during the survey window meant that four sites were sampled in non-sunny weather. Air temperatures were nonetheless fairly warm at these sites which presumably offset any potential reduction in detections (Appendix E).

Table 5-3. Coastal Tailed Frog sampling sites, 2019.

Site	Valley Side	Date	Easting	Northing	Elev. (m)	Weather	Water Temp. (°C)	Air Temp. (°C)
Archibald Creek - 1	East	2019-09-04	502387	5550606	695	Sunny	11.4	18
Archibald Creek - 2	East	2019-09-04	502854	5550298	835	Sunny	11.2	15
Archibald Creek - 3	East	2019-09-04	503310	5549422	1026	Sunny	9.4	17
Blackcomb Creek @ Yummy Numby	East	2019-09-06	505211	5552576	762	Sunny	8.0	11
FJ Unnamed	West	2019-09-05	496157	5548481	699	Cloudy	11.0	18
FJ West Creek - 1 (South Flank)	West	2019-09-05	496383	5548374	648	Cloudy	11.2	18
FJ West Creek - 3 (Into the Mystic)	West	2019-09-03	496022	5549522	1119	Sunny	11.3	14
Sproatt Creek - 1 (Danimal South)	West	2019-09-03	499063	5549434	692	Lt. Rain	12.9	16

Site	Valley Side	Date	Easting	Northing	Elev. (m)	Weather	Water Temp. (°C)	Air Temp. (°C)
Sproatt Creek - 2 (Don't Look Back)	West	2019-09-03	498996	5549662	790	Lt. Rain	12.3	17
Sproatt Creek - 3 (Flank Trail)	West	2019-09-03	498483	5550455	996	Sunny	12.0	15
Van West - 1 (Flank Trail)	West	2019-09-05	497563	5549038	706	Sunny	12.5	16
Van West - 3 (Into the Mystic)	West	2019-09-03	497125	5549816	1036	Sunny	11.7	14.5
Whistler Creek - 1	East	2019-09-06	501041	5549045	692	Sunny	11	11
Whistler Creek - 2	East	2019-09-05	501417	5548276	879	Sunny	10	11
Whistler Creek - 3	East	2019-09-05	501649	5547961	972	Sunny	10.2	11

A total of 60 tadpoles were detected in 2019 (Table 5-4, Appendix F). This total is lower than in the past two years but still higher than in 2016 (39) and much higher than when the surveys used an area-constrained approach (only nine tadpoles were detected in the September 2015 survey). Fluctuations between yearly totals at two creeks, Archibald Creek and Whistler Creek, explain most of the difference in annual totals since 2016. These have been the two most productive creeks throughout the surveys. In contrast, only two tadpoles were detected at four sites located on FJ West Creek, FJ Unnamed Creek, and Blackcomb Creek. This is the second year of that only one tadpole was found at FJ West Creek. No hatchlings (T0 cohort = <15mm length) were detected in 2019 which is consistent with all September surveys conducted to date in the RMOW. Contrary to most years, no juveniles (metamorphs) or adults were detected at any site in 2019.

Table 5-4. Tadpole surveys by creek, 2015-2019.

Survey Year	Valley Side	Site	No. of Sites	Total Survey Area (m^2)	Average Survey Area (m^2)	Number of Tadpoles Detected	Tadpoles /100m^2	Average Water Temp. (°C)
2015	East	Alpha Creek	3	69.6	23.2	4	5.7	7.5
	East	Archibald Creek	3	46.9	15.6	4	8.5	8.7
	West	Scotia Creek	3	45.8	15.3	1	2.2	8.8
	West	19 Mile Creek	3	73.6	24.5	0	0.0	7.9
		All 2015 Sites	**12**	**235.9**	**19.7**	**9**	**3.8**	**8.2**
2016	East	Alpha Creek	3	72.5	24.2	9	12.4	7.0
	East	Archibald Creek	3	45.2	15.1	5	11.1	6.4
	West	Scotia Creek	3	86.7	28.9	3	3.5	10.1
	East	Whistler Creek	4	97.6	24.4	22	22.5	8.8
		All 2016 Sites	**13**	**302.0**	**23.2**	**39**	**12.9**	**8.1**
2017	West	Agnew Creek	3	56.2	18.7	0	0.0	8.8
	East	Archibald Creek	3	88.2	29.4	33	37.4	12.0
	East	Horstman Creek	3	56.2	18.7	6	10.7	9.3

Survey Year	Valley Side	Site	No. of Sites	Total Survey Area (m²)	Average Survey Area (m²)	Number of Tadpoles Detected	Tadpoles /100m²	Average Water Temp. (°C)
	East	Whistler Creek	3	36.2	12.1	48	132.6	13.0
		All 2017 Sites	**12**	**236.8**	**19.7**	**87**	**36.7**	**10.8**
2018	West	Agnew Creek	3	82.3	18.7	0	0.0	8.1
	East	Archibald Creek	3	55.5	18.7	30	54.1	8.1
	West	FJ West Creek	2	18.0	18.7	1	5.6	9.0
	West	Scotia Creek	1	9.5	18.7	2	21.1	9.0
	West	Sproatt Creek	1	19.5	18.7	11	56.4	9.1
	West	Van West Creek	2	30.0	18.7	17	56.7	10.0
	East	Whistler Creek	3	89.0	18.7	21	23.6	8.1
		All 2018 Sites	**15**	**303.8**	**18.7**	**82**	**27.0**	**8.8**
2019	East	Archibald Creek	3	60.5	20.2	14	23.1	10.7
	East	Blackcomb Creek	1	23.5	23.5	0	0.0	8.0
	West	FJ Unnamed	1	23.5	23.5	1	4.3	11.0
	West	FJ West Creek	2	32.0	16.0	1	3.1	11.3
	West	Sproatt Creek	3	48.0	16.0	11	22.9	12.4
	West	Van West Creek	2	25.0	12.5	6	24.0	12.1
	East	Whistler Creek	3	51.9	17.3	27	52.0	10.4
		All 2019 Sites	**15**	**264.4**	**17.6**	**60**	**22.7**	**10.8**

Several conclusions can be drawn from a comparison of surveys conducted over the past five years (Figure 5-2):

- Survey area per site has been relatively consistent, even including the switch from area-constrained searches in 2015 to time-constrained searches since.
- Detections increased with the switch to time-constrained searches in 2016 and were even higher between 2017 and 2019.
- The 2018 report showed a possible though weak connection between water temperature and detections. Results from 2019 surveys, which had lower detections than in 2018 in spite of warmer water, weaken this hypothesis.

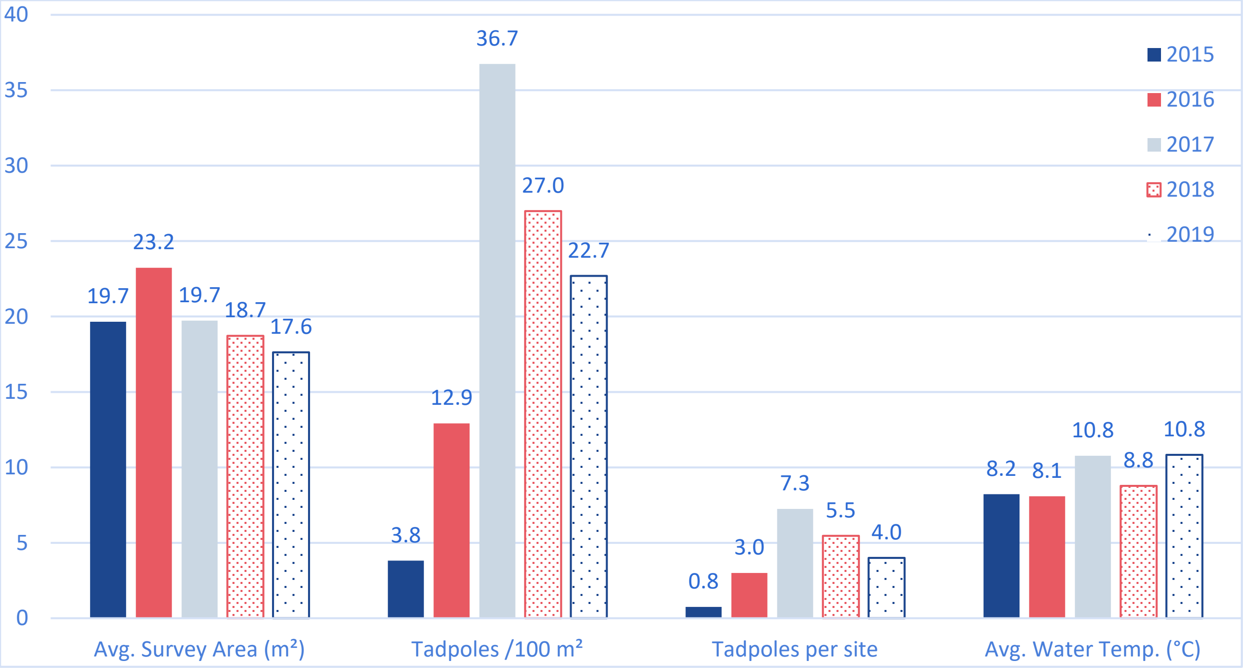


Figure 5-2. Average survey area per site, number of tadpoles per 100 m^2, number of tadpoles per site and average water temperature for September Coastal Tailed Frog surveys, 2015-2019.

The proportion of tadpole by cohort has fluctuated since 2016 with no clear pattern emerging (Table 5-5). Statistical analysis for this relatively small number of detections would have low power to reliably detect trends but one observation is still possible. Even without statistics it is reasonable to conclude that there is no indication of lower survivorship over those years. The proportion of older (T3) tadpoles has been relatively stable and the absolute number has actually increased each year.

Table 5-5. Tadpole detections by year, site, elevation and cohort, 2016-2019.

	Cohort (No. of Tadpoles)			Cohort (% of Tadpoles)		
Year	**T1**	**T2**	**T3**	**T1**	**T2**	**T3**
2016	25	5	9	64%	13%	23%
2017	63	11	13	72%	13%	15%
2018	64	2	16	78%	2%	20%
2019	26	14	20	43%	23%	33%
Total	178	32	58	66%	12%	22%

Surveys in 2016 recorded tadpoles by cohorts recommended by Malt (2014a, b), that is, T0, T1, T2, and T3. Since 2017, surveyors have recorded more detailed developmental stages that broadly coincide with Malt's cohorts but potentially increase the ability to ensure they are true cohorts (see Section 5.2.2 for more details).

A comparison of the 229 tadpoles captured since 2017 shows that while there is a relationship between length and developmental stage, there is also significant overlap between classes, whether Malt's three cohorts or the five more detailed developmental stages also recorded for this study (Table 5-6). It is clear from this comparison that length alone is a poor proxy for developmental stage, regardless of how detailed that classification is. Another conclusion from this data is that Developmental Stages 1 and 2 are similar enough that grouping them together in Malt's cohort T1 is reasonable. Similarly, Developmental Stage 5 probably separates out strongly enough from Developmental Stage 4 to show that Malt's cohort T3 is distinct, except when the tadpoles are transitional between the two (though see below). The largest overlaps are in the middle stages: Developmental Stages 3 and 4 and their assumed equivalent, cohort T2.

Table 5-6. Length comparisons between detailed developmental stages (upper) and age classes/cohorts (lower; Malt et al 2014a, b).

	Development Stage				
	1 - No hind legs	2 - Bulge only, hind legs not defined	3- Hind legs visible but covered	4- Hind feet protruding	5 -Hind knees protruding
Number of Tadpoles	63	90	15	33	28
Mean Length (mm)	31	35	39	45	50
Median Length (mm)	30	35	38	45	50
Smallest (mm)	25	27	33	40	43
Largest (mm)	43	45	50	54	60
Length Range (mm)	25 to 43	27 to 45	33 to 50	40 to 54	43 to 60
Largest to Smallest	1.7	1.7	1.5	1.4	1.4
	Cohort (Malt et al. 2014a, b)				
	T1		**T2**		**T3**
Number of Tadpoles	153		48		28
Mean Length (mm)	33		43		50
Median Length (mm)	33		44		50
Smallest (mm)	25		33		43
Largest (mm)	45		54		60
Length Range (mm)	25 to 45		33 to 54		43 to 60
Largest to Smallest	1.8		1.6		1.4

Notes: No hatchlings <15mm (T0 or development stage 1) have yet been detected in a September survey in Whistler.

The most difficult classifications have between tadpoles demonstrating intermediate stages between cohort 1 and 2 and between cohort 2 and cohort 3 classifications. For cohort 1 and 2, many tadpoles were transitional between having an undefined "bulge" and defined legs contained within that bulge (Photo 5-4). Between cohort 2 and 3, there were some tadpoles whose rear feet but not knees were free of the skin that covered the bulge. They were transitional to cohort 3 but without the exact characteristics described by Malt *et al*. (2014a,b). These observations and the ones above suggest caution in interpreting age cohorts from length and/or development stage, especially between streams.

Almost three times as many tadpoles have been detected in east-side than west-side creeks since 2016. (Table 5-7). As discussed in Section 5.2.1, glacier-fed creeks are predominantly on the east side of Whistler Valley. Glacial run-off increases overall flow and also means that post-snowmelt fluctuations in flow are reduced compared to creeks reliant solely on rainwater. Creeks on the east side of the valley are therefore more likely to be larger and, as found in these surveys, seem overall to offer better habitat characteristics including: more cobbles, less embeddedness, and more riffles. These are preliminary conclusions that need to be further tested, especially since the predominance of detections from two creeks (Whistler and Archibald) affects the totals so much. Although data to date showed east side creeks to be slightly colder than west-side creeks, temperature loggers (Section 2) provide more robust data for the actual magnitude of that difference.

Table 5-7. Tadpoles detected in east-side versus west-side creeks since 2016.

Valley Side	No. Sites	Mean Elev. (m)	Mean Tadpoles /Site	Mean Water Temp. (°C)
East	32	850	6.7	9.3
West	23	809	2.3	10.1

5.3.2 Remarks on Notable Streams Surveyed in 2019

5.3.2.1 Archibald Creek

In 2016, significant depositions of sand and small gravel occurred in Archibald Creek below the main part of the Whistler Bike Park (Photo 5-5;Photo 5-6). The deposition was especially deep at the lowest reach, Archibald 1, located uphill of Panorama Drive in Brio. This site was downstream of the data logger that became clogged with sand and gravel in 2016. Low detections that year were attributed to two possible causes: (i) the sedimentation; and/or (ii) low water temperatures.

Photo 5-5. Sedimentation in 2016 at Archibald Creek-1 (near Panorama Drive).

Photo 5-6. Sedimentation in 2016 at Archibald Creek-2 (near Crank It Up in the Whistler Bike Park).

No evidence of negative impacts on tailed frogs was detected in 2019, from either the 2016 event or from a rain-caused flush of sediments after a long dry spell in August 2018 (Photo 5-7 and Photo 5-8). The most tadpoles in the four years were recorded in 2017 and 2018, each with more twice as many as the 14 recorded in 2019. As in past years, pre-survey reconnaissance found variable numbers of tadpoles on bedrock in the main flow and the low number recorded during the actual survey were likely at the low end of those pre-surveys. As a result, there is no compelling evidence that there has been a significant (if any) decline in the tailed frog population in this creek. In addition, even if there have been negative impacts on the creek from the Whistler Bike Park and/or other sources, they have (so far) not been significant enough to prevent a viable and potentially stable population of tailed frogs in the creek.

Photo 5-7. Sedimentation at Archibald Creek-1 on August 29, 2018, likely caused by runoff from a heavy rainfall that was the first significant precipitation in many weeks.

Photo 5-8. A photo near the same location as Photo 5-7 on Archibald Creek-1 one week later (September 6, 2019).

5.3.2.2 Whistler Creek

Whistler Creek was added to the monitoring program in September 2016 (when the Whistler Bike Park was being extended into this drainage) and no direct impacts on the creek were then noted. Sometime between then and 2017 surveys, however, machines imported and moved rocks at the lowest elevation site (Whistler Creek-1, located below the Snowridge pedestrian bridge). This work removed streamside vegetation and channelized the creek (Photo 5-9). The channel was also filled with large angular rocks that replaced many of the cobbles that were previously in the stream. The detections of tadpoles in the 2017 survey were nonetheless higher than those in 2016 despite the apparent degradation of habitat. By September 2018, the stream had mostly reverted to its pre-disturbed condition, presumably because the imported rocks had been washed downstream. By September 2019 no obvious evidence of that in-stream work was visible (Photo 5-10). There was also no evidence of negative impacts (such as turbidly or sedimentation) in Whistler Creek from the expanded trail network or increased traffic associated with the Whistler Bike Park..

Photo 5-9. Significant in-stream disturbance occurred at the Whistler Creek 1 site before the 2017 surveys.

Photo 5-10. The Whistler Creek 1 streambed has mostly returned to an undisturbed appearance by September 2019.

5.3.2.3 Blackcomb Creek

Blackcomb Creek, surveyed for the first time in 2006 from valleybottom to 1377 m, is the coldest creek surveyed to date. On August 25, 2006 it was only 4.0°C at 1377 m and 6.3°C at 859 m (at the RMOW water intake; Wind 2006) and no tadpoles were detected even at the two warmer sites below. Since temperatures below 5.0°C are inhospitable for egg development (Section 5.1), it is possible this creek may not support tailed frog reproduction; at least until run-off from the melting Blackcomb Glacier diminishes enough to reduce its cooling effect. This creek therefore provides a monitoring opportunity. If additional surveys continue to find no tadpoles, it is probable that the creek is too cold. If so, tailed frogs would only colonize this creek after the glacier melts to a point at which it has less influence on stream temperatures than relatively warmer sources (mainly rain, but also non-glacial tributaries). If proved true, this hypothesis would demonstrate direct effects of climate change on local habitat and species.

One test site was therefore surveyed under the bridge leading to Yummy Mummy Trail and at 762 m elevation (Photo 5-11). The glacial flour in the creek reflected its glacial source (Photo 5-12). This site was almost 100 m elevation below the water intake site surveyed in 2006 and measured 8.0°C, slightly warmer than that site in 2006. Although within a temperature range that could successfully allow egg development, no tadpoles were detected. Higher elevations on this creek are difficult to access but should ideally be added in future years' surveys.

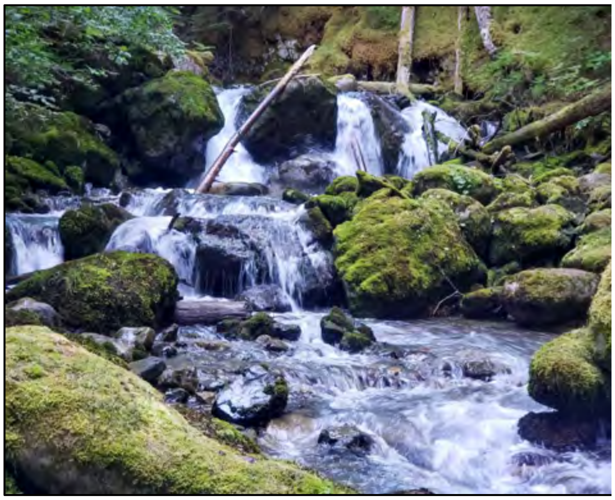


Photo 5-11. Blackcomb Creek at the Yummy Numby bridge, looking upstream.

Photo 5-12. Blackcomb Creek at the Yummy Numby bridge, looking downstream.

5.3.3 Inconsistencies in Stream Mapping

The 2018 work plan included tailed frog sampling for the first time in small creeks accessed by the Flank Trail and new Sproatt Mountain Trails (e.g., Into the Mystic). After extensive reconnaissance, referencing of various maps, and field surveys, it became evident that the mapping of some west-side creeks was incorrect and/or that they did not have surface flow in late summer. While not originally within the scope of this monitoring project, the 2019 work plan included further investigation of these inconsistencies on three creeks: Sproatt, Van West, and FJ West.

5.3.3.1 Sproatt Creek

RMOW mapping[9] for Sproatt Creek shows two outlets, the main channel that feeds into Miller Creek and a second that feeds southeast into Alpha Lake (Figure 5-2). Fieldwork in 2018 showed that the year-round flow at higher elevations of Sproatt Creek disappears in low flow (e.g., late summer) somewhere downstream of the break in slope and upstream of the CN Rail tracks.

Surveys in 2019 confirmed the exact spot that the last water flowed underground, approximately 110 m upstream of the CN Rail tracks (Photo 5-13; Figure 5-2). It also confirmed that the second outlet mapped as flowing southeast to Alpha Lake is not (or no longer) connected to the main stem of Sproatt Creek. A significant berm at the mapped junction with the main stem currently prevents any flow in that direction. The lack of year-round above-ground connection of Sproatt Creek with Miller Creek presumably does not negatively tailed frogs since: (a) an apparently healthy population inhabits the creek; and (b) valleybottom creeks like Miller Creek that support fish typically provide less hospitable habitat for tailed frogs due to predation.

---

[9] https://webmap.whistler.ca/HTML5Viewer/Index.html?viewer=ExternalGIS

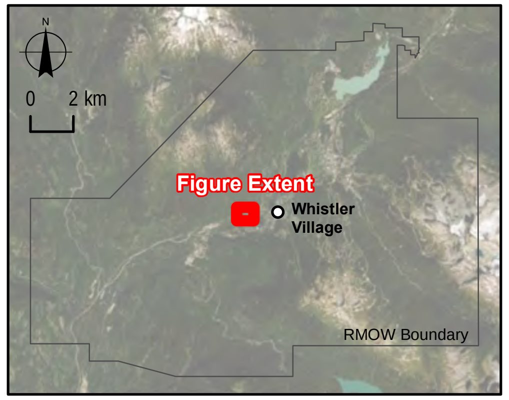
Photo 5-13. The last above-ground flow of Sproatt Creek disappears underground (as marked by arrow) ~110 m upstream of the railway tracks on September 6, 2019. See Figure 5-2 for location and context.

Legend

- Flowing Creek
- Dry Creek (September, 2019)
- Flow Direction
- Contour (10 m)

Notes:
(1) Orthoimagery (2014) provided by RMOW.
(2) Watercourse data provided by RMOW (modified).

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



0 25 50 75 100
metres

N

DRAWN: B. Elder
CHECKED: B. Brett
PROJECT: 1602505
DATE: Jan 13, 2020

Scale 1:2500
UTM Zone 10N
NAD 1983

Palmer™

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2019

Sproatt Creek – Seasonal Disappearance

FIGURE 5-3

Document Path: C:\Egnyte\Shared\Projects\Active\16025 - Resort Municipality of Whistler\1602505 - 2019 Annual Monitoring\Mapping\Figures\5_ArcGIS\1602505_Figure_Sproatt Creek.mxd

5.3.3.2 Van West Creek

Observations during the 2018 surveys also raised the possibility that at least some of the flow of Van West Creek is diverted underground below the break in slope that occurs at the uphill edge of Function Junction (specifically, just uphill of the Rona rear parking lot). On September 5, 2019, the flow at the Van West Creek-1 site at 706 m appeared to be much stronger than that observed just upstream (at 604 m) of that creek's confluence with Miller Creek in Function Junction (Photo 5-14).

An attempt to locate that possible diversion on September 26, 2019 was unsuccessful because heavy rain in the previous days and resulting high flow obscured any possible diversion. Subsequent visits confirmed that streamflow stayed strong for the remainder of fall 2019. Although not conclusive, evidence to date suggests that at least some water is diverted underground between the abrupt break in slope near 613 m and the creek ~100 downstream at 604 m (Photo 5-14). Testing of this hypothesis will require another site visit during low streamflow, ideally in early September 2020.

Photo 5-14. Van West Creek upstream of Function Junction. The top icon at 706 m shows the lowest site surveyed for tailed frogs on Van West Creek in 2018 and 2019 (Van West Creek-1 at the Lower Flank Trail). An abrupt break in slope occurs at the middle icon (~613 m). Water flow at the lower icon (at 604 m) in late summer appeared much lower than at 706 m on September 5, 2019.

5.3.3.3 *FJ West Creek*

Another puzzle emerged during 2018 tailed frog surveys at “FJ West Creek”[10] when the streambeds on RMOW maps did not always correspond with actual flows. Similar to Sproatt Creek and, to a lesser degree Van West Creek, there is a very abrupt break in slope where the mountainside meets the valleybottom. The 2018 survey at the lower FJ West Creek site (648 m, where it meets with the South Flank Trail) saw many signs of a recent and significant flood, and the main stem of the creek appeared to have moved from its mapped location. A second site could not be established in 2018 partly due to this uncertainty.

Subsequent research showed the evidence seen in 2018 was almost certainly caused by a major rainstorm and flooding on November 23, 2017 (Photo 5-15). This hypothesis was corroborated by Google Earth images showed land scouring in and below the chasm at the break in slope on FJ West Creek sometime between July 4, 2017 and August 6, 2018[11] (Photo 5-16). Similar scouring seen in September 2018 at the upper Sproatt Creek survey site (996 m, at the Mid-Flank Trail) was obviously caused by a recent flood, presumably the same November 2017 event.

Photo 5-15. Flooding on November 23, 2017 washed out the railway tracks at Sproatt Creek.

Fieldwork in 2019 was able to confirm that: (a) FJ West Creek does not currently connect with Miller Creek via a southeast branch as currently mapped; (b) that FJ West Creek blew out enough during that storm to create a temporary channel to FJ Unnamed Creek; and that (c) multiple, shallow streambeds now occur in

---

[10] *No official name could be found for this creek nor for the creek adjacent to the west (“FJ Unnamed Creek”).*
[11] *No imagery between these two dates was available.*

that area so the exact creek locations are difficult to discern. Further fieldwork in 2020 will help determine the location of active creekbeds and hopefully also establish a third, middle tailed frog site on FJ West Creek.

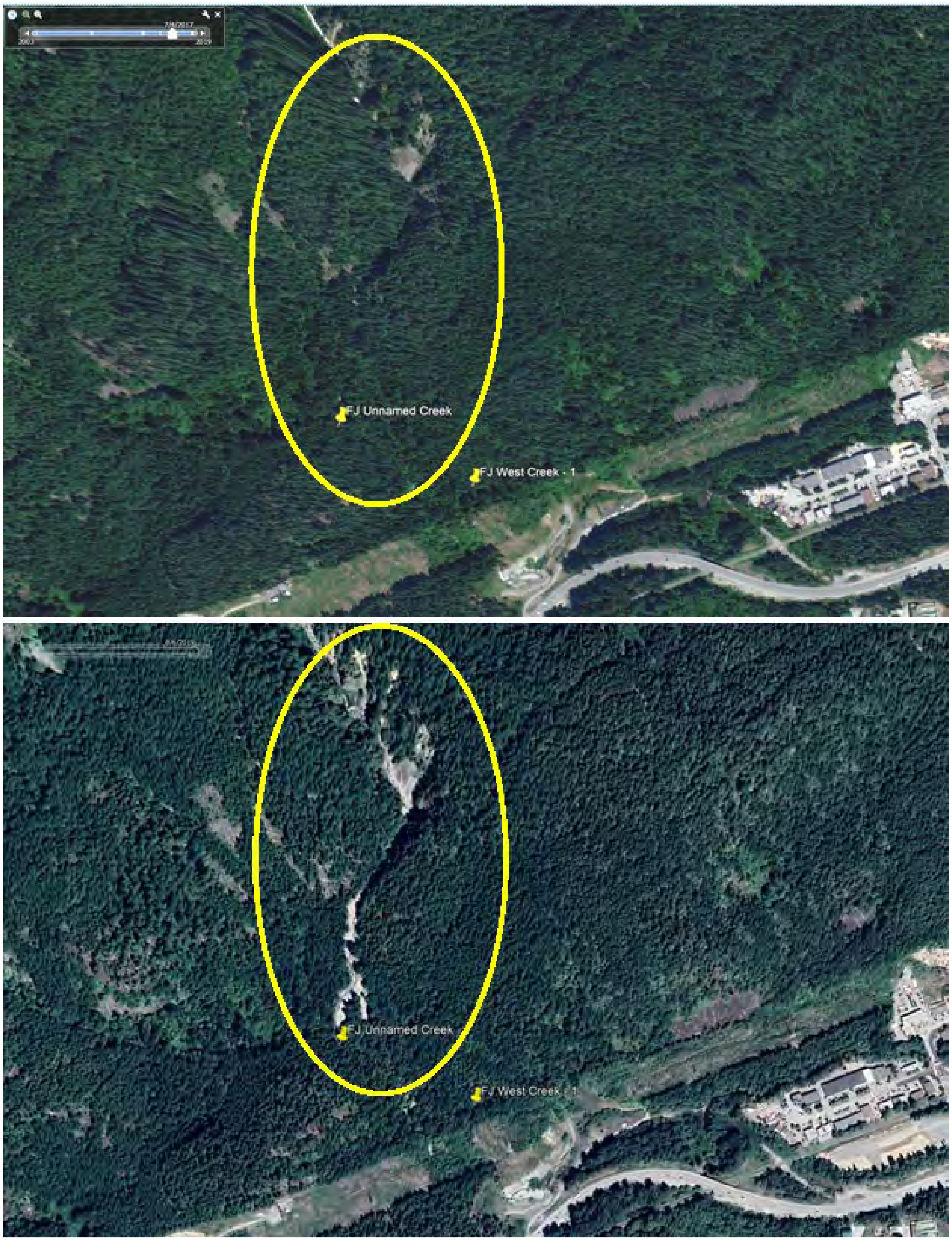


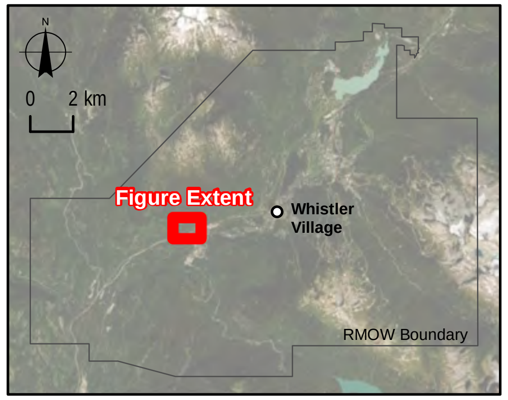
Photo 5-16. FJ West Creek chasm, uphill of the break in slope and west of Function Junction from Google Earth imagery on July 4, 2017 (top); and August 6, 2019 (bottom).

Legend

- Blowout and/or Diversion
- Mapped Watercourse
- Diverted Watercourse
- Flow Direction
- Contour (10 m)

Notes:
(1) Imagery (Aug 6, 2019) provided by Google Earth (CNES / Airbus)
(2) Watercourse data provided by RMOW (modified).

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



DRAWN: B. Elder
CHECKED: B. Brett
PROJECT: 1602505
DATE: Jan 09, 2020

Scale 1:4000
UTM Zone 10N
NAD 1983

Palmer™

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2018

Hydrological Changes West of Function Junction Since 2017

FIGURE 5-4

Document Path: C:\Egnyte\Shared\Projects\Active\16025 - Resort Municipality of Whistler\1602505 - 2019 Annual Monitoring\Mapping\Figures\5_ArcGIS\1602505_Figure_FJ Creek.mxd

6. Beavers

Lead Biologist and Author: Bob Brett
Additional Surveyors: Kristen Jones and Jagoda Kozikowska

6.1 Introduction

Beavers are a keystone species, second only to humans in their ability to alter Whistler's landscape. The ponds and wetlands created by Whistler's beavers provide important habitat for a wide range of other species including waterfowl, amphibians, snakes, fish, mammals, aquatic plants and insects. Flooding and other damage caused by beavers can bring them into conflict with humans, which is why there is a long history of removing beavers from urban and other habitats.

Beavers are colonial animals. They maintain a family lodge which houses the adult parents and typically two years of offspring, newborns as well as yearlings (Müller-Schwarze and Sun 2003). Two-year-old beavers generally disperse to form new colonies except when quality habitat is already occupied and dispersal is sometimes delayed. A lodge can remain active indefinitely but more often it is periodically inactive or abandoned permanently (as shown by Whistler data). The dispersal of offspring, death and migration of adults indicate that the location of active lodges changes each year within the landscape (here defined as lower elevations in Whistler Valley).

Beavers provide a unique situation for field biologists because it is possible to document all colonies (overwintering lodges) in a valley the size of Whistler. This information, when combined with an estimate of number of beavers per colony, provides a population census that can be monitored without statistical analysis as required in most population surveys (statistical sampling). The human equivalent is the Canada census compared to election polling: the former includes the whole population while the latter includes a small subset and uses statistical analysis to estimate figures for the whole population.

The Whistler Biodiversity Project initiated Whistler's first beaver census in 2007 (Brett 2007; Mullen 2008). Surveys continued through 2011, the last two of which were in conjunction with RMOW staff (Mullen 2009; Pevec 2009; Tayless 2010; Tayless and Burrows 2011). The survey was reinitiated in 2013 as part of this Ecosystem Monitoring Program but focussed only on a subset of lodges (Cascade 2014-2016). The 2016 surveys (Palmer and Snowline 2017) returned to a full census approach where all possible active beaver locations within Whistler Valley were enumerated. The greater survey effort and geographic range that started in 2016 increased the number of documented colonies from nine (2015), 13 (2016), 14 (2017), and 18 (2018). The documentation of inactive lodges and other activity similarly increased. Each year, these surveys have come closer to a full census of all beaver colonies in Whistler.

The 2018 surveys increased the knowledge of active colonies on the River of Golden Dreams and other areas. It also produced the first mapping of wetlands created and/or maintained by beavers ("beaver-affected wetlands"). The main goals for 2019 surveys were to:

- Build on 2018 results to move closer to a full census of beavers in Whistler Valley. Two areas were again targetted for additional survey effort: the River of Golden Dreams and Millar Creek Wetlands;

- Obtain and tabulate historic and recent trapping records. Correlate those trapping records where possible to past and current beaver locations;
- Work with RMOW staff to convey information about beavers to avoid/mitigate conflicts, especially where the new Valley Trail is being built in Function Junction;
- Continue to communicate with local golf courses about beaver activities and possible ways to coexist better with beavers; and
- Field truth beaver-affected wetlands to reconcile the discrepancy between the RMOW wetlands layer and what was mapped for this report. The eventual goals are to be able to: (a) accurately monitor the extent of beaver-affected wetland; and ideally (b) provide a better historic baseline to which that extent can be compared.

6.2 Methods

6.2.1 Sampling Design

Sites included in the 2016 to 2019 surveys were based on the following sources: (i) locations documented in surveys dating back to 2007; (ii) incidental sightings; and (iii) anecdotal reports. Each beaver survey recorded all past and current beaver activity, e.g., freshly cut branches and trees, tracks, food caches submerged in the water, new twigs and branches on dams, new construction on lodges (fresh mud or branches; Photo 6-1), tunnels through terrestrial vegetation and exit slides from water edges (Photo 6-2).

Photo 6-1. Fresh mud is an example of recent activity and an active lodge. This lodge photographed in November 2017 was still active at Alta Vista Pond in 2019.

Photo 6-2. Other evidence of recent beaver activity: a lodge (left); tracks (middle); and a runway through adjacent vegetation (right).

In most cases, it is possible to confidently identify where a lodge, burrow, dam, or area is active based on observations that include:

- Sightings of beavers, especially if entering and exiting structures;
- New construction or repair, especially in the fall;
- Functioning and freshly-maintained dam(s)
- Fresh food caches submerged at the entrance to a lodge;
- Beaver tracks;
- Well-worn paths (tunnels and slides) through vegetation that links to the lodge's pond; and
- Evidence of extensive clippings and cuttings along those paths.

Signs of inactivity include:

- Absence of any beaver sightings in the area;
- Absence of a structurally sound lodge;
- Absence of functioning or freshly-maintained dam(s); and
- Absence of any other fresh signs (*i.e*., that were obviously not from the survey year).

Since it is not always possible to conclude whether there has been recent activity, past reports have included a third classification (Unknown). For 2019, this uncertainty has been recognized by question marks beside a record, that is, "Active" or "Inactive." This change forced surveyors to choose which of the two classifications was most probable and was meant to allow easier interpretation of population trends.

6.2.2 Data Analysis

Three factors introduced uncertainty into the 2019 estimate of Whistler's beaver population. Firstly, and as discussed above (Section 6.2.1), it was not always possible to conclude whether a lodge was occupied.

Secondly, it is likely that not all occupied lodges were detected, though the number of undetected lodges continued to fall as the census built on past years' results. Thirdly, the population estimate relies on a multiplier of beavers per lodge that has not been verified (and would require extensive research beyond the scope of this project). It is therefore necessary to rely on data published from other areas.

The number of beavers per colony (overwintering lodge or possibly bank burrow) is based on several factors, especially habitat type and beaver density (Müller-Schwarze and Sun 2003). In 2008, data was averaged from five studies to derive an estimate of the total Whistler beaver population based on a multiplier of 5.8 beavers per lodge (Mullen 2008). This multiplier has been used each year since to derive an estimated total population. Other studies (Müller-Schwarze and Sun 2003) reported the average number of beavers per family from twelve locations that ranged from 4.1 to 8.2 and in which half were 5.1 or below and the average was 5.6 (Table 6-1). While these figures suggest the past multiplier used for Whistler studies date is reasonable, Section 6. 3 includes low, middle, and high estimates of Whistler's beaver population.

Table 6-1. Number of beavers per family in various locations (Müller-Schwarze and Sun 2003).

Location	Avg. No. per Family	Location	Avg. No. per Family
Alaska	4.1	**Alleghany**	5.4
Montana	4.1	**Ohio**	5.9
Newfoundland	4.2	**Colorado**	6.3
Adirondacks	4.3	**Isle Royale**	6.4
California	4.8	**Massachusetts**	8.1
Michigan	5.1	**Nevada**	8.2

6.2.3 Quality Assurance and Quality Control

Results from beaver surveys are comparable year to year, with the caveat that the survey effort and reliability has been variable to an unknown degree. It is nonetheless certain that population estimates have become more reliable since 2016 when survey efforts were expanded. Surveys each year since 2016 has built on the previous years' results and improved the accuracy of the census.

6.3 Results and Discussion

6.3.1 2019 Surveys

For the fourth consecutive year, beaver surveys detected more active colonies and came closer to a full census of beavers in Whistler. A total of 65 lodges were surveyed of which 27 were determined to have active colonies (Table 6-2). This result continues the upward trend of both number of total lodges and active colonies surveyed since surveys began in 2007.

Table 6-2. Summary table of documented lodges from 2007 through 2019 by activity status. Surveys were not conducted in 2012.

Status	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018	2019
Lodge - Active	9	27	16	16	17	10	10	7	13	13	16	27
Burrow - Active	0	0	0	0	0	0	0	0	0	0	2?	0
Lodge - Inactive	9	12	13	7	21	5	14	18	11	21	32	36
Summer Only									2	2	2	0
Unknown	1	4	4	4	0	8	1	3	3	8	9	NR
Total	**19**	**43**	**33**	**27**	**38**	**23**	**25**	**28**	**29**	**44**	**59**	**65**

Note: NR = not recorded. Starting in 2019, surveyors classified lodges with an uncertain status as either "Active?" or "Inactive?" based on available evidence.

The number of active colonies documented in 2019 (27) is 50% more than in 2018 (18) and the highest recorded since surveys began in 2007 with one exception (Table 6-2). Mullen (2008) also recorded 27 active lodges but almost certainly over-counted. For example, she recorded 15 active lodges on the River of Golden Dreams in 2008, more than twice the number documented in any other year (Section 6.3.2).

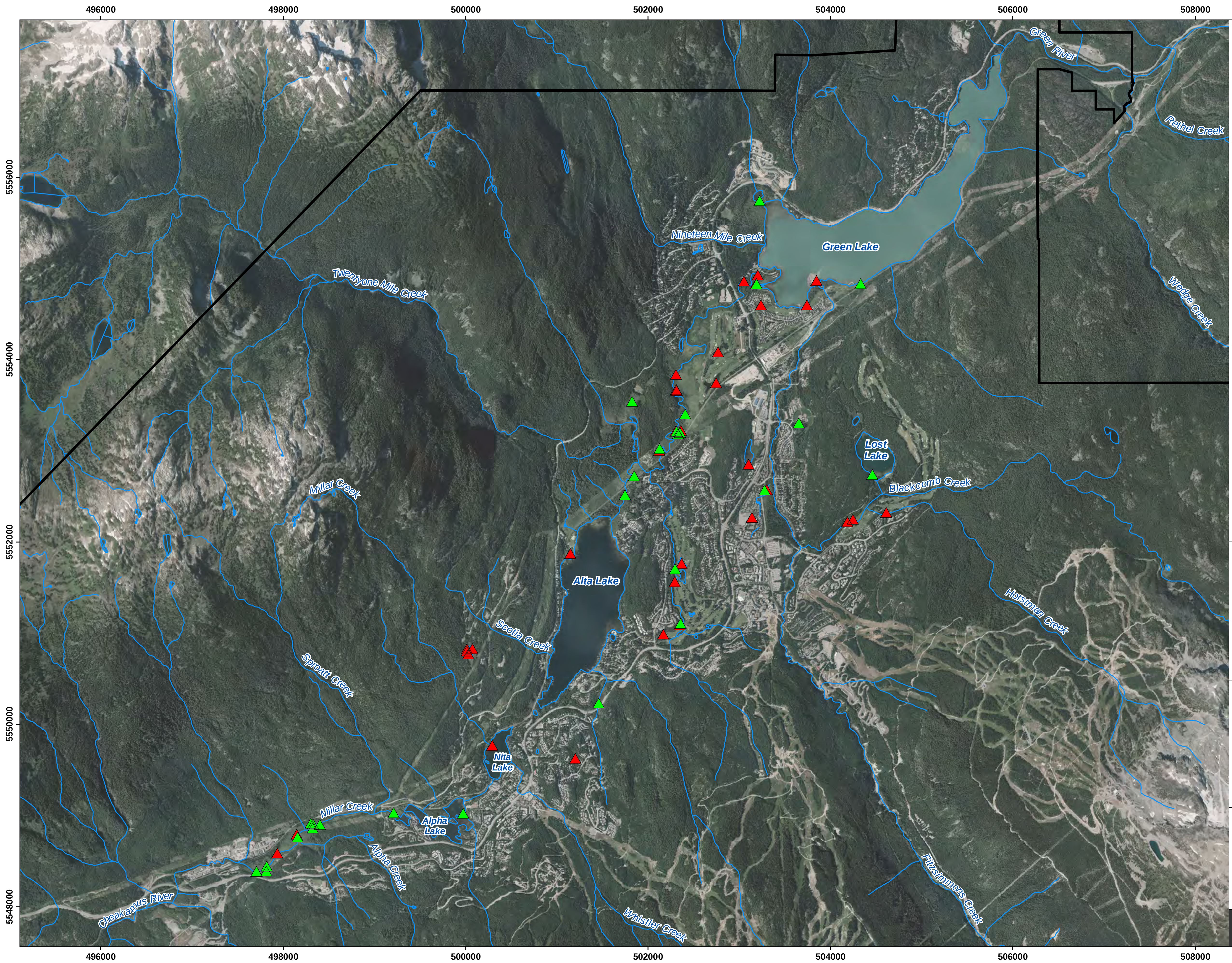
Two areas accounted for seven out of nine active lodges added since 2018: The River of Golden Dreams (ROGD) and the Miller Creek Wetlands (Table 6-3; Photos 6-3). Since 2007 surveys began, more active colonies have been documented on the ROGD than any other area. In 2019, the importance of this habitat was again emphasized by the detection of seven active colonies which is two more than in 2018. More surprisingly, 2019 surveys revealed that the Miller Creek Wetlands provides similarly important beaver habitat. Previous surveys have been hampered by the difficult accessing this site but in 2019 exceptional effort was directed to documenting as many lodges as possible Photos 6-3. As a result, eight active lodges were detected compared to the two found in 2018. This concentration of beaver activity demonstrates the value of the Miller Creek Wetlands to those beavers and almost certainly provides a second critical source of beaver out-migration to the ROGD.

The 2018 survey recorded the first bank burrows (two) considered to house overwintering colonies. The 2019 did not find any evidence of overwintering in bank burrows. Future surveys will presumably verify if bank burrows are indeed used for overwintering in Whistler.

Table 6-3. Lodges and burrows documented in 2019.

Location	**2017 Status**	**2018 Status**	**2019 Status**	**Easting**	**Northing**
Alpha Lake, near dog beach	Active	Active	Active	499970	5549027
Alpha Lake, outlet at Millar Creek	NR	Active	Active	499208	5549034
Alta Vista Pond	Active	Active	Active	501458	5550235
Fitz Creek Pond - Blackcomb Way/Nancy Greene Dr.	NR	Active	Active	503275	5552571
Green Lake - ROGD, Fitz Fan, Parkhurst area]	Active?	Active?	Active?	504330	5554834
Lost Lake	Unknown	Active	Active	504458	5552740
Millar Cr. Wetlands - bet. hydro tower and Valley Tr. bench	NR	Inactive?	Active	498301	5548918
Millar Cr. Wetlands -FJ (Valley Trail access)	NR	NR	Active	498321	5548863
Millar Cr. Wetlands -FJ (Valley Trail access)	NR	NR	Active	498324	5548906
Millar Cr. Wetlands -FJ (Valley Trail access)	NR	NR	Active	498398	5548903
Millar Cr. Wetlands -FJ (water access)	NR	Active	Active	497706	5548388
Millar Cr. Wetlands -FJ (water access)	NR	Active	Active	497812	5548393
Millar Cr. Wetlands -FJ (water access)	NR	Inactive	Active	497818	5548447
Millar Cr. Wetlands -FJ (water access)	NR	NR	Active?	498156	5548764
Rainbow Wetlands, NE end near 21-Mile Creek	Active	Active	Active	501848	5552727
ROGD1 - Alta Lake entrance to fish weir	Active	Active	Active	501744	5552517
ROGD4 - RR bridge to bend nearest Valley Tr.	NR	Active	Active	502327	5553188
ROGD4 - RR bridge to bend nearest Valley Tr.	NR	Active?	Active	502349	5553202
ROGD4 - RR bridge to bend nearest Valley Tr.	NR	NR	Active	502126	5553026
ROGD4 - RR bridge to bend nearest Valley Tr.	NR	NR	Active	502312	5553214
ROGD4 - RR bridge to bend nearest Valley Tr.	NR	NR	Active	502406	5553403
ROGD6 - Hwy. 99 bridge to Green Lake	NR	Inactive?	Active	503187	5554830
Spruce Grove Park, entrance	Active	Active	Active	503652	5553307
Wedge Pond	Inactive	Active	Active	503223	5555744
Whistler GC, #15 fairway, s. of #16 outflow	Active	Active	Active?	502356	5551107
Whistler GC, Crabapple Cr. #10 sand trap	Active	Active	Active?	502293	5551708
Wildlife Refuge, middle pond	Active	Active	Active	501825	5553543

Photos 6-3. (left) The kayak used to survey additional parts of Miller Creek Wetlands atop an active beaver dam. (right) A second active dam in the middle of the Millar Creek Wetlands.



Legend

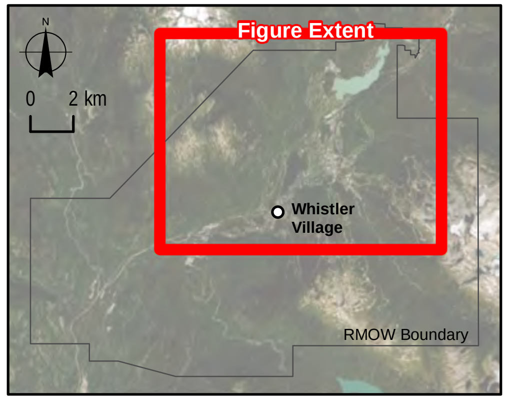
2019 Beaver Lodge Status

▲ Active
▲ Inactive

▭ RMOW Boundary
— Watercourse

Notes:
(1) Orthoimagery (2014) provided by RMOW.
(2) Watercourse data from BC Freshwater Atlas (accessed 2017).

Contains information licensed under the Open Government Licence - British Columbia. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



DRAWN: B. Elder
CHECKED: B. Brett
PROJECT: 1602505
DATE: Jan 13, 2020

Scale 1:40000
UTM Zone 10N
NAD 1983

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2019

Results of 2019 Census of Beaver Lodges in Whistler

FIGURE 6-1

6.3.2 Estimated Whistler Beaver Population in 2019

The 27 lodges documented in 2019 significantly raise the estimated beaver population in Whistler from past estimates, primarily due to the large concentration of beaver lodges detected for the first time in Miller Creek Wetlands. The middle estimate for the population (based on 5.8 beavers per lodge; Section 6.2.2) has risen from 104 in 2018 to 157 in 2019 (Table 6-4; Figure 6-2). Even the lowest multiplier of 4.1 beavers per lodge yields an estimated population of over 100 beavers living in Whistler in 2019.

Table 6-4. Estimated number of beavers overwintering in Whistler, 2007-2019.Surveys were not conducted in 2012.

	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018	2019
Active lodges/burrows	9	27	16	16	17	10	10	7	13	14	18	27
4.2 beavers/site	38	113	67	67	71	42	42	29	55	59	76	113
5.8 beavers/site	52	157	93	93	99	58	58	41	75	81	104	157
6.4 beavers/site	58	173	102	102	109	64	64	45	83	90	115	173

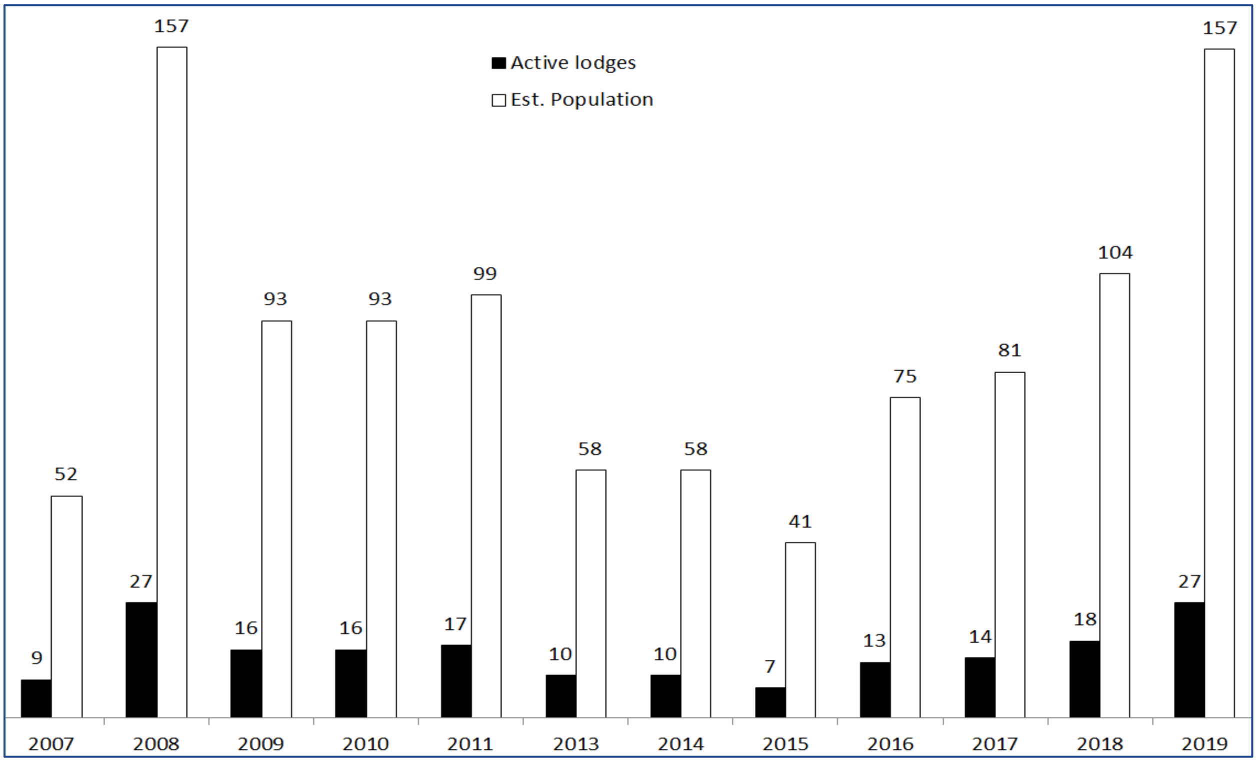


Figure 6-2. Estimated beaver population from 2007-2019 based on a multiplier of 5.8 beavers per overwintering site. Surveys were not conducted in 2012.

Results in 2019 again demonstrated the benefit of annual surveys in which past years' helped direct the next year's focus areas, especially on the River of Golden Dreams and in the Miller Creek Wetlands. Knowledge about how many beavers are in Whistler and where they are located has improved with each survey since 2016 and 2019 results again approach ever nearer to a complete beaver census. It is now unlikely that a significant beaver habitat has not been detected in the Whistler Valley.

These advances in information about beavers are already valuable in terms of knowing which areas support beavers and therefore should be considered in environmental planning. They are not, however, enough to confidently conclude any annual trends in their overall population since annual results are based on incomplete information (though least so in 2019). It is likely that monitoring the number and location of active lodges will remain more important than population estimates for environmental planning in the future since: (a) the location of lodges is by nature spatially defined; and (b) estimates of total population are not as reliable.

6.3.3 Two Major Beaver Habitats in Whistler

Previous surveys established the River of Golden Dreams (ROGD) as the single most important beaver habitat in Whistler Valley but 2019 surveys revealed the Miller Creek Wetlands have a similar importance (Table 6-2). The 2019 surveys successfully expanded the documentation of active lodges on ROGD from five to seven, a result that probably represents better documentation of existing lodges rather than an expanded population. Even more significantly, 2019 surveys in the Miller Creek Wetlands confirmed eight active lodges (versus two in 2018 and one in 2017) and therefore a similar population to that in the ROGD wetlands. Between them, these two areas account for more than half of all active lodges detected in 2019 (15 of 27).

Both of these areas are very difficult to access but for different reasons. To date, all lodges detected in the ROGD wetland complex have been at the edge of the flowing water and therefore accessible by kayak. Many of these lodges are, however, hidden even when only a few metres from the water's edge. Surveys since 2017 have therefore spent much more survey effort on land to increase detections (***Photos 6-4***).

Photos 6-4. (Left) Two surveyors search for active lodges and beaver sign on land beside the River of Golden Dreams. (Right) The lodge in the bottom left of the photo is approximately two metres from the water's edge and not visible without searches on land.

Most of the eight lodges detected in 2019 in the Miller Creek Wetlands were also beside the main stem of the creek which runs through it. Miller Creek is, however, much more difficult than the River of Golden Dreams to access by kayak because of: (a) no easily-accessible put-in locations; (b) dams and other obstructions; and (c) faster moving water. The 2019 surveys nonetheless managed to reach many previously inaccessible areas (Photos 6-3) which is the reason so many lodges were detected for the first time. These efforts were rewarded with the discovery of six active lodges which brought the total for the area from two in 2018 to eight in 2019. Similar to new detections on the ROGD, this result almost certainly represents a more accurate tally rather than an expanded population.

6.3.4 Beaver-affected Wetlands

Beavers are well-known keystone species also referred to as “wetlands engineers” for their role in creating and maintaining wetlands (Müller-Schwarze and Sun 2003). The 2018 report described the first effort to map wetlands that have been engineered and/or directly affected by beavers within Whistler Valley (“beaver-affected wetlands”). The goal of these maps was to create a baseline calculation of beavers’ impact on wetland habitat in the form of total hectares of beaver-affected wetlands in Whistler Valley.

The 2018 report discussed the challenges in producing an accurate map of beaver-affected wetlands, especially that the exact extent of beaver impacts within these wetlands is often not obvious. The only way to truly determine that extent would be to remove the beavers and compare the wetlands before and many years after removal. With this caveat, the maps and tables presented in 2018 and updated below (Table 6-5; Table 6-6) highlight the importance of beavers within Whistler Valley.

One significant change in 2019 mapping was in the Miller Creek Wetlands where field surveys revealed almost twice as much area flooded by beaver activity than was mapped in 2018 (Table 6-5). This increase is probably not related to additional beaver activity in 2019 but rather that the mapping last year was based on aerial photos which hid flooded areas under tree cover. The current total of beaver-affected wetlands is now just over 100 ha. Alpha Lake is not included in this total even though beaver dams elevate the water level there by up to 1 m which means the lake covers approximately 7.1 ha more area than it would without damming.[12]

---

[12] *This estimate is based on GIS analysis performed for the 2018 report.*

Table 6-5. Location and area of beaver-affected wetlands in Whistler, 2019.

Wetland (South to North)	2018(ha)	2019 (ha)	2019 (%)
Millar Creek Wetlands	7.6	**13.3**	13%
Beaver Lake	1.8	1.8	2%
Alta Vista Pond	1.3	1.3	1%
Rainbow Wetlands	14.7	14.7	15%
Fitzsimmons Wetlands	1.4	1.4	1%
Chateau GC #18 Pond	0.7	0.7	1%
Wildlife Refuge	10.4	10.4	10%
Spruce Grove Wetland	0.3	0.3	0%
Lost Lake - Sawmill Wetland	1.6	1.6	2%
Buckhorn Pond	0.5	0.5	0%
River of Golden Dreams	47.9	47.9	48%
Fitzsimmons Creek Back Channels	0.9	0.9	1%
Wedge Pond	5.5	5.5	5%
Total beaver-affected wetlands	**94.7**	**100.3**	**100%**
Alpha Lake (flood effect of dam)	7.1	7.1	
Total beaver effect	**101.8**	**107.4**	

The River of Golden Dreams accounted for almost half of all beaver-affected wetlands in 2019 (Table 6-5 and Table 6-6). By far, the largest part of this area is the main section between the CN Rail bridge and Highway 99 (ROGD-4 and ROGD-5; Section 6.3.4.2). Two of the next largest beaver-affected wetlands are the Rainbow Wetlands and the Wildlife Refuge (Table 6-5). Before development, these two wetlands areas would have been linked with the River of Golden Dreams in a complex spanning from Alta Lake to Green Lake on either side of the current railway line, as well as what is now the Whistler Golf Course (McBlane 2007). There would also have been much greater connectivity southward to the Miller Creek Wetlands. In total, these four wetlands account for 86% of all beaver-affected wetlands. Descriptions of all 13 wetlands as well as beaver impacts on Alpha Lake wetland are included below as Section 6.3.4.2.

Table 6-6. Areal extent of beaver-affected wetlands of different sections along the River of Golden Dreams (ROGD).

ROGD Survey Area	Area (ha)	Area (%)
ROGD-1 (Alta Lake to fish weir)	3.0	6%
ROGD-2 (fish weir to 21-Mile Creek)	0.1	0.2%
ROGD-4/5 (railway bridge to Hwy. 99)	40.4	84%
ROGD-6 (Hwy. 99 to Green Lake)	4.4	9%
Total	**47.9**	**100%**

Note: ROGD-3 is located between the junction with 21 Mile Creek and railway bridge; this section is not included because no beaver activities have yet been detected there. See Section 6.3.4.2 for mapping of the other sections.

.

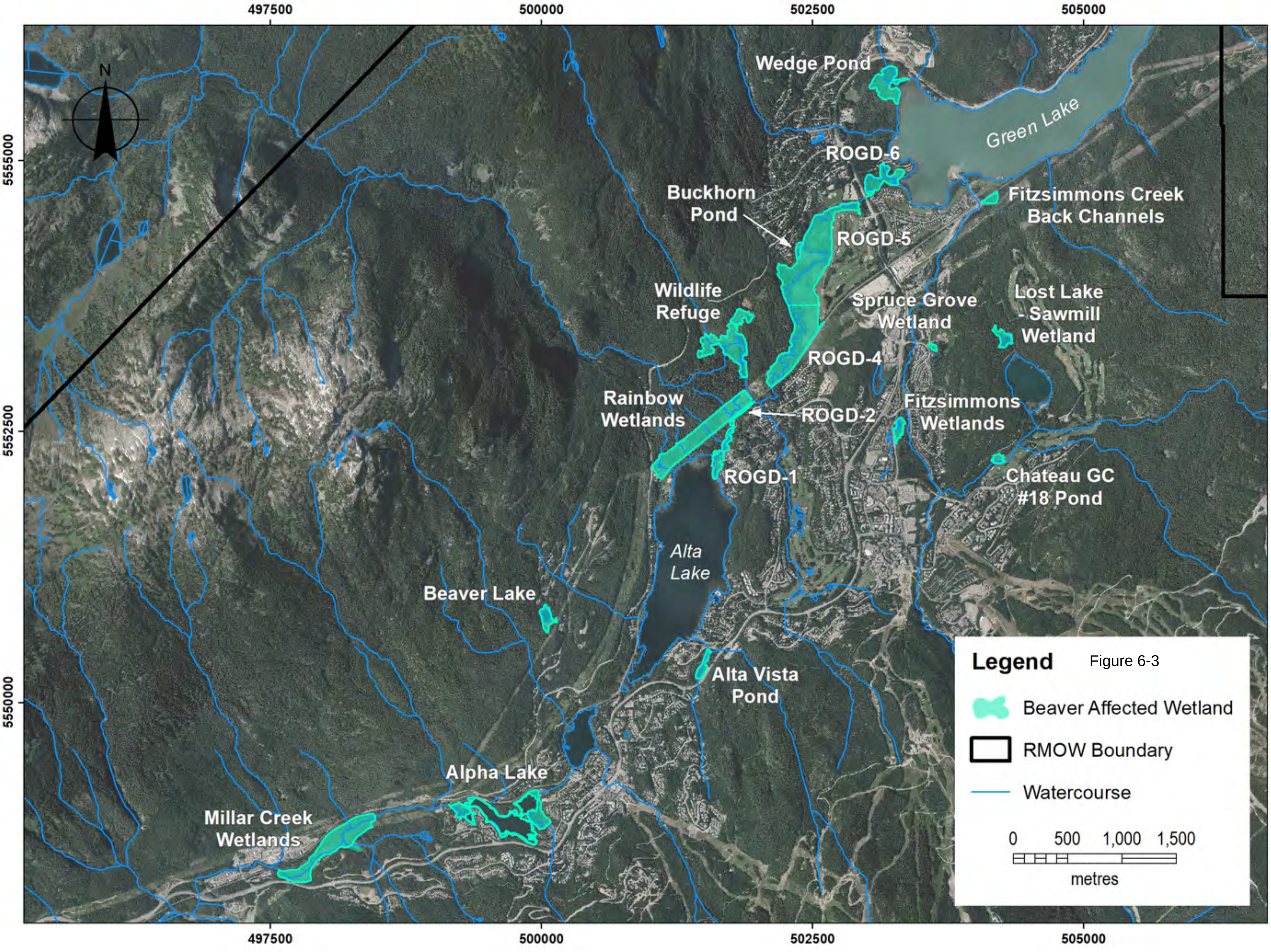


Figure 6-3
497500
500000
502500
505000
555000
552500
550000
N
Wedge Pond
Green Lake
ROGD-6
Buckhorn Pond
Fitzsimmons Creek Back Channels
ROGD-5
Wildlife Refuge
Spruce Grove Wetland
Lost Lake - Sawmill Wetland
ROGD-4
Rainbow Wetlands
ROGD-2
Fitzsimmons Wetlands
ROGD-1
Chateau GC #18 Pond
Alta Lake
Beaver Lake
Alta Vista Pond
Alpha Lake
Millar Creek Wetlands
Legend
Beaver Affected Wetland
RMOW Boundary
Watercourse
0
500
1,000
1,500
metres

6.3.4.1 Historic Context

There were at least two changes that significantly impacted beavers since the railway grade was established before operations began in 1913:

1. the railbed for that railway and the ensuing increase in human presence it facilitated; and
2. the increased urban development starting in the 1960s and continuing to the present.

The railway bisected the large wetland complex mentioned above[13] which changed the hydrology and reduced the connectivity of that area. As Whistler's population started to grow in the 1960s and 1970s, wetlands were increasingly replaced by subdivisions, golf courses and other urban developments. By 2003, at least 72% of the original area covered by wetlands was lost to development (McBlane 2007; Table 6-7; Figure 6-3).

Table 6-7. Wetland area in the RMOW by year and scope.

Year	Wetland Scope	Area (ha)	Compared to 1946	Source
1946	All RMOW	604.4	100%	McBlane 2007
2003	All RMOW	169.9	28%	McBlane 2007
2014	All RMOW	193.4	32%	Palmer (unpubl.)
2014	All RMOW <800 m	169.7	28%	Palmer (unpubl.)
2014	<800 m, study area only	150.7	25%	Palmer (unpubl.)
2018	Beaver-affected, study area only	94.7	16%	Palmer and Snowline 2019
2019	Beaver-affected, study area only	100.3	17%	This report.

Notes: The current study area is equivalent to the RMOW Development Footprint, from Function Junction to the north end of Green Lake. McBlane (2007) compared air photos taken in 1946 and 2003 within a similar but not exact scope. The 2014 data is based on the RMOW's most recent mapping of wetlands.

The loss of wetlands since 2003 has definitely slowed, though it is not possible with current data to provide exact figures. The RMOW's most recent mapping shows that approximately 25% of the area originally occupied by wetlands remain below 800 metres and within the Development Footprint[14] remained in 2014 (Table 6-7).

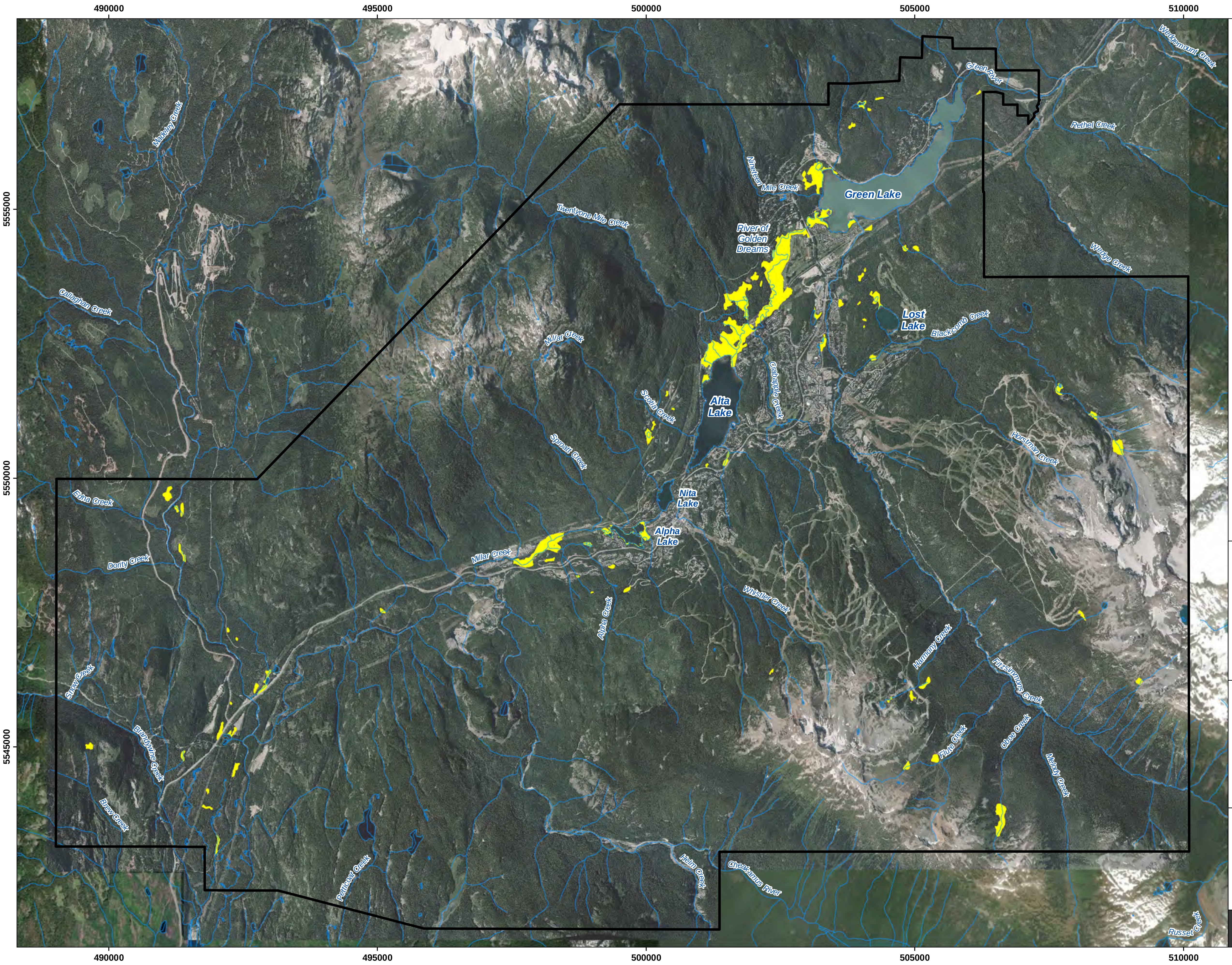
A comparison of wetlands affected by beavers (Figure 6-3) and all wetlands (Figure 6-3) highlights the importance of beavers in Whistler Valley. Beavers have created or at least affected approximately two-thirds (100.3 of 150.7 ha) of all wetlands in Whistler's Development Footprint: as of 2019 (Table 6-7). [15]

---

[13] *Rainbow Wetlands, Wildlife Refuge, and River of Golden Dreams.*

[14] *Roughly from Function Junction north to Emerald Estates and mostly below 800 metres.*

[15] *The 2019 total is 5.6 ha larger than in 2018 due to more accurate ground-based mapping.*



Legend

🟨 Wetland

▭ RMOW Boundary

— Watercourse

Notes:
(1) Orthoimagery (2014) provided by RMOW.
(2) Wetlands displayed include features from Whistler Official Community Plan (2007/2008) and delineated "Beaver Afftected" wetlands (Annual Monitoring - Palmer).
(3) Watercourse and lake data from BC Freshwater Atlas (accessed 2017).

0 1 2 3
kilometres

N

DRAWN: B. Elder
CHECKED: B. Brett
PROJECT: 1602505
DATE: Dec 15, 2020

Scale 1:68000
UTM Zone 10N
NAD 1983

Palmer™

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2019

Wetlands

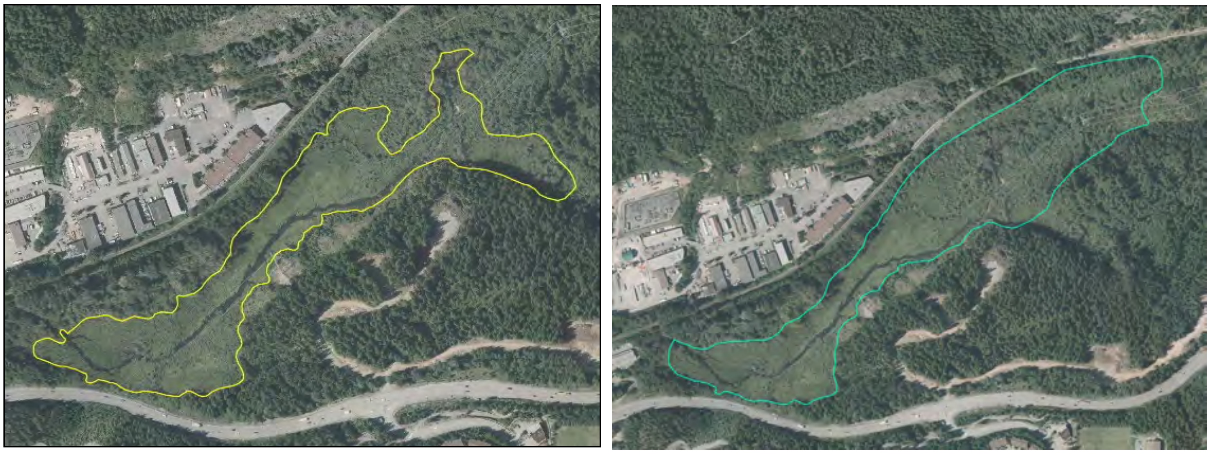
FIGURE 6.4

Document Path: G:\Shared drives\Projects 2016\16025 - Resort Municipality of Whistler\1602506 - 2020 Annual Monitoring\Mapping\Figures\5_ArcGIS\1602506_Wetlands.mxd

6.3.4.2 Detailed descriptions of Beaver-affected Wetlands (from South to North)

Millar Creek Wetlands

The 2019 beaver survey included two objectives for the Miller Creek Wetlands: (i) confirm the number of active lodges; and (ii) ground-truth the true extent of areas flooded by beaver activity. Both of these objectives were met. The number of active lodges detected in 2019 raised the number of confirmed lodges from two in 2018 to eight, a total that represents a beaver population as significant as that inhabiting the River of Golden Dreams (Section 6.3.3). Ground-truthing also revealed that almost twice as much area was flooded by beavers than showed in air photos: 13.3 ha versus 7.6 ha, respectively (Table 6-5; Photo 6-5).



Photos 6-5. (left) Air photo analysis in 2018 estimated that 7.6 ha were by beavers in the Miller Creek Wetlands. (right) Ground-truthing in 2019 showed 13.3 ha were actually affected by beavers. Most of this increase was due to flooded areas under tree cover that were not detectable from air photos.

Beaver Lake

In the past, Beaver Lake had four active lodges, but beaver activity has not been detected in the area since 2006. While active lodges are not present, the old lodge structures are still visible, and the related dams still impound water (Photo 6-6). There is no known impediment to recolonization by beavers in this location.

Photo 6-6. The beaver-affected wetland at Beaver Lake.

Alta Vista Pond

The old lodge at Alta Vista Pond was recolonized by beavers in 2016 and has been active since. In 2018 and early 2019, damming of the outlet weir raised water levels enough to create one large pond (vs three different water levels behind two dams; (Photos 6-7). In September 2019, RMOW crews installed a pipe to lower the water level approximately 1.0 to 1.5 m (Section 6.3.6).

Due to the lowered water level, two previously built (and still functional) dams are visible and the pond again has three water levels: the lodge pond, a middle pond, and the lowest pond feeding into the weir. The total flooded area remained the same even with this change. (See Section 6.3.6 for a description and photos of the change in water level.)

Photos 6-7 (left) The approximate outline of the beaver-affected area of Alta Vista Pond. (right) The active lodge is shown in the left foreground of this photo from April 2019 before the pond was partially drained in September 2019 (Section 6.3.6).

Rainbow Wetlands

The Rainbow Wetlands complex is a large swath of partially inundated land with a long history of beaver activity (Photo 6-8). Until recently there was an active lodge at the west end of Rainbow Park and multiple dams upstream that impounded the water in the area nearest to the Rainbow Park lower parking lot (6-8, right, foreground). Most of the current beaver activity is now in the northern half of this area where a long-standing lodge was again confirmed active. Abundant signs suggested at least one more active lodge may not have been detected.

The RMOW's wetland layer of the Rainbow Wetlands area includes moist, forested areas especially on the upstream side of 21 Mile Creek (Figure 6-4) which means that the area of wetland calculated in this report is conservative.

Photo 6-8. (left) The approximate outline of the beaver-affected area of the Rainbow Wetlands includes the entire hydro corridor. (right) Inactive beaver dams at the southwest end of the wetlands still impound water, as seen in the foreground of this photo.

Fitzsimmons Wetland

Hillary Williamson (RMOW staff) recorded an active lodge in the Fitzsimmons Wetland in 2018. Detailed surveys in 2019 confirmed one large active lodge and one inactive lodge.

The Fitzsimmons Wetland (Photo 6-9) is the only remaining remnant of the large wetland that the Village North development replaced in the 1990s. Even when inactive (for an unknown number of years before 2017), old beaver dams maintained raised water levels and current dams have likely raised them even further. In spite of this activity, the construction of the Montebello bioswale in 2007 has apparently reduced water flow north into the Fitzsimmons Wetland and resulted in encroachment into it by cattails and other vegetation.

Photo 6-9. The Beaver-affected wetlands at Fitzsimmons Wetland: outlline (left) and the lodge that has been active since at least 2018 (right).

Chateau Golf Course #18 Pond

The Chateau Golf Course #18 Pond (Photo 6-10, and Photos 6-11) is another remnant of a historically larger wetland. A very large dam (Photos 6-11) impounded water for many years (at least dating back to the first beaver surveys) and other dams have also changed water flow. The two lodges below the dam remained inactive in 2019, but recent beaver signs showed evidence of a lodge nearby (the closest detected lodges were in Lost Lake and Fitzsimmons Wetland).

The main pond drained in 2018 apparently due to lack of maintenance by beavers (Photos 6-11).[16] In 2019, the pond rose partway to its height in 2017 which suggests the resumption of at least some dam maintenance by beavers. Since non-resident beavers are unlikely to maintain a dam, the 2020 survey will need to confirm whether there was an undetected lodge nearby or whether changes in water levels are unrelated to beaver activities.

Photo 6-10. Chateau Golf Course #18 Pond

---

[16] *Dan Nash, the course Superintendent, confirmed his staff did not drain the pond (pers. comm., Oct. 2018).*

Photos 6-11. The Chateau Golf Course #18 pond in fall 2017 (top); fall 2018 (middle), and fall 2019 (bottom). After many years of creating this pond, the dam was not functional in late 2018. Beaver activity was again detected below the dam in 2019 (though no active lodges). This presence

apparently included enough maintenance that the dam again raised the water partway to 2017 levels.

Wildlife Refuge Wetland

The Wildlife Refuge Wetland (Photos 6-12, left) has had an active beaver population for at least 20 years[17] and it is almost certain beaver activity predated the railway in 1913. Beaver dams have raised water levels and signs of beaver activities are common in the area. One long-active lodge was again confirmed active in 2019.

Photos 6-12. Beaver-affected wetlands in the Wildlife Refuge (left) and Spruce Grove Park (right).

Spruce Grove Wetland

There has been beaver activity in Spruce Grove Park for at least the last three years (Photos 6-12). The beavers have blocked the outflow weir to impound water behind it. The active lodge was located for the first time in 2018 and was very active in 2019.

Lost Lake – Sawmill Wetland

The 2019 surveys found evidence of feeding and repairs to the outflow dam in the old sawmill site north of Lost Lake (Photos 6-13, left). Since there is no evidence of new or old lodge structures in this area, the beavers associated with that activity are likely from the active lodge in Lost Lake itself.

---

[17] *A photo of an old beaver dam at the south end of the wetland dates back to 2000 (B. Brett photo -- https://www.whistler.ca/services/environmental-stewardship/ecosystem-monitoring).*

Photos 6-13. (left) Beaver-affected wetlands at north of Lost Lake at the old sawmill site; and (right) at Buckhorn Pond.

Buckhorn Pond

Buckhorn Pond is connected to the River of Golden Dreams Wetlands and is the only large pond within the complex (Photos 6-13, right). Water levels are maintained by a dam that, although functional, has not been repaired in at least two years. A resident saw beavers eating aquatic vegetation in this pond in 2016 (Palmer and Snowline 2017) and beavers from lodges on the River of Golden Dreams likely continue to access this source of food.

River of Golden Dreams Wetlands

The River of Golden Dreams wetland complex contains almost one-half of the area of beaver-affected wetlands in Whistler (Table 6-5; Table 6-6). This is a complex system to survey and to describe which is why reports since 2016 have segmented the river into six sections:

- ROGD-1 (Alta Lake entrance to fish weir);
- ROGD-2 (fish weir to junction with 21 Mile Creek);
- ROGD-3 (21 Mile Creek to railway bridge);
- ROGD-4 (railway bridge to closest approach to Valley Trail – about midway through this section);
- ROGD-5 (closest approach to Valley Trail to Highway 99 bridge); and
- ROGD-6. (Highway 99 bridge to Green Lake).

All except for the ROGD-3 segment have been affected by beaver activities.

ROGD-1 (Alta Lake entrance to fish weir)

The first segment of the River of Golden Dreams (Photos 6-14; left) includes one large, long-standing lodge upstream of the Valley Trail bridge. While there are not many obvious alterations on land from this lodge, there is a small dam (frequently breached by boaters) that slightly raises the water level. In 2019, the lodge had active slides and well-used pathways leading to and from its entrance.

ROGD-2 (fish weir to junction with 21 Mile Creek)

The second segment of the River of Golden Dreams (Photos 6-14, right) is a narrow, constructed channel that is defined by the CN railbed adjacent to it. Beavers have long-used this area, most notably in recent years, with bank burrows that are presumably unoccupied in winter. Active lodges have been previously observed in this area (e.g., Tayless 2010), but none in recent years.

Photos 6-14. The southern most segment of the River of Golden Dreams (ROGD) wetland: (left) ROGD-1; (right) ROGD-2. ROGD-2 occupies the narrow channel that drains from the fish weir to 21-Mile Creek.

ROGD-4 and ROGD-5 (railway bridge to Highway 99 bridge)

This segment is by far the largest wetland through which the River of Golden Dreams flows (Photo 6-15). Yearly evidence of beaver activity is apparent throughout the area and includes: lodges, bank burrows, food caches, gnawed trees and branches, tracks, scent mounds, slides, tunnels through vegetation, as well as some direct sightings of beavers.

Five active lodges were detected in this part of the River of Golden Dreams in 2019, the highest total to date. All appeared to be older structures which were not previously detected due to how well they were hidden under dense vegetation (mainly hardhack) and back from the water’s edge.

Photo 6-15. The largest contingous wetland that the River of Golden Dreams passes between the railway bridge to the south and bridge over Highway 99 to the north. This area is coded as ROGD-4 (south end of the polygon) and ROGD-5 (north end of the polygon). The Wildlife Refuge Wetland is shown to the southwest (bottom left).

ROGD-6. (Highway 99 bridge to Green Lake)

Beavers are also active each year in the downstream segment of the River of Golden Dreams (Photo 6-16). Small dams are usually maintained, though they don't tend to impound much water. Although there were abundant signs of activity in the river and on the adjacent shore in 2019, only one active lodge could be detected.

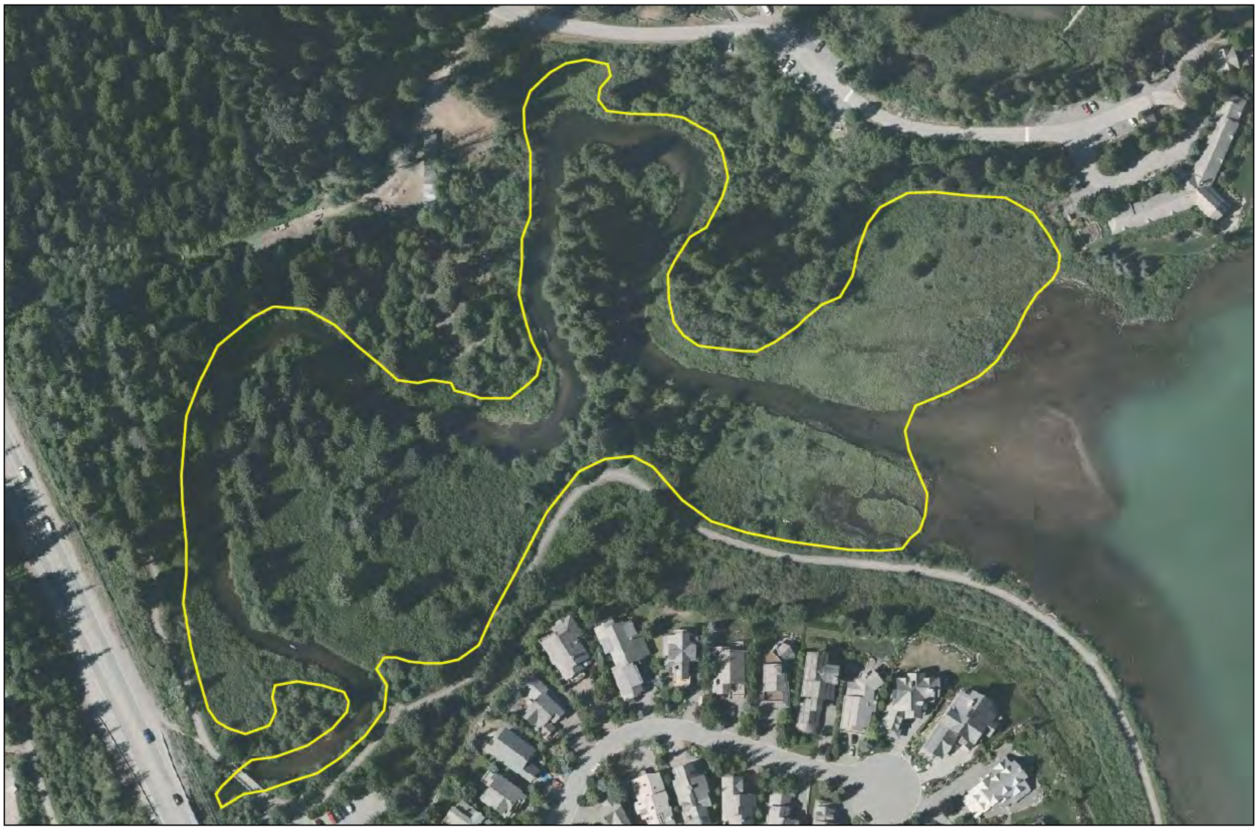


Photo 6-16. The northmost section of the River of Golden Dreams wetland, ROGD-6, is located between the Highway 99 bridge and Green Lake.

Fitzsimmons Creek Back Channels

The Fitzsimmons Creek back channels (Photo 6-17) are on the uphill (northeast) side of the railway tracks, east of and adjacent to the Fitzsimmons Creek main channel at Nicklaus North Golf Course. Extensive beaver activity was first documented in this location in 2016 but no active structures were detected until surveys conducted in 2018. One active lodge and six burrows were found during surveys of the Fitzsimmons Creek back channels in 2018 and at least one colony was active. Surveys in 2019 were unable to detect any active colonies in spite of evidence such as feeding and caches. Burrow entrances found in 2018 appeared unused and the lodge had no signs of recent activity. It is unclear whether recent trail building in the area (as part of the Lost Lake Zappa Trails) had any impact (also see Section 6.3.6).

Photo 6-17. The approximate area influenced by beavers at the Fitzsimmons Creek back channels.

Wedge Pond

An active lodge at Wedge Pond (Photo 6-18) first detected in 2018 was again confirmed as active in 2019. Although active lodges have not been found in many survey years, there has always been extensive evidence of their presence in the area including numerous channels, dams, structures and other signs.

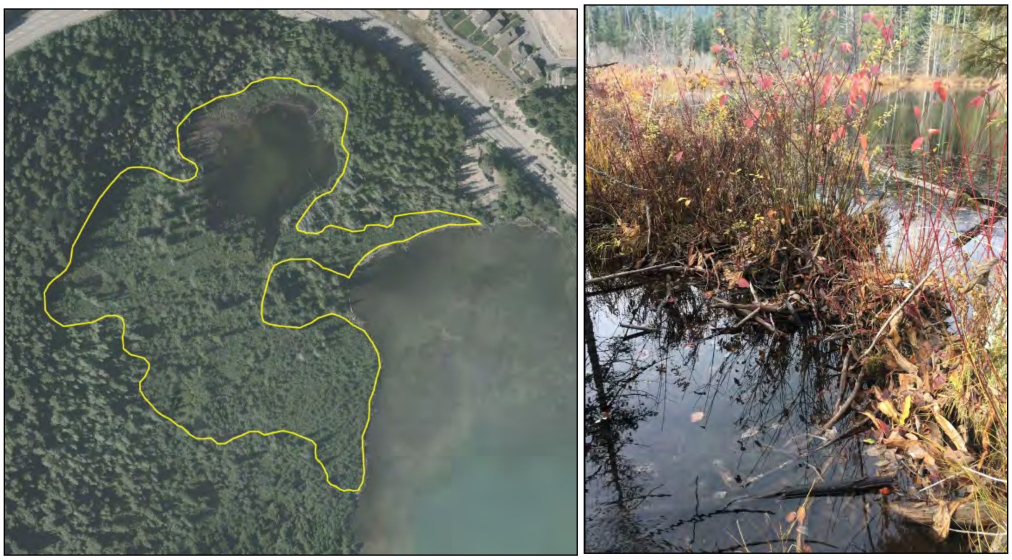


Photo 6-18. The beaver-affected wetlands at Wedge Pond.

Alpha Lake (non-wetland)

Alpha Lake is the only non-wetland area included in the discussion of beaver-affected habitats (Photo 6-19). The beaver dam at the outlet of the lake has been functional for at least 30 years (and likely far longer) and maintains water levels approximately 1 m higher than if the dam was not present. Given the large amount of area that is covered by shallow water, it is apparent that the beaver dam greatly increases the lake's surface area. At least some of these shallow areas, especially on the west and east edges, have wetland characteristics. Two active lodges were detected in 2019.

Photo 6-19. The outlet dam created by beavers on Alpha Lake (top left). The outer yellow line shows the approximate extent of the beavers' influence (e.g., wetland vegetation). The inner line attempts to delineate how much the open lake surface would diminish without the dam. The estimated impact of beavers is the area within the two lines.

6.3.5 Trapping Records as a Proxy for Historic Beaver Population in Whistler

A baseline population pre-development is an important component of an effective monitoring program but not always possible to determine. For beavers, it is clear they have always been an important part of Whistler's valley bottom ecosystems (e.g., Racey and McTaggart-Cowan 1935). It is almost certain beavers were much more numerous before the development of Whistler Valley based on two pieces of evidence. Firstly, the area of wetlands has decreased by approximately 75% (McBlane 2007; Section 6.3.4) which suggests the historic population of beavers was possibly four times larger than it is today. The second is a recollection of Don Maclaurin, a well-known figure who moved to Whistler in 1964 and remembered seeing six lodges on Alpha Lake at that time.[18] Surveys since 2007 have meanwhile documented between one and two active lodges on Alpha Lake, a decrease consistent with the 75% loss of wetlands in Whistler as a whole.

---

[18] *Personal communication with Bob Brett, approximately 20 years ago.*

One of the 2019 goals was to examine historic and recent trapping records as a proxy of the past beaver population. An extensive online search did not reveal any trapping records, even on the BC Government websites. At the time of writing, replies to emails to many government and independent biologists have not returned any leads. This effort will be pursued with the goal of including results from it with next year's report.

6.3.6 Conflict Areas in 2018

Beavers have a long history of conflict with humans, especially when urban development occurs in valley bottoms, as is the case in Whistler. Beaver conflicts are seldom made public, thus limiting the ability to report on them. All available information about 2019 conflicts is discussed below.

Millar Creek Wetlands: Line maintenance in 2018 by Fortis Gas included the new Valley Trail alignment between Alta Lake Road and Function Junction that passed through beaver-dammed parts of this wetland. Fortis BC applied for a trapping permit but was able to achieve their goals instead by breaching some of the dams.[19] This situation exemplified an opportunity to design new developments to avoid beaver conflicts, especially when the developer is the RMOW. As of fall 2018, the RMOW planned to build the trail to accommodate flooding,[20] and no conflicts with beavers were recorded in 2019.

Alta Vista Pond: The 2018 report noted that the RMOW Roads Department was troubled by beavers blocking the outflow weir in this pond. It suggested that the RMOW investigate ways to accommodate a higher water level in the pond by lining the road subsurface and/or other measures that would protect the integrity of the road while also protecting beaver habitat.

In September 2019, the Roads Department built a gravel road to access the pond and build a more beaver-proof drain. As a result, the pond level was lowered by 1-1.5 metres (Photo 6-20). It appears other options were not considered.

---

[19] *Hillary Williamson (RMOW) email to B. Brett, September 2018.*

[20] *Heather Beresford email to B. Brett, September 2018.*

Photo 6-20. Alta Vista Pond in April 2019 before draining (top) and in September 2019 after draining (bottom).

Rainbow Wetlands: CN Rail continues to breach dams each year along the section of tracks in the Rainbow Wetlands area. Dam breaches over the past four years have not prevented beavers from inhabiting the area, and the population was again robust enough in 2019 to rebuild the dams throughout the summer and into the fall.

River of Golden Dreams. The main concern for beaver conservation within this important habitat is human use of the river. On most sunny days in the summer, large numbers of people boat on the river by canoe and kayak (primarily customers of outdoor recreation companies) or by inflatable boats. Dams are routinely breached by the passage of these vessels (possibly unintentional). Without this human activity, dams would impound more water, beavers could likely remain active more hours in a day (as they would not have to avoid humans), colonies would likely be more plentiful and more area in the wetland complex would likely to be inundated.

Whistler Golf Course: The golf course is built on a previous wetland which has a creek passing through the course to the west (the creek is named Archibald Creek above the course and Crabapple Creek inside the course). Since the level of the creek is not far below the level of the course, damming by beavers can flood the course and cause damage. The Whistler Golf Course has a long but unquantified history of trapping beavers,[21] but recently has made some efforts to co-exist with them. The lodge at the #10 sand trap was trapped out and re-colonized at least once during the time beaver surveys have been conducted (2007-2018). This lodge is in a relatively benign location since it is far below the golf course and therefore some damming and beaver activity can be tolerated. The other frequent site for beavers to recolonize after being trapped out is adjacent to the #15 fairway. The elevation of the creek at that point is very close to the elevation of the golf course which means that it is less tolerable for golf course operations. Golf course staff breached dams and hired a trapper in the fall of 2018 who was unsuccessful in eliminating the beavers in the two lodges. In 2019 the #10 lodge appeared inactive but it is unknown if that was due to trapping.

Spruce Grove Park: In 2018, RMOW road crews responded to increased beaver activity blocking the outflow weir by removing material. Though not confirmed, it appears RMOW crews again removed material blocking the weir in 2019 since the water level has not increased in spite of extensive beaver activity in the pond. This site may be another opportunity for the RMOW to set a standard that allows co-existence with beavers.

Chateau Golf Course #2 and #18 Ponds: Beaver activity appears to have ceased in this area since sometime in 2017. The main dam in #18 failed in 2018 but appears to have been repaired by beavers enough to again raise water levels at least partly back to past levels. The course superintendent, Dan Nash, confirms there was no trapping again in 2019 on the course and does not have any information about the absence of active lodges.[22]

Nicklaus North Golf Course: Whistler's third golf course has a long history with beavers, understandably given its location used to be a major portion of the historic Alta Lake to Green Lake wetland complex. The course is very close to the River of Golden Dreams Photo 6-15). Beavers have used golf course ponds to forage and, less frequently, to build lodges (most recently on #10 pond, now inactive for three years). No known trapping or other control efforts took place in 2019.

---

[21] *Past trapping records should be maintained by the BC Government but have not yet been located (Section 6.3.5).*
[22] *Several conversations with Bob Brett throughout summer and fall 2019.*

<u>Fitzsimmons Back Channels</u>:

At least one beaver colony was active in this area in 2018 but no active lodges or overwintering burrows were found in 2019. It is possible a new single-track bike trail (Muffin Man; Photo 6-21) built through this area in 2018 and finished in 2019 may have negatively affected beavers.

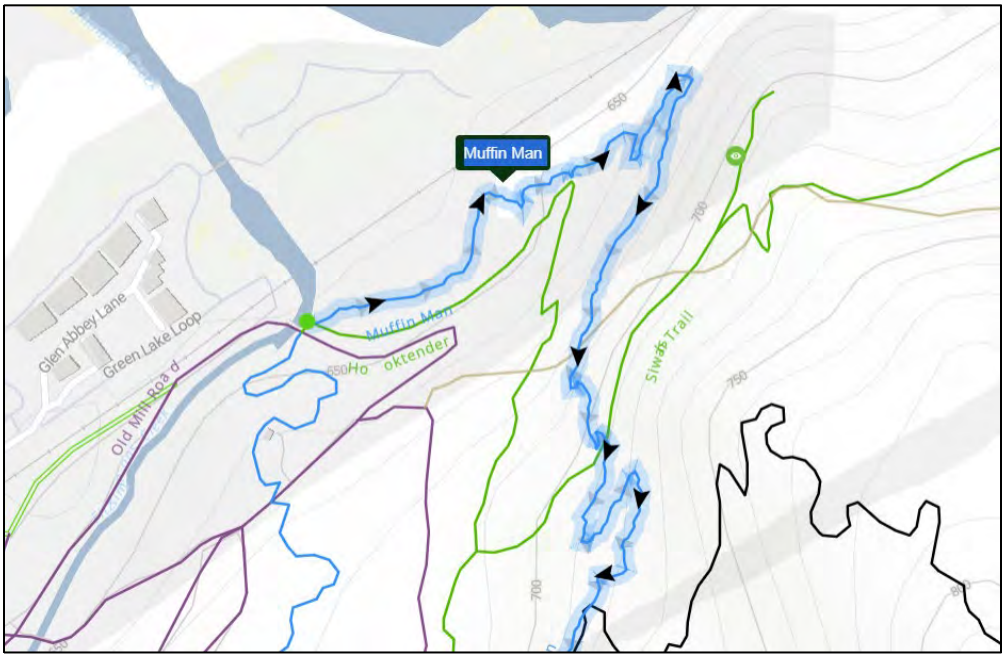


Photo 6-21. The new Muffin Man single-track bike trail built through the Fitzsimmons Back Channels.

7. Additional Species

Lead Biologist and Author: Bob Brett

7.1 Northern Goshawks

The population of BC's Northern Goshawks (*Accipiter gentilis*) has declined precipitously in recent years, at least partly due to the loss of old forest habitat (BC MFLNRO 2018). Two subspecies occur in British Columbia. Queen Charlotte Goshawk occurs in the Whistler area (*A. gentilis laingi*; MFLNRO and Madrone 2014, 2015; CDC 2020). [23] The other subspecies, *A. gentilis atricapillus*, occurs throughout the rest of BC and other parts of North America. Both subspecies of the Northern Goshawk are listed as species at risk. The *A.* laingi subspecies is Red-listed in BC (CDC 2020) and Threatened under the Canadian Species At Risk Act (Government of Canada 2020). The other subspecies of Northern Goshawk that occurs in BC, ssp. *atricapillus*, is Blue-listed in BC but considered Not At Risk by the Canadian Government (CDC 2020; Government of Canada 2020).

Northern Goshawks were selected by the Working Group (Brett 2018) for consideration as indicators within this RMOW Ecosystems Monitoring Program (EMP). The 2018 EMP report included an initial effort towards compiling and updating current knowledge about goshawks within the RMOW to help assess how or whether they could be cost-effective indicators within the program. This section updates that information and also considers ways to include monitoring of Northern Goshawks in future years.

Available data includes 57 records of Northern Goshawk observed in Whistler since 2001 (Figure 7-1; Appendix F), including 11 new records from 2019. The BC Government has conducted or commissioned sporadic surveys for goshawks in Whistler since 2011 when they reported an active nest uphill and west of the current Whistler RV Park.[24] Surveys in advance of construction of an Independent Power Project (IPP) on Wedge Creek found active nests near Comfortably Numb Trail in 2014 and 2015 (MFLNRO and Madrone). Another active nest was recorded by this program in 2016 and 2017.

Goshawk surveys are time-consuming and require experienced biologists, especially when searching for new nests. While less-experienced surveyors can be used to monitor known nest sites, searching for new nests requires the surveyors to be able to distinguish calls and observations of goshawks from other raptors and also from mimics including Gray Jays (*Perisoreus canadensis*). In addition, knowledge of goshawk behaviour and the ability to detect goshawk feeding, whitewash, and other signs is important for maximizing the accuracy of the survey. These requirements mean that a comprehensive search for new nests in Whistler is outside the scope of the RMOW EMP.

An independent study in 2019 by the Association of Whistler-Area Residents for the Environment (Brett 2020) undertook the first attempt to do a comprehensive survey for goshawks in Whistler. It was able to confirm juvenile calls near the 2014 Comfortably Numb nest that showed a breeding pair was still active in 2019 (Photo 7-1). Several anecdotal reports of goshawk sightings in that area Figure 7-1; Appendix G) may

---

[23] *See Brett (2020) for an update and discussion of the taxonomic and conservation status of Northern Goshawk.*

[24] *BC Conservation Data Centre (CDC) Species Occurrence Report Shape ID 106601. This area was recorded as Brew Creek.*

have been associated with that nest. Another concentration of goshawk sightings occurred in the Kadenwood area, near enough to the 2016-17 nest to suggest a second breeding pair still resides near there. Even if there was a breeding pair there, it is unknown if it successfully bred in 2019.

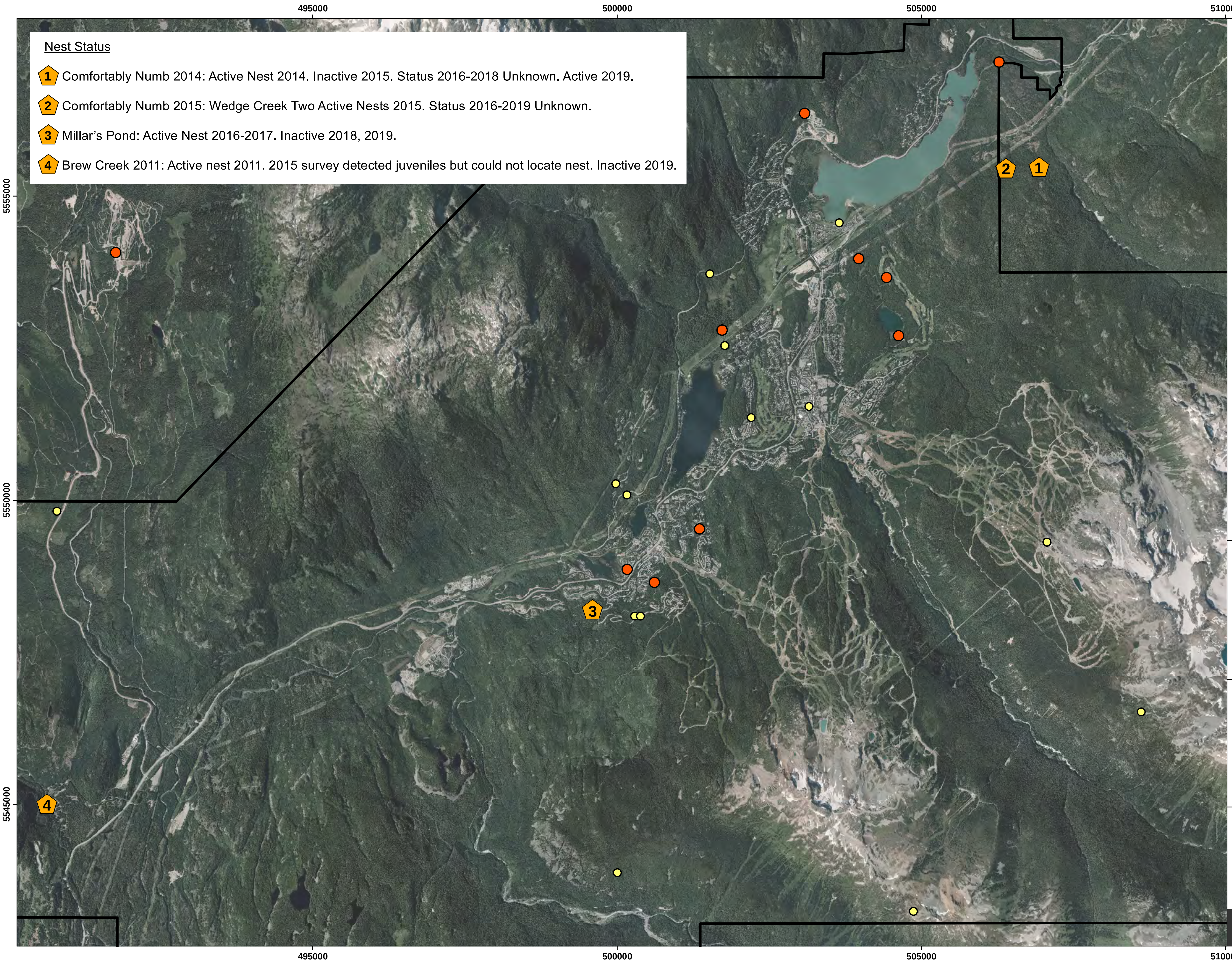
Photo 7-1. Northern Goshawk habitat near Comfortably Numb Trail, west of Wedge Creek: (left) large, wide-spaced trees, open flyways and access to the forest floor typical of excellent goshawk habitat; (right) juveniles were detected near this nest in 2019 which was last active in 2014 (Brett 2020).

The last point is important since a sustainable local population of goshawks requires breeding pairs as well as suitable habitat, for both nesting and foraging. Based on research, the ideal goshawk habitat in Whistler is in old forests that have characteristics not found in other habitats including: (a) large, tall trees with abundant potential nest platforms; (b) wide tree spacing and open flyways to facilitate hunting under the canopy; and (c) relatively unobstructed access to potential prey on the forest floor (Brett 2020;Figure 7-1). Brett (2020) mapped how logging since 2011 has reduced known and potentially available goshawk habitat near Comfortably Numb Trail and the Whistler RV Park ("Brew Creek"). It also raised questions about the future viability of the Miller's Pond site that is currently very close to zoning for a large housing development proposed in the RMOW draft OCP.[25]

Monitoring Northern Goshawks in Whistler remains a priority, even if the cost and effort remain a challenge. One benefit of outside research (e.g., Brett 2020 and also cooperation with BC Government biologists) is that, once located, less effort is required to monitor known nests.

---

[25] https://www.whistler.ca/ocp



Nest Status

1 Comfortably Numb 2014: Active Nest 2014. Inactive 2015. Status 2016-2018 Unknown. Active 2019.

2 Comfortably Numb 2015: Wedge Creek Two Active Nests 2015. Status 2016-2019 Unknown.

3 Millar's Pond: Active Nest 2016-2017. Inactive 2018, 2019.

4 Brew Creek 2011: Active nest 2011. 2015 survey detected juveniles but could not locate nest. Inactive 2019.

Legend

⬟ Nest

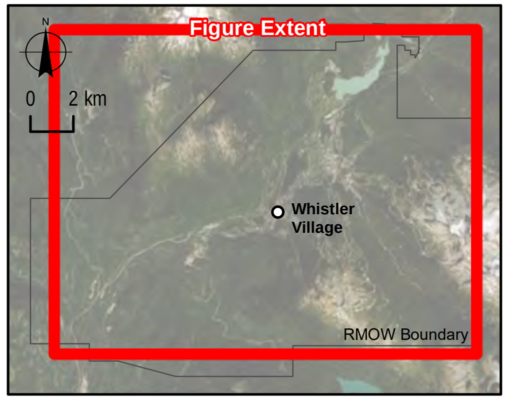
● Sighting *2019*

○ Sighting (Includes Non-Visual IDs) *2001-2018*

▭ RMOW Boundary

Notes:
(1) Nest and sighting location source - www.eBird.org; MFLNRO and Madrone 2014, 2015; and B. Brett, unpubl. data
(2) Orthoimagery (2014) provided by RMOW.

Contains information licensed under the Open Government Licence - British Columbia. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



DRAWN: B. Elder
CHECKED: B. Brett
PROJECT: 1602505
DATE: Jan 15, 2020

Scale 1:60000
UTM Zone 10N
NAD 1983

Palmer™

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2019

Northern Goshawk records from the Whistler area since 2001

FIGURE 7-2

Document Path: C:\Egnyte\Shared\Projects\Active\16025 - Resort Municipality of Whistler\1602505 - 2019 Annual Monitoring\Mapping\Figures\5_ArcGIS\1602505_Figure_NorthernGoshawk.mxd

7.2 Western Toads

The RMOW Environmental Stewardship department has monitored amphibian populations at the south end of Whistler over the past decade, especially near the Cheakamus Crossing neighbourhood. In that time, the only annual breeding site confirmed for Western Toads has been at Lost Lake. Given the number of anecdotal reports of juvenile and adult toads at the south end of Whistler, it seems reasonable to assume there would be one or more annually-used breeding sites in that part of the RMOW as well. One site was chosen by the RMOW to survey in 2018 as part of the effort to test this hypothesis: a pond on the northwest corner of the entrance from Highway 99 to the Callaghan Forest Service Road (UTM 493120E 5546435N, elevation 512m) No toads or other amphibians were detected in two shore surveys that year. The work plan for 2019 included re-surveys at that pond which occurred on May 22 and 23 (Photo 7-2) again with no detections.

Photo 7-2. The pond surveyed for Western Toads and other amphibians on May 22 and 23, 2019. This pond is on the northwest corner of the entrance from Highway 99 to the Callaghan Forest Service Road and is labelled as "1" in Figure 7-2.

There are many small wetlands near the Callaghan FSR pond, including two directly southwest and a third on the east side of the highway, south of the new Callaghan road (Figure 7-2). These ponds were assessed on May 22, 2019 for possible inclusion in future surveys. The artificial wetlands constructed in the Brandywine snowmobile parking lot (in 2009?) were also assessed.

Figure 7-2. Wetlands surveyed May 22-23, 2019 near the Callaghan River.

Ponds 2 and 3 (Figure 7-2)

These ponds were partially filled in during the widening of Highway 99 prior to the 2010 Olympics. The road bed falls very steeply into them (Photo 7-3) and access to them would be difficult, either by kayak or by foot. It nonethless may be worthwhile to attempt a kayak-based survey in 2020 survey.

Photo 7-3. The steep road bed beside wetland #2 (Figure 7-2) complicates access for amphibian surveys.

Photo 7-4. Kayak access for amphibian surveys is relatively easy at wetland #4 (Figure 7-2).

Pond 4 (Figure 7-2)

Kayak access to this larger pond is also somewhat difficult but definitely possible (Photo 7-4). Foot access around the perimeter of the pond is not advisable due to dense vegetation and rough terrain.

Brandywine Artificial Wetlands (Figure 7-2)

The Cheakamus Community Forest created appromately four shallow depressions as replacement wetlands in approximately 2009 (Photo 7-5). All but one are now covered by an extension of the parking lot. The remainder is covered by vegetation and is similarly non-wetland.

Photo 7-5. Small depressions were created in approximately 2009 in the Brandywine snowmobile parking lot (labelled "5" in Figure 7-2). Most of that area is now covered by an extension of the parking lot (middle left). The southmost depression is now completely grown over with vegetation.

Additional surveys would be worthwhile in 2020 and beyond to determine the location of toad breeding in the southern end of the RMOW.

7.3 Western Screech-Owls

A February 2018 video of a Western Screech-Owl inside a house on Alta Lake Road was circulated to BC Government biologists, including Kym Welstead. In May 2019, she organized the installation of two Autonomous Recording Units (ARUs) in the area. No detections of owls were reported and a report will be published by the end of March.[26] Kym Welstead expects to conduct additional surveys in 2020 and indicated willingness for cooperation.

7.4 Black Cottonwoods

Black cottonwoods (*Populus trichocarpa*), especially when large and old, provide important habitat for a wide range of organisms in Whistler. Mapping for a conservation ranking of species and habitats (Brett 2018) showed cottonwood forests are relatively uncommon in Whistler and generally concentrated in areas associated with valley bottom wetlands and riparian areas between Alta and Green Lakes. The Working Group assembled for this report prioritized black cottonwood as a priority species which should be considered for inclusion in future years of the RMOW Ecosystems Monitoring Program. The first step towards that goal was the initial analysis of the extent and distribution of cottonwood forests presented below.

The cottonwood map layer in Brett (2018) included all ecosystem polygons that contained cottonwoods (regardless of percent cover) and showed the age of trees within (<100 years, 100-250 years and >250 years). Conclusions from that report included:

1. The largest contiguous area mapped as containing cottonwoods (between Spruce Grove and Nicklaus North) appears to have been mostly developed since that mapping. Updated mapping from air photos and/or field-truthing may be required to determine the current extent of cottonwoods in that area.
2. The main areas with old (>250-years) cottonwoods are the Edgewater forest, Rebagliati Park north on the west edge of Fitzsimmons Creek to the wetlands south of Nancy Greene Drive (Photo 7-6. Large cottonwoods near the River Runs Through It (left) and Rebagliati Park (right). The tree on the right is approximately 300 years old (Brett and Ruddy, 2019). The tree on the left has not been cored but based on the age of other trees in the area, it is likely in the range of 100 years-old. Older trees are larger, have more complex branching and provide more habitat for more organisms, especially those that benefit from tree cavities.) and in riparian areas of the Cheakamus River upstream near the park entrance.
3. Significant components of younger cottonwoods occur in the River Runs Through It area Photo 7-6 and Photo 7-7), edges of both the River of Golden Dreams wetlands (Photo 7-8.), Millar Creek Wetlands and south of the development footprint in the riparian edges of Cheakamus River near the Sugar Cubes (across from the entrance to the Callaghan Forestry Service Road).

---

[26] *Kym Welstead, January 6, 2019 email to Bob Brett.*

The work plan for 2019 included the investigation of LIDAR as a way to more accurately map cottonwoods, even down to significant individual trees, but this was unsuccessful. Consultation with RMOW GIS Analyst Greg Thistle[27] revealed the RMOW's new LIDAR layer is not suitable for that use. As a result, field surveys combined with detailed orthophoto analysis would be required to develop better mapping of Whistler's cottonwoods. Perhaps the most promising option is the use of air photos that have been taken when cottonwoods turn yellow in fall (Photo 7-8). Unfortunately, air photos are normally taken earlier in the fall[28] which means another source for those photos would be needed.

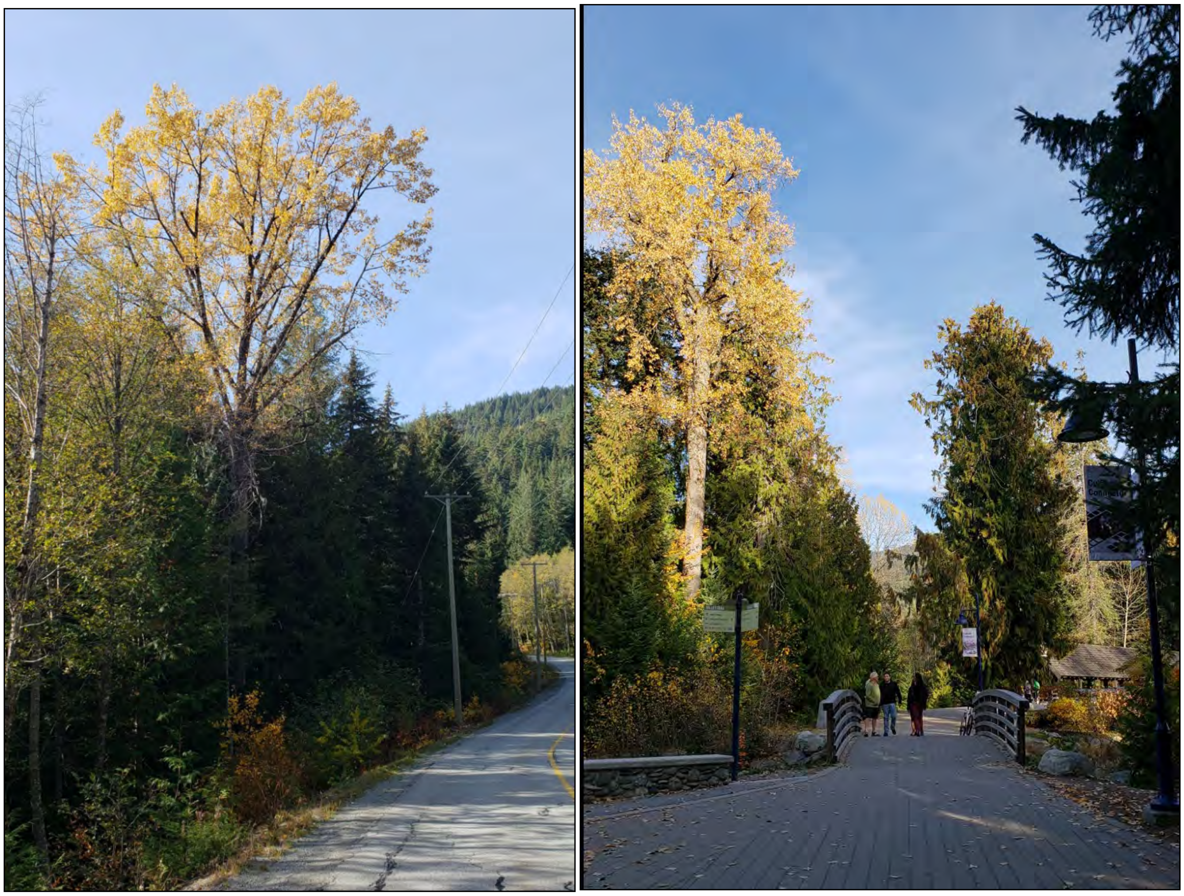


Photo 7-6. Large cottonwoods near the River Runs Through It (left) and Rebagliati Park (right). The tree on the right is approximately 300 years old (Brett and Ruddy, 2019). The tree on the left has not been cored but based on the age of other trees in the area, it is likely in the range of 100 years-old. Older trees are larger, have more complex branching and provide more habitat for more organisms, especially those that benefit from tree cavities.

---

[27] *By email to Bob Brett, December 3, 2019.*

[28] *Ibid.*

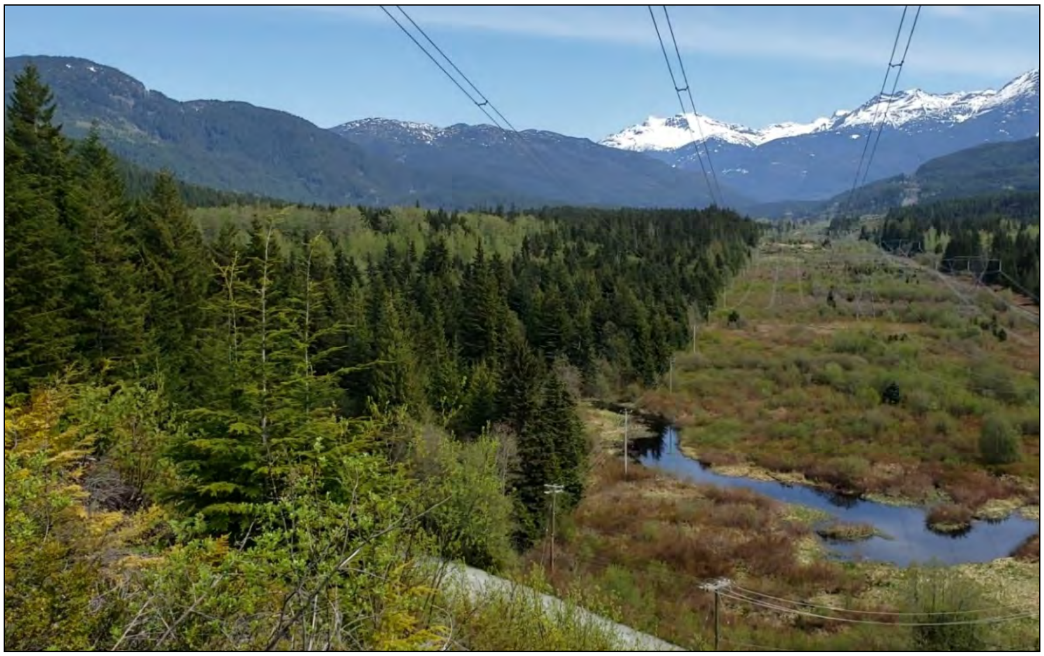


Photo 7-7. A cottonwood-dominated forest in the River Runs Through It area adjacent to 21 Mile Creek.

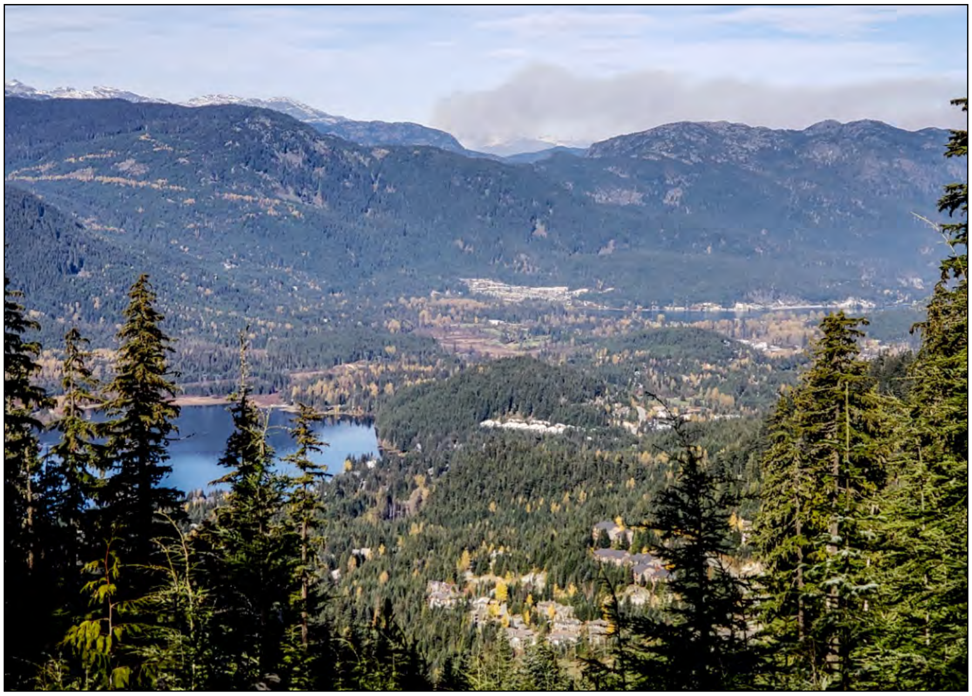


Photo 7-8. Cottonwoods are most visible after turning yellow in fall. This photo shows the view northward across Whistler Valley and highlights cottonwoods interspersed in developed areas, especially at low elevations of the wetland corridor in the mid background.

8. Climate Indicators

Lead Biologist and Author: Bob Brett

The timing and duration of ice on Alta Lake has been used as a climate indicator since the inception of the Ecosystems Monitoring Program. Cascade (2013) compiled data from two reporting periods: 1942 to 1975, and from spring 2002 to present. No data is known to have been recorded between those two periods. The current dataset is derived from the Alta Lake Ice Break Up Raffle, a fundraiser for The Point Artist-Run Centre.[29] The purpose of presenting and analyzing this data is to document how the timing and duration of ice on Alta Lake has changed over time to predict how it may change in the future.

Fifty years of data from 1942 through spring 2019 are presented as Appendix H. There has been a significant reduction in the duration of ice on Alta Lake between the early records and records since 2002 (Figure 8-1; Table 8-1). Nine of 10 of the winters with the longest duration of ice on Alta Lake were from the earlier dataset, and six of 10 of the winters with the shortest duration were from the current dataset (Appendix H). The median reduction in number of days that the lake was frozen between those two reporting periods was 23 days (average 27 days; Table 8-1). There has been less change in the date that Alta Lake freezes over (ice-on) than the date it thaws (ice-off). The median ice-on date is six days later in the recent dataset compared to earlier dataset: December 18th compared to December 12th. The median ice-off date for the recent dataset is April 10th compared to April 23rd for the earlier dataset, which represents a reduction of 13 days.

During the past winter, 2018-19, Alta Lake was frozen from January 1st to April 12th. While that 102 day duration was close to the average for the 2002-2019 period of records, it was still below the average of the earlier recording period. These two datasets provide convincing evidence of a changing climate that is consistent with other observations, for example, glacial recession within that same time. The conclusions would be stronger with more complete data from 1976 to 2001, and ideally data before 1942.

---

[29] *Annual data has been supplied by Stephen Vogler. The 2019 date was emailed by him on January 10, 2020.*

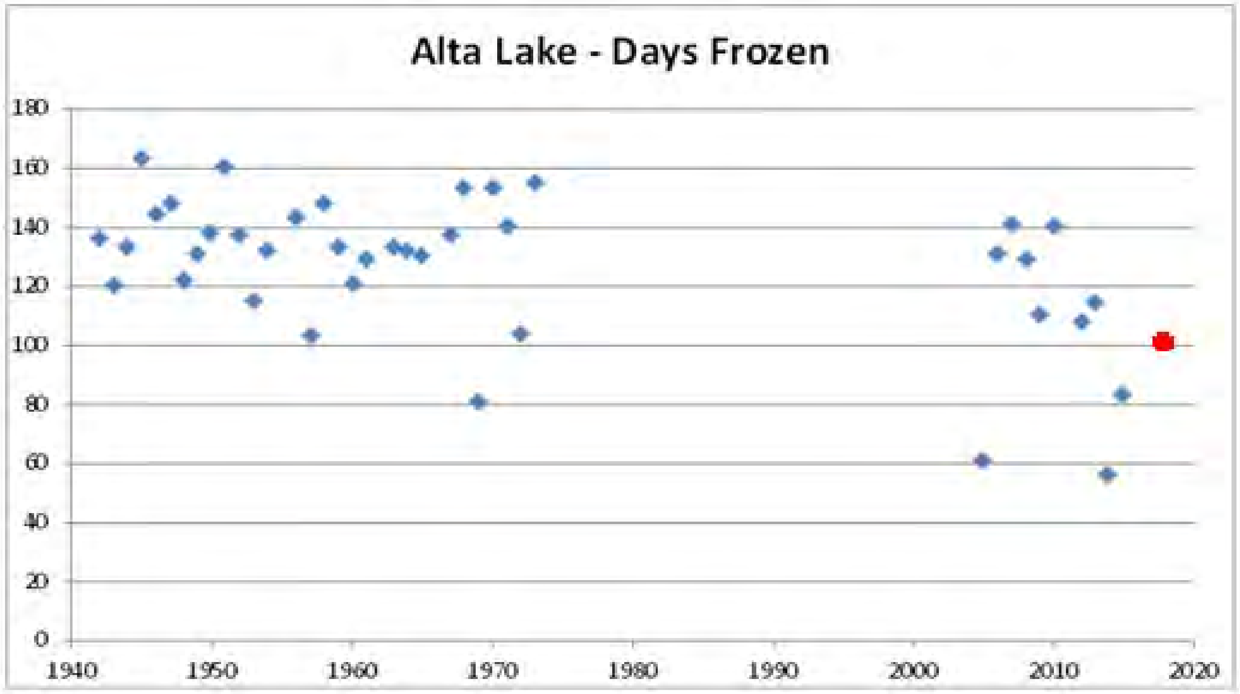


Figure 8-1. Ice records from Alta Lake from two datasets, 1942-1975 and 2002-2019. No data was recorded between those two periods.

Table 8-1. Ice records from Alta Lake from two datasets, 1942-1975 and 2002-2019. No data was recorded between these two periods. Some years did not record all data.

		Dataset				**Recent vs. Early Records**
		1942-1975		**2002-2018**		
		Date	**Day Count**	**Date**	**Day Count**	
Ice-On	Records	n/a	31	n/a	11	20 records fewer
	Earliest	8-Nov-45	312	30-Nov-06	334	22 days later
	Latest	15-Jan-70	380	6-Jan-06	371	9 days earlier
	Median	Dec. 12th	346	Dec. 18th	353	6 days later
	Average	Dec. 12th	346	Dec. 16th	351	5 days later
Ice-Off						
	Records	n/a	31	n/a	17	14 records fewer
	Earliest	23-Mar-63	82	20-Feb-15	51	31 days earlier
	Latest	21-May-52	142	29-Apr-08	120	22 days earlier
	Median	April 23rd	113	April 10th	100	13 days earlier
	Average	April 23rd	113	April 5th	95	18 days earlier
Days Frozen						
	Records	n/a	29	n/a	11	18 records fewer
	Median	n/a	133	n/a	110	23 days shorter
	Average	n/a	134	n/a	107	27 days shorter

9. Conclusions

9.1 Plain Language Summary

The Resort Municipality of Whistler (RMOW) is located in the southern Coast Mountains of British Columbia, approximately 100 km north of the city of Vancouver. For many years the RMOW has been concerned about describing and conserving biodiversity within the urban development footprint of the RMOW. To help address those concerns, an Ecosystem Monitoring Program (the Program) was initiated by the RMOW in 2013. The objective of the Program was to describe both the waters and lands within the RMOW and to find out if there have been changes over time that might indicate a loss, or possible loss, of biodiversity.

Because it is not possible to look at everything in an ecosystem, the Program design was based on the use of indicators to describe and look for changes in the waters and lands over time. These indicators have included plants, animals, and specific parts of the environment. For 2019, the most important indicators in the Program included surface water, sediment, benthic invertebrates, and the fish community in streams, and Coastal Tailed Frogs (*Ascaphus truei*) and beavers (*Castor canadensis*) in areas within streams and ponds. Additional indicators for 2019 included Northern Goshawks (*Accipiter gentilis laingi*), Western Toads (*Anaxyrus boreas*), Western Screech Owls (*Megascops kennicottii*), black cottonwoods (*Populus trichocarpa*), and the timing and duration of ice on Alta Lake.

The 2019 stream Program looked at the main indicators listed above for four of the streams located within the RMOW: Jordan Creek, Crabapple Creek, The River of Golden Dreams, and 21-Mile Creek. The Program included collection and description of surface water and sediment samples, benthic invertebrate samples, and fish in the four streams.

9.1.1 Surface Water and Sediment

For surface water samples both the water chemistry, physical conditions (pH, temperature, conductivity, oxygen), and sediment chemistry were described and compared with the British Columbia Water Quality Guidelines (BCWQG). The BCWQG are guidelines that have been established by the BC Government so that if guidelines are met, then the plants and animals that live in the water will be protected, but if guidelines are not met, then there is an increased risk to the health of the plants and animals that live in the water.

The 2019 results for surface waters showed that BCWQG were met for all the chemical and physical measurements except for aluminum in Crabapple Creek. For sediment there were a few measurements that did not meet the BCWQG, including copper in Jordan Creek, and arsenic and copper in Crabapple Creek. Overall, the 2019 Program showed that the chemical and physical conditions in Jordan Creek, Crabapple Creek, The River of Golden Dreams, and 21-Mile Creek were suitable for supporting the continued health of the animal and plant communities living in these streams.

9.1.2 Benthic Invertebrates

Benthic invertebrates are animals that live in the sediment of streams, rivers, ponds, and lakes. These animals are useful for describing the health and biodiversity of communities that live in surface waters because they are numerous, are found in almost all habitats, do not migrate, are sensitive to pollution, are easy to collect, and can be easily identified. For the benthic invertebrate samples collected in 2019, the benthic invertebrate community was described and then assessed using a weight-of-evidence approach using three different methods.

For the benthic invertebrate samples collected in 2019, the benthic invertebrate community was described and then compared with the Fraser Basin 2014 Reference Model as developed through the Canadian Biomonitoring Network (CABIN) Program within Environment Canada. The CABIN Program collects benthic invertebrate samples from many sites within a region and over time develops an understanding of what the benthic invertebrate community should look like in a pristine, reference stream or river. Benthic invertebrate samples from test sites, such as at Whistler, can then be compared with the reference samples. If the benthic invertebrate communities from a test site are comparable with the community from the reference sites, then the test sites are said to be in 'reference condition' and in good health. If the test sites are slightly unusual in comparison reference sites, they are assessed as 'mildly divergent', and if the tests sites are highly unusual then they are assessed as 'divergent' to 'highly divergent'.

The 2019 results showed that the benthic invertebrate community was in reference condition for The River of Golden Dreams and Jordan Creek, and mildly divergent for Crabapple Creek and 21-Mile Creek. Results from previous years were also variable, with all creeks either in reference or mildly divergent most of the time. A closer look at the benthic invertebrate community structure also showed that the benthic invertebrate communities in the four streams appeared healthy, with pollution-sensitive species present and abundant at all sites. The weight-of-evidence therefore indicated that the four creeks were unimpaired, although Jordan Creek was relatively borderline.

For the benthic invertebrate samples collected in 2019, the benthic invertebrate community was also described using the Hilsenhoff Index of Biotic Integrity (HIBI). The HIBI is calculated using tolerance scores, which have been developed over time by experts and relate to the response of benthic invertebrates to organic pollution. The HIBI scores range from 0 to 10, with a score of 0 indicating that a site is dominated by pollution-sensitive benthic invertebrates and that there is no apparent organic pollution at the site, and a score of 10 indicating that a site is dominated by pollution-tolerant benthic invertebrates. The HIBI is of interest because of the potential for organic pollution in an urban setting, including from stormwater runoff, septic tank leakage, fertilizer runoff, and/or wildlife waste.

The 2019 results indicated that the benthic invertebrate community was in good to very good condition within the four streams that were assessed, with the potential for some slight amount organic pollution. Including the CABIN assessment, these results will be tested again in 2020 to find out if there have been any consistent changes over time that might be of concern.

9.1.3 Fish

A total of 179 fish were captured during the 2019 electrofishing and minnow trap efforts. As with previous years, three species of fish were captured in 2019: Threespine Stickleback (*Gasterosteus aculeatus*), undifferentiated trout fry from resident populations of Rainbow Trout (*Oncorhynchus mykiss)* and Coastal Cutthroat Trout (*O. clarkii clarkii),* and sculpin (*Cottus* sp.). The fish communities within the sampled creeks were inhabited by 0+ year fry and juvenile trout, demonstrating the importance of the four creeks as rearing and feeding habitat. The condition of the fish was generally good in 2019, in keeping with previous years: there were no differences in the length/weight relationship between sites.

The results of the 2019 Ecosystem Monitoring Program showed that Jordan Creek, Crabapple Creek, The River of Golden Dreams, and 21-Mile Creek had healthy benthic invertebrate and fish communities and that the 2019 results were consistent with earlier results collected in 2016, 2017, and 2018.

9.1.4 Coastal Tailed Frogs

Fifteen sites were surveyed for Coastal Tailed Frogs (Ascaphus truei) in 2019 with a continued emphasis on previously unsurveyed creeks on the west side of Whistler Valley (Van West Creek, Sproatt Creek, and “FJ West Creek”). No evidence of negative impacts was detected at any creek, including the two on Whistler Mountain which could potentially be impacted by ski and mountain bike activities (Whistler Creek and Archibald Creek).

Mapping irregularities were discovered at lower elevations of the west-side creeks during 2018 tailed frog surveys. Further investigation in 2019 located where Sproatt Creek is diverted underground upstream of the CN Rail tracks (which is why it is dry downstream in low flows). It also confirmed that a branch mapped southeast to Alpha Lake is currently dry since there is no connection with the main stream. Evidence of extensive flooding and stream diversion on FJ West Creek was traced to a storm in November 2017. As a result, the RMOW’s stream mapping in that area is no longer correct.

9.1.5 Beavers

The primary goal for beaver (Castor canadensis) monitoring since 2016 has been to establish a full survey of Whistler’s active lodges. Work in 2019 built on past years and resulted in the most comprehensive beaver survey to date. More active lodges were recorded than ever before (27), mainly due to determined efforts to fully access the Miller Creek Wetlands. A total of eight lodges were detected (compared to two in 2018) which confirmed for the first time that the Miller Creek Wetlands provide beaver habitat as significant as the River of Golden Dreams (where seven lodges were found).

Based on number of beavers per lodge, the beaver population is now estimated to be 157 in Whistler Valley (low to high estimates range from 113 to 173 beavers). There was no direct evidence that lodges were lost due to development or other human activities in the past year. Valley Trail construction beside the Millar Creek Wetlands has apparently not prevented the large beaver population from thriving. Lowering of the water level in Alta Vista Pond by the RMOW Roads Department reduced the area of beaver habitat but that lodge nonetheless remains active. Beavers were detected near the western entrance of Lost Lake Park in 2018 but not in 2019. It possible that the new Muffin Man bike trail had a negative impact on beavers, but no direct evidence of this was detected. Based on 2019 observations, Whistler's beaver therefore appears to be stable.

The total area of beaver-affected wetlands in 2019 was estimated at 100.3 hectares, or approximately two-thirds the total area of Whistler's wetlands. This total includes six hectares added in 2019; field surveys revealed more beaver-caused flooding in the Miller Creek Wetlands than was mapped in 2018 from air photos. The total area of beaver-affected wetlands in Whistler can therefore be considered stable or possibly expanding slightly.

9.1.6 Other Indicators

Three exploratory indictors added to the program in 2018 were again included in 2019: Northern Goshawk (Accipiter gentilis laingi), Western Toad (Anaxyrus boreas), and black cottonwood (Populus trichocarpa). Recent breeding of Northern Goshawks has been sporadically documented since 2011 in Whistler's unlogged forests at low elevations. There were 11 records of goshawks, including evidence of breeding near Comfortably Numb Trail. Based on a concentration of visual records between Whistler Creekside and Kadenwood, it is possible there was a second pair in 2019 there but no evidence of breeding was reported. No evidence of breeding of Western Toads has been recently found south of Lost Lake, including in 2019. Several new ponds adjacent to Highway 99 in the Callaghan Creek area were confirmed to be suitable for inclusion in 2020 surveys. A plan to improve the mapping of black cottonwoods in Whistler Valley using the RMOW's new LIDAR layer was unsuccessful which means field surveys will be needed instead.

10. Certification

This report was prepared and reviewed by the undersigned:

Prepared By:

Bob Brett

Bob Brett, M.Sc., R.P.Bio.
Forest Ecologist and Conservation Biologist

Prepared By:

Cgomez

Crisostomo Gomez, M.Sc., R.P.Bio.
Aquatic Biologist

Prepared By:

Erin Donkers.

Erin Donkers, PG [ER]
Aquatic Ecologist

Prepared By:

Dave Huebert, Ph.D., P.Biol., R.P.Bio.
Senior Environmental Scientist

Approved By:

Irene Tuite

Irene Tuite, M.Sc., P.Bio
Senior Aquatic Ecologist

11. References

Adams, Ian and J. Hobbs. 2016. Rocky Mountain environmental DNA inventory – year three (2016). Vast Resource Solutions, Cranbrook BC, and Hemmera Envirochem Inc., Vancouver BC. Contract report for BC Min. For., Lands, and Nat. Res. Ops., Victoria, BC. 19pp + app.

Askey, Ethan, Bob Brett, and Linda Dupuis. 2008. A proposed framework for the use of ecological data in monitoring and promoting the conservation of biodiversity in Whistler. Golder Associates Ltd., Squamish, BC. Contract report prepared for the Resort Municipality of Whistler. 36 pp. plus appendices.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition. EPA 841-B-99-002. 339pp.

Baumsteiger, J., D. Hankin, and E. J. Loudenslager. 2005. Genetic analyses of juvenile steelhead, coastal cutthroat trout, and their hybrids differ substantially from field identifications. Transactions of the American Fisheries Society 134:829–840.

Beals, E.W. 1984. Bray-Curtis Ordination: An Effective Strategy for Analysis of Multivariate Ecological Data. Adv. Ecol. Res. 14: 1-55.

Bowman, M.F., and K.M. Somers. 2005. Considerations when Using the Reference Condition Approach for Bioassessment of Freshwater Ecosystems. Water Qual. Res. J. Canada: 40: 347-360.

BC Ministry of Environment (ENV). 1997. UTM: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/dissolvedoxygen-or.pdf. Accessed January 23, 2020.

BC Ministry of Environment (ENV). 2015. Management plan for the Coastal Tailed Frog (*Ascaphus truei*) in British Columbia. B.C. Ministry of Environment, Victoria, BC. 49 pp. URL: http://a100.gov.bc.ca/pub/eirs/finishDownloadDocument.do?subdocumentId=10303.

BC Ministry of Environment, Lands and Parks Resources Inventory Branch (BC MELP). 2000. Inventory Methods for Tailed Frog and Pacific Giant Salamander. Standards for Components of British Columbia's Biodiversity No. 39. Version 2. Ministry of Environment, Lands and Parks. Victoria, BC.

BC Ministry of Environment (ENV). 2018. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Summary Report. British Columbia Ministry of Environment

BC Ministry of Forests, Lands, and Natural Resource Operations. 2017a. Sport Fish of BC – Coastal Cutthroat Trout. URL: http://www.env.gov.bc.ca/fw/fish/sport_fish/#CoastalCutthroatTrout. Accessed January 23, 2020.

BC Ministry of Forests, Lands, and Natural Resource Operations. 2017b. Bull Trout (*Salvelinus confluentus*). URL: http://www.env.gov.bc.ca/omineca/esd/faw/bulltrout/. Accessed January 23, 2020.

Brett, Bob and Claire Ruddy. 2019. Old and Ancient Trees in Whistler. Snowline Ecological Research and Association of Whistler-Area Residents for the Environment (AWARE), Whistler, BC. Double-sided map.

Brett, Bob and Claire Ruddy. In prep. Old and Ancient Trees in Whistler. Snowline Ecological Research and Association of Whistler-Area Residents for the Environment (AWARE), Whistler, BC. Double-sided map.

Brett, Bob. 2007. Whistler Biodiversity Project -- Progress report and provisional checklists. Whistler Biodiversity Project, Whistler, BC. 101 pp.

Brett, Bob. 2015. Whistler Biodiversity Project – progress report. Whistler Biodiversity Project, Whistler, BC. 7 pp.

Brett, Bob. 2018. Species and Habitat Priorities for Biodiversity Conservation in the Resort Municipality of Whistler. Snowline Ecological Research, Whistler BC, and Palmer Environmental Consulting Group, Vancouver, BC. Contract report prepared for the Resort Municipality of Whistler.

Brett, Bob. 2019. Species and Ecosystems at Risk in the Resort Municipality – 2019 Update. Whistler Biodiversity Project, Whistler, BC. Contract report prepared for the Resort Municipality of Whistler. 43 pp.

Brett, Bob. 2020. Northern Goshawk Surveys in Whistler's Old Forests. Whistler Biodiversity Project, Whistler, BC. Contract report for the Association of Whistler-Area Residents for the Environment and the Community Foundation of Whistler. 23 pp.

Brett, Bob. In prep. Species and Ecosystems at Risk in the Resort Municipality –2018 Update. Whistler Biodiversity Project, Whistler, BC. Contract report prepared for the Resort Municipality.

British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BCMFLNRO). 2018. Implementation plan for Northern Goshawk, *laingi* subspecies in British Columbia. Victoria, BC. 23 pp.

British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BCMFLNRO). 2018. Implementation plan for Northern Goshawk, *laingi* subspecies in British Columbia. Victoria, BC. 23 pp.

CCME. 2014. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Canadian Council of Ministers of the Environment. http://ceqg-rcqe.ccme.ca/en/index.html#void

Cascade Environmental Resource Group (Cascade). 2014. RMOW Ecosystem Monitoring Program 2013. Contract report for the Resort Municipality of Whistler, Whistler, BC. 78 pp. plus appendices.

Cascade Environmental Resource Group (Cascade). 2015. RMOW Ecosystem Monitoring Program 2014. Contract report for the Resort Municipality of Whistler, Whistler, BC. 75 pp. plus appendices.

Cascade Environmental Resource Group (Cascade). 2016. RMOW Ecosystem Monitoring Program 2015. Contract report for the Resort Municipality of Whistler, Whistler, BC. 65 pp. plus appendices.

Conservation Data Centre (CDC). 2020. B.C. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria B.C. Accessed January 8, 2020. URL: http://a100.gov.bc.ca/pub/eswp/.

Corkran, C.C. and C. Thoms. 1996. Amphibians of Oregon, Washington and British Columbia. Lone Pine Publishing, Vancouver, B.C. 175 pp.

Environment and Climate Change Canada (ECCC). 2011. Canadian aquatic biomonitoring network: wadable streams field manual.

Government of Canada. 2020. Species at Risk Public Registry. Government of Canada, Ottawa, ON. URL: https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm. Accessed January 8, 2020.

Hobbs, Jared and Caren Goldberg. 2017. Environmental DNA protocol for freshwater aquatic systems. Hemmera Envirochem Inc., Vancouver, BC. Contract report prepared for the BC Ministry of Environment, Victoria, BC. 32 pp.

Invasive Species Council of BC (ISCBC) 2017. URL: https://bcinvasives.ca/ Accessed on January 15, 2020.

Johnson, D. H., B. M. Shrier, J. S. O'Neal, J. A. Knutzen, X. Augerot, T. A. O'Neil, and T. N. Pearsons. 2007. Salmonid field protocols handbook: Techniques for assessing status and trends in salmon and trout populations. Maryland: American Fisheries Society.

Johnston, N. T., and P. A. Slaney. 1996. Fish habitat assessment procedures. Watershed Restoration Technical Circular No. 8. Ministry of Environment, Lands and Parks and Ministry of Forests. Vancouver, BC.

Jones, Lawrence L.D., William P. Leonard and Deanna H. Olson (eds.). 2005. Amphibians of the Pacific Northwest. Seattle Audubon Society, Seattle, WA. 227 pp.

Leigh-Spencer, Sally. 2004. Wildlife species in the Resort Municipality of Whistler. Contract report prepared for BA Blackwell and Associates, North Vancouver, BC. 21 pp.

Malt, Josh, Danielle Courcelles, and Sarah Nathan. 2014a. Study Design and Field Methods: Guidance on Coastal Tailed Frog monitoring of run-of-river hydropower projects. Version 1.2, May 2014. Ministry of Forests, Lands, and Natural Resource Operations. 22 pp.

Malt, Josh, Danielle Courcelles, and Sarah Nathan. 2014b. Study Design and Field Methods: Guidance on Coastal Tailed Frog monitoring of run-of-river hydropower projects. Version 1.3, December 2014. Ministry of Forests, Lands, and Natural Resource Operations. 22 pp.

Matsuda, Brent M., David M. Green and Patrick T. Gregory. 2006. Amphibians and reptiles of British Columbia. Royal BC Museum, Victoria, BC. 266 pp.

McBlane, Lindsay. 2007. Connectivity changes in wetland ecosystems from 1946 to 2003 in the Resort Municipality of Whistler, British Columbia. Masters thesis, Simon Fraser University, Vancouver, BC. 77 pp.

McDermott, H., T. Paull, S. Strachan. 2014. Laboratory Methods: Processing, Taxonomy, and Quality Control of Benthic Macrinvertebrate Samples, Environment Canada. ISBN: 978-1-100-25417-3.

Ministry of Forests, Lands, and Natural Resources Operations and Madrone Environmental Services Ltd. (MFLNRO and Madrone). 2015. Northern Goshawk laingi inventory in the South Coast: 2015 field survey results. Victoria, BC. 11 pp.

Ministry of Forests, Lands, and Natural Resources Operations and Madrone Environmental Services Ltd. (MFLNRO and Madrone). 2015. Northern Goshawk laingi inventory in the South Coast: 2015 field survey results. Victoria, BC. 11 pp.

Mullen, Jory. 2008. Whistler Biodiversity Project preliminary beaver census – 2007. Whistler Biodiversity Project, Whistler, BC.

Mullen, Jory. 2009. Whistler Biodiversity Project beaver census – 2008. Whistler Biodiversity Project, Whistler, BC.

Müller-Schwarze, Dietland and Lixing Sun. 2003. The beaver: natural history of a wetlands engineer. Cornell University Press, Ithaca, NY. 190 pp.

Palmer Environmental Consulting Group and Snowline Ecological Research (Palmer and Snowline). 2017**.** Whistler Ecosystems Monitoring Program 2016. Palmer Environmental Consulting Group, Vancouver, BC, and Snowline Ecological Research, Whistler, BC. Contract report for the Resort Municipality of Whistler.

Palmer Environmental Consulting Group and Snowline Ecological Research (Palmer and Snowline). 2018**.** Whistler Ecosystems Monitoring Program 2017. Palmer Environmental Consulting Group, Vancouver, BC, and Snowline Ecological Research, Whistler, BC. Contract report for the Resort Municipality of Whistler.

Palmer Environmental Consulting Group and Snowline Ecological Research (Palmer and Snowline). 2019**.** Whistler Ecosystems Monitoring Program 201. Palmer Environmental Consulting Group, Vancouver, BC, and Snowline Ecological Research, Whistler, BC. Contract report for the Resort Municipality of Whistler.

Perrin, C. J., S.A. Bennett, S. Linke, A.J. Downie, G. Tamblyn,B. Ells, I. Sharpe, and R.C. Bailey. 2007. Bioassessment of streams in north-central British Columbia using the reference condition approach. Final report v.2a. March 31, 2007.

Pevec, Zuleika. 2009. Whistler Biodiversity Project beaver census – 2009. Whistler Biodiversity Project, Whistler, BC.

PNAMP. 2015. Pacific Northwest Aquatic Monitoring Partnership. www.pnamp.org

Racey, Kenneth and Ian McTaggart-Cowan. 1935. Mammals of the Alta Lake Region of South-Western British Columbia. Royal BC Museum 1935, Victoria, BC. 29 pp.

Resource Information Standards Committee (RISC). 2001. Reconnaissance (1:20 000) fish and fish habitat inventory: Standards and procedures. Victoria, B.C.

Rosenberg, D.M., T.B. Reynoldson, and V.H. Resh. 1999. Establishing Reference Conditions for Benthic Invertebrate Monitoring in the Fraser River Catchment, British Columbia, Canada. DOE-FRAP-1998-32. 169pp.

SAFIT. Southwest Association of Freshwater Invertebrate Taxonomists. www.safit.org.

Strachan, S., M. Edwards, T. Reynoldson, J. Bailey. 2014. Reference Model Supporting Documentation for CABIN Analytical Tools. Fraser Basin 2014 Model. 14 pp.

Sylvestre, Stephanie, Monique Fluegel and Taina Tuominen. 2005. Benthic invertebrate assessment of streams in the Georgia Basin using the reference condition approach: Expansions of the Fraser River invertebrate monitoring program 1998-2002. Environment Canada, Vancouver BC. EC/GB/o4/81.

Tayless, Emma and Julie Burrows. 2011. Whistler Biodiversity Project beaver census – 2009. Whistler Biodiversity Project and Resort Municipality of Whistler, Whistler, BC. Unpublished data.

Tayless, Emma. 2010. Whistler Biodiversity Project beaver census – 2009. Whistler Biodiversity Project, Whistler, BC.

Welsh, H.H., Jr. and L.M. Ollivier. 1998. Stream amphibians as indicators of ecosystem stress: A case study from California’s redwoods. Ecological Applications 8(4): 1118–1132.

Wind, E. 2005-2009. Whistler Biodiversity Project amphibian survey. Annual reports for the Whistler Biodiversity Project. Whistler, BC

Appendix A

Daily Stream Temperature Data

	Month	Year	month-year	BRB-DS_AQ010	Jordan Creek	River of Golden Dreams	Scotia Creek	Alpha Creek
Average	August	2018	Aug-18	14.229	17.012	11.939	11.364	10.499
	September	2018	Sep-18	9.775	11.565	7.734	7.162	6.36
	October	2018	Oct-18	5.811	7.597	5.619	5.265	4.796
	November	2018	Nov-18	3.921	3.332	2.554	0.842	1.811
	December	2018	Dec-18	1.622	2.04	1.365	0.189	1.321
	January	2019	Jan-19	1.601	1.494	0.977	-2.994	0.746
	February	2019	Feb-19	0.325	1.079	0.958	-1.327	0.55
	March	2019	Mar-19	1.647	2.703	2.89	1.953	1.718
	April	2019	Apr-19	4.176	7.063	4.491	3.905	2.871
	May	2019	May-19	7.542	9.731	5.609	6.579	6.438
	June	2019	Jun-19	11.143	13.664	9.751	10.544	9.621
	July	2019	Jul-19	12.848	16.381	12.524	12.46	10.574
MIN								
	August	2018	Aug-18	10.761	14.553	9.287	8.469	7.72
	September	2018	Sep-18	6.687	8.369	4.272	4.037	3.221
	October	2018	Oct-18	3.906	5.642	3.221	-0.088	1.967
	November	2018	Nov-18	2.021	0.88	0.522	-3.986	0.051
	December	2018	Dec-18	0.051	1.588	0.246	-2.859	0.051
	January	2019	Jan-19	-0.032	0.825	0.024	-10.898	0.024
	February	2019	Feb-19	-0.032	0.687	0.19	-4.987	0.218
	March	2019	Mar-19	-0.032	1.18	0.66	0.135	0.825
	April	2019	Apr-19	2.584	4.011	2.744	-0.255	1.534
	May	2019	May-19	3.722	7.167	3.354	3.063	2.903
	June	2019	Jun-19	7.242	11.516	5.565	5.308	6.94
	July	2019	Jul-19	10.59	14.146	9.854	6.763	8.02
MAX								
	August	2018	Aug-18	17.272	20.103	15.008	13.786	13.137
	September	2018	Sep-18	13.137	14.984	10.418	9.731	8.99
	October	2018	Oct-18	7.77	9.509	7.217	7.494	6.839
	November	2018	Nov-18	7.745	5.745	4.766	5.05	4.089
	December	2018	Dec-18	3.354	2.53	2.047	2.744	2.155
	January	2019	Jan-19	2.956	2.021	2.101	1.044	1.967

Month	Year	month-year	BRB-DS_AQ010	Jordan Creek	River of Golden Dreams	Scotia Creek	Alpha Creek
February	2019	Feb-19	2.503	1.967	2.047	0.273	0.907
March	2019	Mar-19	5.024	4.688	5.949	4.402	2.69
April	2019	Apr-19	7.192	10.956	7.116	7.77	5.076
May	2019	May-19	12.823	12.727	9.336	11.005	10.98
June	2019	Jun-19	14.266	16.915	13.666	14.96	11.516
July	2019	Jul-19	14.984	19.056	14.481	17.938	11.953

Appendix B

Benthic Invertebrate Taxonomy Results and CABIN Outputs

Methods and QC Report 2019

Project ID: Whistler 160255

Client: Palmer Environmental

Prepared by:
Cordillera Consulting Inc.
Summerland, BC

Unit 1, 13216 Henry Ave B1202
Summerland, BC, V0H 1Z0
www.cordilleraconsulting.ca

P: 250.494.7553
F: 250.494.7562

Table of Contents

Sample Reception

On August 21, 2019, Cordillera Consulting received 6 benthic samples from palmer Environmental. When samples arrived to Cordillera Consulting, exterior packaging was initially inspected for damage or wet spots that would have indicated damage to the interior containers.

Samples were logged into a proprietary software database (INSTAR1) where the clients assigned sample name was recorded along with a Cordillera Consulting (CC) number for cross-reference. Each sample was checked to ensure that all sites and replicates recorded on field sheets or packing lists were delivered intact and with adequate preservative. Any missing, mislabelled or extra samples were reported to the client immediately to confirm the total numbers and correct names on the sample jars. The client representative was notified of the arrival of the shipment and provided a sample inventory once intake was completed.
See table below for sample inventory:

Table 1: Summary of sample information including Cordillera Consulting (CC) number

Sample	Site Code	CC#	Date	Size	# of Jars
RGD-AQ11	RGD-AQ11	CC200370	7/30/2019	400µM	1
RGD-AQ11QA/QC	RGD-AQ11	CC200371	7/30/2019	400µM	2
CRB-DS-AQ01	CRB-DS-AQ01	CC200372	7/30/2019	400µM	2
RGD-DS-AQ12	RGD-DS-AQ12	CC200373	7/31/2019	400µM	1
JOR-DS-AQ31	JOR-DS-AQ31	CC200374	7/31/2019	400µM	1
21M-DS-AQ21	21M-DS-AQ21	CC200375	7/30/2019	400µM	1

Sample Sorting

- Using a gridded Petri dish, fine forceps and a low power stereo-microscope (Olympus, Nikon, Leica) the sorting technicians removed the invertebrates and sorted them into family/orders.
- The sorting technician kept a running tally of total numbers excluding organisms from Porifera, Nemata, Platyhelminthes, Ostracoda, Copepoda, Cladocera and terrestrial drop-ins such as aphids. These organisms were marked for their presence (given a value of 1) only and left in the sample. They were not included towards the 300-organism subsample count.
- Where specimens are broken or damaged, only heads were counted.
- Subsampling was conducted with the use of a Marchant Box.
- When using the Marchant box, cells were extracted at the same time in the order indicated by a random number table. If the 300th organism was found part way into sorting a cell then the balance of that cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted.
- The total number of cells sorted and the number of organisms removed were recorded manually on a bench sheet and then recorded into INSTAR1
- Organisms were stored in vials containing 80% ethanol and an interior label indicating the site names, date of sampling, site code numbers and portion subsampled. This information was also recorded on the laboratory bench sheet and on INSTAR1.
- The sorted portion of the debris was preserved and labeled separately from the unsorted portion and was tested for sorting efficiency (Sorting Quality Control – Sorting Efficiency). The unsorted portion was also labeled and preserved in separate jars.

Percent sub-sampled and total countable invertebrates pulled from the samples were summarized in the table below.

Table 2: Percent sub-sample and invertebrate count for each sample

Sample	Date	CC#	400 micron fraction	
			% Sampled	# Invertebrates
RGD-AQ11	30-Jul-19	CC200370	27%	320
RGD-AQ11QA/QC	30-Jul-19	CC200371	100%	6
CRB-DS-AQ01	30-Jul-19	CC200372	10%	350
RGD-DS-AQ12	31-Jul-19	CC200373	23%	313
JOR-DS-AQ31	31-Jul-19	CC200374	35%	328
21M-DS-AQ21	30-Jul-19	CC200375	18%	323

Sorting Quality Control - Sorting Efficiency

As a part of Cordillera's laboratory policy, all projects undergo sorting efficiency checks.

- As sorting progresses, 10% of samples were randomly chosen by senior members of the sorting team for resorting.
- All sorters working on a project had at least 1 sample resorted by another sorter.
- An efficiency of 90 % was expected (95% for CABIN samples).
- If 90/95% efficiency was not met, samples from that sorter were resorted.
- To calculated sorting efficiency the following formula was used:

$$\frac{\#Orgamisms\ Missed}{Total\ Organisms\ Found} * 100 = \%OM$$

Table 3: Summary of sorting efficiency

				Total from Sample	**Percent Efficiency**
Site - QC, Sample - QC1, CC# - CC200375, Percent sampled = 18%, Sieve size = 400					
Ephemeroptera		1			
Total:		**1**		**323**	**100%**

Taxonomic Effort

The next procedure was the identification to genus-species level where possible of all the organisms in the sample.

- Identifications were made at the genus/species level for all insect organisms found including Chironomidae (Based on CABIN protocol).
- Non-insect organisms (except those not included in CABIN count) were identified to genus/species where possible and to a minimum of family level with intact and mature specimens.
- The Standard Taxonomic Effort lists compiled by the CABIN manual[1], SAFIT[2] , and PNAMP[3] were used as a guide line for what level of identification to achieve where the condition and maturity of the organism enabled.
- Organisms from the same families/order were kept in separate vials with 80% ethanol and an interior label of printed laser paper.
- Chironomidae was identified to genus/species level where possible and was aided by slide mounts. CMC-10 was used to clear and mount the slide.
- Oligochaetes was identified to family/genus level with the aid of slide mounts. CMC-10 was used to clear and mount the slide.
- Other Annelida (leeches, polychaetes) were identified to the family/genus/species level with undamaged, mature specimens.

- Mollusca was identified to family and genus/species where possible
- Decapoda, Amphipoda and Isopoda were identified at family/genus/species level where possible.
- Bryozoans and Nemata remained at the phylum level
- Hydrachnidae and Cnidaria were identified at the family/genus level where possible.
- When requested, reference collections were made containing at least one individual from each taxa listed. Organisms represented will have been identified to the lowest practical level.
- Reference collection specimens were stored in 55 mm glass vials with screw-cap lids with polyseal inserts (museum quality). They were labeled with taxa name, site code, date identified and taxonomist name. The same information was applied to labels on the slide mounts.

Taxonomy Notes: Baetis tricaudatus group has now been renamed to Baetis rhodani group. There has been no change in the determination of the taxa. See Webb 2017 in the taxonomy keys.

Taxonomists

The taxonomists for this project were certified by the Society of Freshwater Science (SFS) Taxonomic Certification Program at level 2 which is the required certification for CABIN projects:

Scott Finlayson: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae (East/West); Group 4 Oligochaeta
Adam Bliss: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae
Rita Avery: Group 1 General Arthropods (East/West); Group 2 EPT (East/West)

Taxonomic QC

Taxonomic QC was performed in house by someone other than the original taxonomist.

- Quality control protocol involved complete, blind re-identification and re-enumeration of at least 10% of samples by a second SFS-certified taxonomist.
- Samples for taxonomic quality control were randomly selected and quality control procedures were conducted as the project progresses through the laboratories.

- The second (QC) taxonomist will calculate and record four types of errors:
    1. Misidentification error
    2. Enumeration error
    3. Questionable taxonomic resolution error
    4. Insufficient taxonomic resolution error

The QC coordinator then calculates the following estimates of taxonomic precision.

1. The percent total identification error rate is calculated as:

$$\frac{Sum\ of\ incorrect\ identifications}{total\ organisms\ counted\ in\ audit} * (100)$$

The average total identification error rate of audited samples did not exceed 5%. All samples that exceed a 5% error rate were re-evaluated to determine whether repeated errors or patterns in error contributed.

2. The percent difference in enumeration (PDE) to quantify the consistency of specimen counts.

$$PDE = \frac{|n_1 - n_2|}{n_1 + n_2} x100$$

3. The percent taxonomic disagreement (PTD) to quantify the shared precision between two sets of identifications.

$$PTD = \left(1 - \left[\frac{a}{N}\right]\right) x100$$

4. Bray Curtis dissimilarity Index to quantify the differences in identifications.

$$BC_{ij} = 1 - \frac{2C_{ij}}{S_j + S_i}$$

Error Summary

All samples report errors within the acceptable limits for CABIN Laboratory methods (less than 5% error).

Table 4: Summary of taxonomic error following QC

Site	Taxa Identified	% Error	PDE	PTD	Bray - Curtis Dissimilarity index
Site - 2019, Sample - RGD-AQ11, CC# - CC200370, Percent sampled = 27%, Sieve size = 400	319	0.31	0.15649452	2.1875	0.02034429

There will always be disagreements between taxonomists regarding the degree of taxonomic resolution in immature specimens and when laboratories make use of different keys for certain groups (Mollusks is an especially disputed group). It is always possible that some taxa found by the original taxonomist were overlooked in QC.

All of the Taxonomic QC samples that were observed passed testing according to the CABIN misidentification protocols. See the tables below for results from taxonomic QC audit.

Error Rationale

Site - 2019, Sample - RGD-AQ11, CC# - CC200370, Percent sampled = 27%, Sieve size = 400	Laboratory Count	QC Audit Count	Agreement	Misidentification	Questionable Taxonomic Resolution	Enumeration	Insufficient Taxonomic Resolution	Comments
Oreodytes	2	2						
Chironomidae	1	1						
Microtendipes	1	1						
Polypedilum	1	1						
Micropsectra	6	5	No			X		
Tanytarsus	1	2	No	1		X		From Micropsectra
Eukiefferiella	4	4						
Tvetenia	1	1						
Tanypodinae	1	1						
Thienemannimyia group	1	1						
Simuliidae	1	1						
Helodon	1	1						
Simulium	52	52						
Ameletus	14	14						
Baetidae	17	17						
Dicranota	1	1						
Baetis	21	22	No			X		
Drunella grandis group	1	1						
Drunella spinifera	1	1						
Heptageniidae	13	17	No			X		
Cinygmula	20	16	No			X		
Epeorus	29	29						
Rhithrogena	7	7						
Leptophlebiidae	2	2						
Capniidae	5	5						
Chloroperlidae	6	6						
Sweltsa	22	22						
Malenka	1	1						
Zapada	3	3						
Zapada columbiana	1	1						
Perlidae	3	3						
Calineuria californica	1	1						

Megarcys	1	1						
Perlodidae	2	2						
Rhyacophila angelita group	1	1						
Crangonyx	4	4						
Atractides	3	3						
Sperchon	6	5	No			X		
Doroneuria	1	1						
Baetis rhodani group	59	58	No			X		
Tubificinae with hair chaetae	1	1						
Tubificinae without hair chaetae	1	1						
Total:	**320**	**319**						
					0	**7**	**0**	
% Total Misidentification Rate =	misidentifications	x100	0.31	**Pass**				
	total number	=						

References

[1] McDermott, H., Paull, T., Strachan, S. (May 2014). Laboratory Methods: Processing, Taxonomy, and Quality Control of Benthic Macroinvertebrate Samples, Environment Canada. ISBN: 978-1-100-25417-3

[2] Southwest Association of Freshwater Invertebrate Taxonomists. (2015). www.safit.org

[3] Pacific Northwest Aquatic Monitoring Partnership (Accessed 2015). www.pnamp.org

Taxonomic Keys

Below is a reference list of taxonomic keys utilized by taxonomists at Cordillera Consulting. Cordillera taxonomists routinely seek out new literature to ensure the most accurate identification keys are being utilized. This is not reflective of the exhaustive list of resources that we use for identification. A more complete list of taxonomic resources can be found at Southwest Association of Freshwater Invertebrate Taxonomists. (2015). http://www.safit.org/Docs/SAFIT_Taxonomic_Literature_Database_1_March_2011.enl

Brook, Arthur R. and Leonard A. Kelton. 1967. Aquatic and semiaquatic Heteroptera of Alberta, Saskatchewan and Manitoba (Hemiptera) Memoirs of the Entomological Society of Canada. No. 51.

Brown HP & White DS (1978) Notes on Seperation and Identification of North American Riffle Beetles (Coleoptera: Dryopidea: Elmidae).Entomological News 89 (1&2): 1-13

Clifford, Hugh F. 1991. Aquatic Invertebrates of Alberta. University of Alberta Press Edmonton, Alberta.

Epler, John. 2001 The Larval Chironomids of North and South Carolina. http://home.earthlink.net/~johnepler/

Epler, John. Identification Manual for the Water Beetles of Florida. http://home.earthlink.net/~johnepler/

Epler, John. Identification Manual for the Aquatic and Semi-aquatic Heteroptera of Florida. http://home.earthlink.net/~johnepler/

Trond Andersen, Peter S. Cranston & John H. Epler (Eds) (2013) Chironomidae of the Holarctic Region: Keys and DIagnoses. Part 1. Larvae. *Insect Systematics and Evolution Supplements* 66: 1-571.

Jacobus, Luke and Pat Randolph. 2005. Northwest Ephemeroptera Nymphs. Manual from Northwest Biological Assessment Working Group. Moscow Idaho 2005. Not Published.

Jacobus LM, McCafferty WP (2004) Revisionary Contributions to the Genus Drunella (Ephemeroptera : Ephemerellidae). Journal of the New York Entomological Society 112: 127-147

Jacobus LM, McCafferty WP (2003) Revisionary Contributions to North American Ephemerella and Serratella (Ephemeroptera : Ephemerellidae). Journal of the New York Entomological Society 111 (4): 174-193.

Kathman,R.D., R.O. Brinkhurst. 1999. Guide to the Freshwater Oligochaetes of North America. Aquatic Resources Center, College Grove, Tennessee.

Larson, D.J., Y. Alarie, R.E. Roughly.2005. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Neararctic Region. NRC-CNRC Research Press. Ottawa.

Merritt, R.W., K.W. Cummins, M. B. Berg. (eds.). 2007. An introduction to the aquatic insects of North America, 4th. Kendall/Hunt, Dubuque, IA

Morihara DK, McCafferty WP (1979) The Baetis Larvae of North American (Ephemeroptera: Baetidae). Transactions of the American Entomological Society 105: 139-221.

Needham, James, M. May, M. Westfall Jr. 2000. Dragonflies of North America. Scientific Publishers. Gainsville FL.

Prescott David, R.C.and Medea M. Curteanu.2004. Survey of Aquatic Gastropods of Alberta. Species at Risk Report No. 104. ISSN: 1496-7146 (Online Edition)

Needham, K. 1996. An Identification Guide to the Nymphal Mayflies of British Columbia. Publication #046 Resource Inventory Committee, Government of British Columbia.

Oliver, Donald R. and Mary E. Roussel. 1983. The Insects and Arachnids of Canada Part 11. The Genera of larval midges of Canada. Biosystematics Research Institute. Ottawa, Ontario. Research Branch, Agriculture Canada. Publication 1746.

Proctor, H. The ‘Top 18’ Water Mite Families in Alberta. Zoology 351. University of Alberta, Edmonton, Alberta.

Rogers, D.C. and M. Hill, 2008. Key to the Freshwater Malacostraca (Crustacea) of the mid-Atlantic Region. EPA-230-R-08-017. US Environmental Protection Agency, Office of Environmental Information, Washington, DC.

Stewart, Kenneth W. and Bill Stark. 2002. The Nymphs of North American Stonefly Genera (Plecoptera). The Caddis Press. Columbus Ohio.

Stewart, Kenneth W. and Mark W. Oswood. 2006 The Stoneflies (Plecoptera) of Alaska and Western Canada. The Caddis Press.

Stonedahl, Gary and John D. Lattin. 1986. The Corixidae of Oregon and Washington (Hemiptera: Heteroptera). Technical Bulletin 150. Oregon State University, Corvalis Oregon.

Thorpe, J. H. and A. P. Covich [Eds.] 1991. Ecology and classification of North American freshwater invertebrates. Academic Press, San Diego.

Tinerella, Paul P. and Ralph W. Gunderson.2005. The Waterboatmen (Insecta: Heteroptera: Corixidae) of Minisota. Publication No.23 Dept. Of Entomology, North Dakota State University, Fargo, North Dakota, USA.

Webb, Jeff. 2017. Baetidae larvae of the western United States and Canada. SAFIT Taxonomic workshop, University of California Davis. Davis CA.

Weiderholm, Torgny (Ed.) 1983. The larvae of Chironomidae (Diptera) of the Holartic region. Entomologica Scaninavica. Supplement No. 19.

Westfall, Minter J. Jr. and May, Michael L. 1996. Damselflies of North America. Scientific Publishers, Gainesville, FL.

Wiggins, Glenn B. 1998. Larvae of the North American Caddisfly Genera (Tricoptera) 2nd ed. University of Toronto Press. Toronto Ontario.

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	21M-DS-AQ21
Sampling Date	Aug 03 2016
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12758 N, 122.97288 W
Altitude	632
Local Basin Name	Twenty-One Mile Creek
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	6.1%	4.0%	28.9%	28.9%	20.6%	11.5%
CABIN Assessment of 21M-DS-AQ21 on Aug 03, 2016	Mildly Divergent					

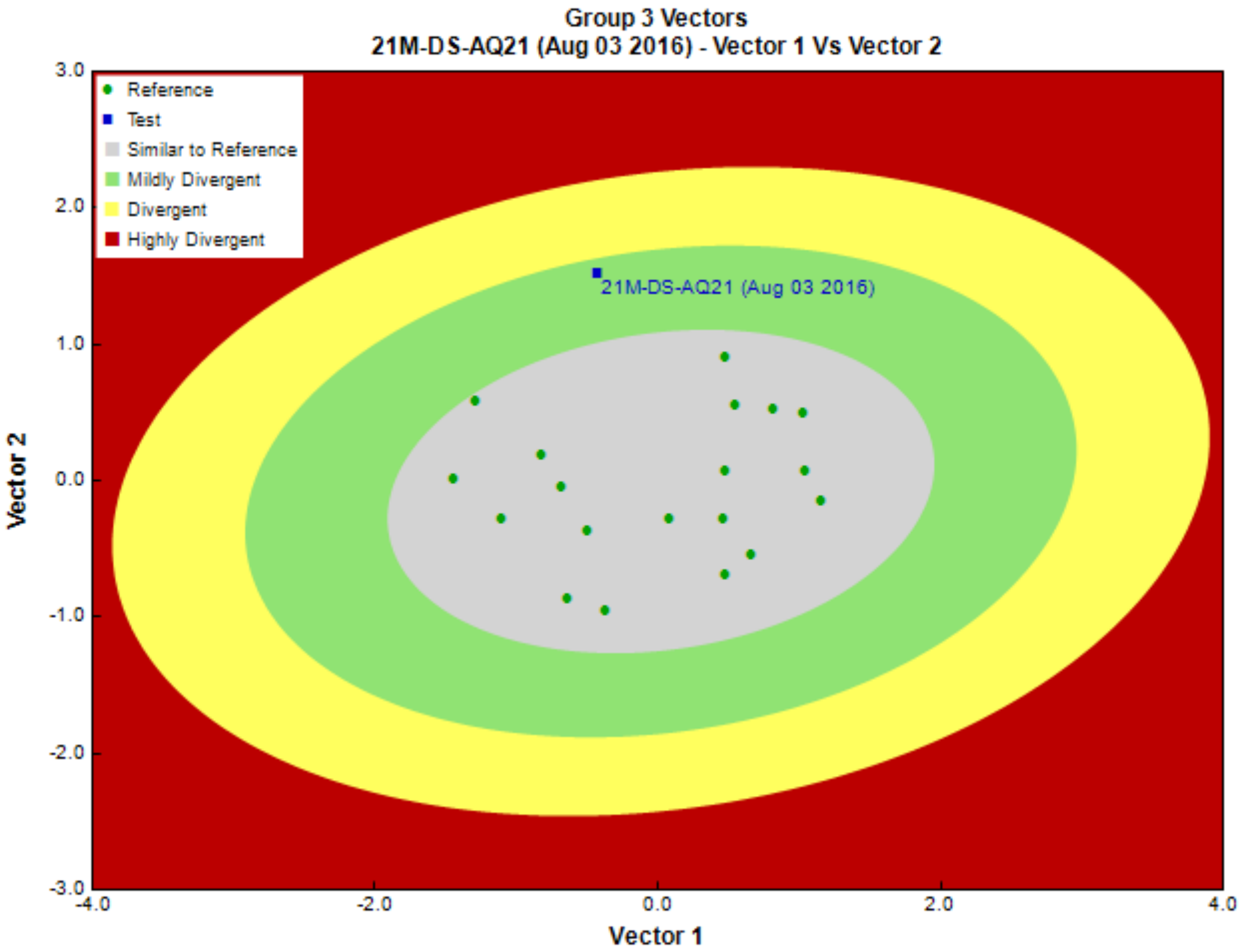


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	October 11, 2016
	Marchant Box
Sub-Sample Proportion	20/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	8	40.0
	Insecta	Diptera	Ceratopogonidae	2	10.0
			Chironomidae	22	110.0
			Empididae	1	5.0
			Simuliidae	29	145.0
			Tipulidae	1	5.0
		Ephemeroptera	Baetidae	103	515.0
			Ephemerellidae	4	20.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Heptageniidae	48	240.0
		Plecoptera	Chloroperlidae	12	60.0
			Nemouridae	65	325.0
			Perlodidae	2	10.0
		Trichoptera	Rhyacophilidae	7	35.0
			Total	304	1,520.0

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.74	0.4 ± 0.2
Functional Measures		
% Filterers	--	1.2 ± 1.0
% Gatherers	39.8	55.3 ± 17.5
% Predatores	22.7	22.0 ± 15.6
% Scrapers	59.2	53.5 ± 23.0
% Shredder	21.7	30.3 ± 22.3
No. Clinger Taxa	8.0	13.6 ± 4.4
Number Of Individuals		
% Diptera + Non-insects	20.7	20.6 ± 17.1
% EPT Individuals	79.3	78.2 ± 17.8
% of 5 dominant taxa	87.8	86.1 ± 8.2
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.8 ± 0.2
Total Abundance	1520.0	3776.0 ± 2948.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	0.0	0.2 ± 0.4
Diptera taxa	5.0	2.9 ± 1.4
Ephemeroptera taxa	3.0	3.3 ± 0.9
EPT Individuals (Sum)	1205.0	2962.4 ± 2556.9
EPT taxa (no)	7.0	9.8 ± 2.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	3.0	4.0 ± 1.2
Shannon-Wiener Diversity	1.9	1.8 ± 0.4
Simpson's Diversity	0.8	0.7 ± 0.1
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	13.0	14.8 ± 4.3
Trichoptera taxa	1.0	2.5 ± 1.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.32
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.08
Arrenuridae	0%	2%	0%	0%	15%	0%	0.03
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.04
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.82
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.23
Caenidae	0%	0%	0%	1%	38%	0%	0.08
Capniidae	81%	60%	37%	65%	31%	69%	0.51
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.24
Chironomidae	100%	100%	89%	99%	100%	100%	0.97
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.77
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.02

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.21
Empididae	51%	65%	47%	62%	8%	51%	0.45
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.25
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.83
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.03
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.19
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.88
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.42
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.14
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.07
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.02
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.37
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.26
Leptoceridae	1%	15%	0%	5%	62%	2%	0.15
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.24
Leuctridae	35%	26%	11%	39%	8%	25%	0.22
Limnephilidae	36%	24%	21%	26%	0%	39%	0.21
Limnesiidae	7%	13%	5%	9%	46%	25%	0.18
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.17
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.03
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.02
Naididae	26%	47%	5%	46%	85%	33%	0.40
Nemouridae	93%	73%	53%	81%	15%	73%	0.59
Oxidae	0%	2%	0%	1%	15%	0%	0.03
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.00
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.04
Perlidae	32%	29%	11%	32%	8%	20%	0.19
Perlodidae	64%	60%	79%	75%	31%	76%	0.66
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.19
Planorbidae	1%	3%	0%	1%	31%	0%	0.07
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.10
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.07
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.45
Sialidae	0%	2%	0%	0%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Simuliidae	52%	29%	16%	32%	8%	24%	0.23
Sperchontidae	17%	34%	37%	50%	23%	45%	0.38
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.02
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.02
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.59
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.53
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.20
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.18
Unionicolidae	0%	0%	0%	0%	15%	0%	0.03
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	7.14
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	1.12
RIVPACS : Expected taxa P>0.70	4.26
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	1.17

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	18.33344 ± 33.50703
Channel		
Depth-Avg (cm)	10.7	28.5 ± 10.6
Depth-BankfullMinusWetted (cm)	100.00	163.00
Depth-Max (cm)	29.0	44.5 ± 18.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	2	3
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	0 ± 1
Slope (m/m)	0.0300000	0.0259896 ± 0.0313728
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 1
Veg-GrassesFerns (Binary)	1	0 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.58	0.49 ± 0.15
Velocity-Max (m/s)	0.93	0.67 ± 0.21
Width-Bankfull (m)	11.2	85.0 ± 66.5
Width-Wetted (m)	9.6	23.1 ± 31.8
XSEC-VelInstrumentDirect (Category(1-3))	1	2
XSEC-VelMethod (Category(1-3))	3	3
Climate		
Precip02_FEB (mm)	155.11000	127.54903 ± 58.24882
Temp07_JULmax (Degrees Celsius)	18.24000	16.49843 ± 2.42987
Landcover		
Natl-SnowIce (%)	26.43000	30.72486 ± 23.89539
Natl-Water (%)	2.82000	0.99760 ± 0.86372
Natl-WetlandHerb (%)	0.00000	0.02638 ± 0.03974
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	9 ± 8

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
%Cobble (%)	18	63 ± 4
%Gravel (%)	3	3 ± 4
%Pebble (%)	79	25 ± 7
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 0
D50 (cm)	4.00	6.67 ± 3.25
Dg (cm)	4.1	8.6 ± 1.6
Dominant-1st (Category(0-9))	5	7 ± 1
Dominant-2nd (Category(0-9))	4	7 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	4 ± 2
Topography		
SlopeAvg (%)	39.45000	41.69956 ± 6.13915
Water Chemistry		
General-DO (mg/L)	9.3900000	12.6052631 ± 1.2122173
General-pH (pH)	6.3	7.4 ± 0.4
General-SpCond (µS/cm)	40.5000000	74.4000000 ± 44.3472660
General-TempAir (Degrees Celsius)	16.3	0.0 ± 0.0
General-TempWater (Degrees Celsius)	12.0000000	5.7731579 ± 1.9704316
General-Turbidity (NTU)	2.6300000	1.3000000 ± 0.9899495

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	21M-DS-AQ21
Sampling Date	Jul 25 2017
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12750 N, 122.97278 W
Altitude	650
Local Basin Name	Twenty-One Mile Creek
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	10.2%	5.3%	33.2%	24.3%	17.2%	9.8%
CABIN Assessment of 21M-DS-AQ21 on Jul 25, 2017	Divergent					

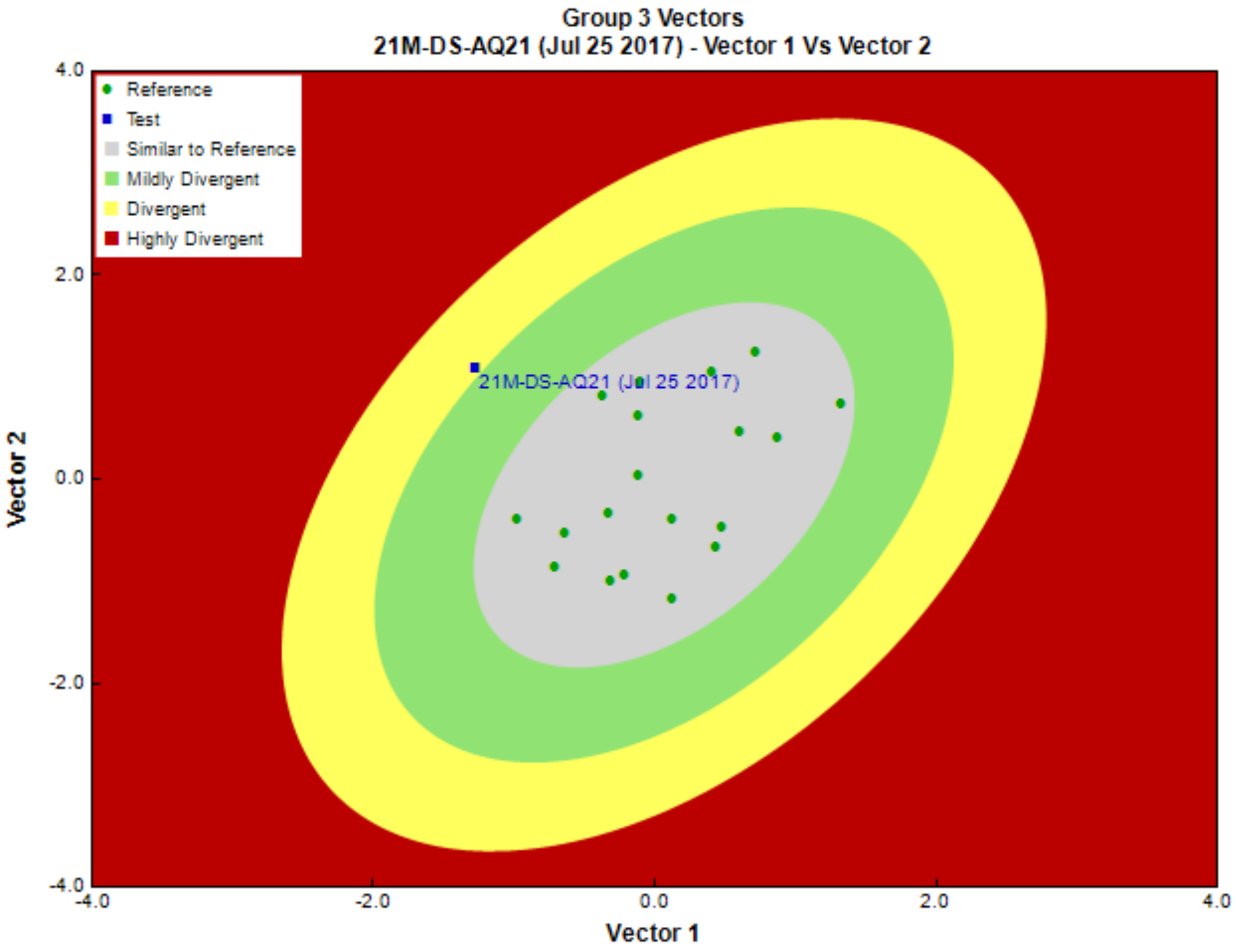

Group 3 Vectors
21M-DS-AQ21 (Jul 25 2017) - Vector 1 Vs Vector 2

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	November 02, 2017
	Marchant Box
Sub-Sample Proportion	24/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	4	16.7
	Insecta	Diptera	Ceratopogonidae	7	29.2
			Chironomidae	11	45.8
			Empididae	1	4.2
			Simuliidae	50	208.3
			Tipulidae	2	8.3
		Ephemeroptera	Baetidae	86	358.3
			Heptageniidae	209	870.8

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera	Chloroperlidae	15	62.5
			Nemouridae	2	8.3
			Perlidae	3	12.5
			Perlodidae	1	4.2
			Total	391	1,629.1

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.78	0.4 ± 0.2
Functional Measures		
% Filterers	--	1.2 ± 1.0
% Gatherers	16.6	55.3 ± 17.5
% Predatores	17.9	22.0 ± 15.6
% Scrapers	88.2	53.5 ± 23.0
% Shredder	1.0	30.3 ± 22.3
No. Clinger Taxa	7.0	13.6 ± 4.4
Number Of Individuals		
% Diptera + Non-insects	19.2	20.6 ± 17.1
% EPT Individuals	80.8	78.2 ± 17.8
% of 5 dominant taxa	94.9	86.1 ± 8.2
No. EPT individuals/Chironomids+EPT Individuals	1.0	0.8 ± 0.2
Total Abundance	1629.2	3776.0 ± 2948.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	0.0	0.2 ± 0.4
Diptera taxa	5.0	2.9 ± 1.4
Ephemeroptera taxa	2.0	3.3 ± 0.9
EPT Individuals (Sum)	1316.7	2962.4 ± 2556.9
EPT taxa (no)	6.0	9.8 ± 2.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.7 ± 0.1
Plecoptera taxa	4.0	4.0 ± 1.2
Shannon-Wiener Diversity	1.4	1.8 ± 0.4
Simpson's Diversity	0.6	0.7 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	12.0	14.8 ± 4.3
Trichoptera taxa	0.0	2.5 ± 1.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.31
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.03
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.04
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.82
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.23
Caenidae	0%	0%	0%	1%	38%	0%	0.07
Capniidae	81%	60%	37%	65%	31%	69%	0.51
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.23
Chironomidae	100%	100%	89%	99%	100%	100%	0.96
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.79
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.02
Curculionidae	0%	0%	0%	1%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.22
Empididae	51%	65%	47%	62%	8%	51%	0.46
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.23
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.83
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.03
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.19
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.90
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.41
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.14
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.07
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.02
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.35
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.25
Leptoceridae	1%	15%	0%	5%	62%	2%	0.13
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.25
Leuctridae	35%	26%	11%	39%	8%	25%	0.22
Limnephilidae	36%	24%	21%	26%	0%	39%	0.22
Limnesiidae	7%	13%	5%	9%	46%	25%	0.16
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.15
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.02
Naididae	26%	47%	5%	46%	85%	33%	0.36
Nemouridae	93%	73%	53%	81%	15%	73%	0.60
Oxidae	0%	2%	0%	1%	15%	0%	0.03
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.04
Perlidae	32%	29%	11%	32%	8%	20%	0.19
Perlodidae	64%	60%	79%	75%	31%	76%	0.67
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.18
Planorbidae	1%	3%	0%	1%	31%	0%	0.06
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.10
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.06
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.45
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.24

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Sperchontidae	17%	34%	37%	50%	23%	45%	0.36
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.02
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.02
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.62
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.53
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.20
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.19
Unionicolidae	0%	0%	0%	0%	15%	0%	0.03
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	7.24
RIVPACS : Observed taxa P>0.50	7.00
RIVPACS : O:E (p > 0.5)	0.97
RIVPACS : Expected taxa P>0.70	4.30
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	0.93

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	18.33344 ± 33.50703
Channel		
Depth-Avg (cm)	25.2	28.5 ± 10.6
Depth-BankfullMinusWetted (cm)	48.00	163.00
Depth-Max (cm)	38.0	44.5 ± 18.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	2	3
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0100000	0.0259896 ± 0.0313728
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 1
Veg-GrassesFerns (Binary)	1	0 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.66	0.49 ± 0.15
Velocity-Max (m/s)	1.02	0.67 ± 0.21
Width-Bankfull (m)	11.5	85.0 ± 66.5
Width-Wetted (m)	48.0	23.1 ± 31.8
XSEC-VelInstrumentDirect (Category(1-3))	1	2
XSEC-VelMethod (Category(1-3))	3	3
Climate		
Precip02_FEB (mm)	155.11000	127.54903 ± 58.24882
Temp07_JULmax (Degrees Celsius)	18.24000	16.49843 ± 2.42987
Landcover		
MNP-WetlandHerb (%)	0.00000	0.00000 ± 0.00000
Natl-SnowIce (%)	26.43000	30.72486 ± 23.89539
Natl-Water (%)	2.82000	0.99760 ± 0.86372
Natl-WetlandHerb (%)	0.00000	0.02638 ± 0.03974
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	9 ± 8
%Cobble (%)	7	63 ± 4

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
%Gravel (%)	30	3 ± 4
%Pebble (%)	63	25 ± 7
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 0
D50 (cm)	3.00	6.67 ± 3.25
Dg (cm)	2.3	8.6 ± 1.6
Dominant-1st (Category(0-9))	5	7 ± 1
Dominant-2nd (Category(0-9))	3	7 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	2	4 ± 2
Topography		
SlopeAvg (%)	39.45000	41.69956 ± 6.13915
Water Chemistry		
General-DO (mg/L)	11.3300000	12.6052631 ± 1.2122173
General-pH (pH)	7.1	7.4 ± 0.4
General-SpCond (μS/cm)	40.0000000	74.4000000 ± 44.3472660
General-TempAir (Degrees Celsius)	31.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	11.6000000	5.7731579 ± 1.9704316

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	21M-DS-AQ21
Sampling Date	Jul 31 2018
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12767 N, 122.97298 W
Altitude	645
Local Basin Name	Twenty-One Mile Creek
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	10.4%	4.7%	22.1%	17.5%	38.9%	6.5%
CABIN Assessment of 21M-DS-AQ21 on Jul 31, 2018	Mildly Divergent					

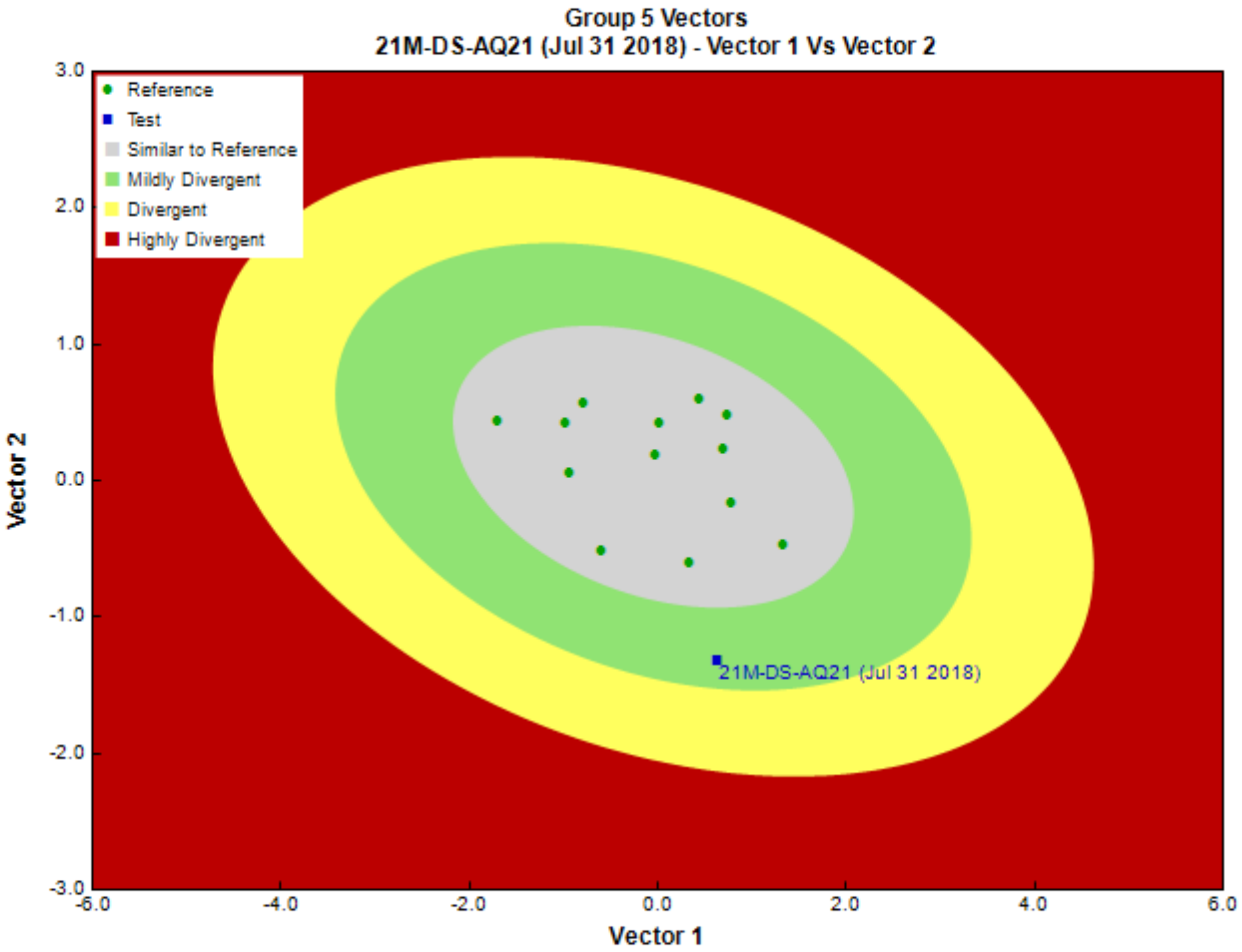


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	100/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	28	27.8
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	33	33.3
			Lebertiidae	11	11.1
			Sperchontidae	22	22.2
			Torrenticolidae	6	5.6
	Insecta	Diptera	Ceratopogonidae	45	44.5
			Chironomidae	145	144.5
			Deuterophlebiidae	6	5.6

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Simuliidae	489	488.9
			Tipulidae	1	1.0
		Ephemeroptera	Ameletidae	28	27.8
			Baetidae	361	361.1
			Ephemerellidae	50	50.0
			Heptageniidae	412	411.2
			Leptophlebiidae	6	5.6
		Plecoptera	Capniidae	6	5.6
			Chloroperlidae	128	127.8
			Leuctridae	6	5.6
			Nemouridae	23	22.3
			Perlidae	95	94.5
			Perlodidae	39	38.9
		Trichoptera		1	1.0
			Hydroptilidae	6	5.6
			Rhyacophilidae	44	44.4
			Total	1,991	1,985.9

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.87	0.6 ± 0.2
Functional Measures		
% Filterers	--	11.5 ± 10.5
% Gatherers	38.9	67.6 ± 30.3
% Predatores	44.5	41.1 ± 20.2
% Scrapers	64.1	34.3 ± 21.0
% Shredder	1.7	13.7 ± 9.2
No. Clinger Taxa	25.0	13.0 ± 5.7
Number Of Individuals		
% Diptera + Non-insects	39.5	47.4 ± 26.3
% EPT Individuals	60.5	49.6 ± 26.3
% of 5 dominant taxa	77.3	86.1 ± 8.4
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.6 ± 0.2
Total Abundance	1985.3	13706.8 ± 8626.5
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	0.0	0.5 ± 0.5
Diptera taxa	5.0	2.6 ± 1.2
Ephemeroptera taxa	5.0	3.4 ± 1.2
EPT Individuals (Sum)	1200.0	7446.2 ± 6472.9
EPT taxa (no)	13.0	9.3 ± 3.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.6 ± 0.1
Plecoptera taxa	6.0	3.4 ± 1.8
Shannon-Wiener Diversity	2.3	1.7 ± 0.4
Simpson's Diversity	0.8	0.7 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	23.0	16.0 ± 4.0
Trichoptera taxa	2.0	2.5 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.23
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.06
Asellidae	0%	2%	0%	0%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Athericidae	0%	8%	0%	9%	8%	0%	0.05
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.78
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.22
Caenidae	0%	0%	0%	1%	38%	0%	0.15
Capniidae	81%	60%	37%	65%	31%	69%	0.47
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.31
Chironomidae	100%	100%	89%	99%	100%	100%	0.98
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.66
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.03
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.00
Elmidae	48%	73%	5%	28%	15%	18%	0.22
Empididae	51%	65%	47%	62%	8%	51%	0.36
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.25
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.77
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.06
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.15
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.80
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.37
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.17
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.02
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.05
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.01
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.41
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.26
Leptoceridae	1%	15%	0%	5%	62%	2%	0.26
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.00
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.24
Leuctridae	35%	26%	11%	39%	8%	25%	0.19
Limnephilidae	36%	24%	21%	26%	0%	39%	0.17
Limnesiidae	7%	13%	5%	9%	46%	25%	0.24
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.23
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.04
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.49
Nemouridae	93%	73%	53%	81%	15%	73%	0.50
Oxidae	0%	2%	0%	1%	15%	0%	0.06
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.00
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.03
Perlidae	32%	29%	11%	32%	8%	20%	0.17
Perlodidae	64%	60%	79%	75%	31%	76%	0.57
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	**Frequency of Occurrence in Reference Sites**						**Probability Of Occurrence at 21M-DS-AQ21**
	Group 1	**Group 2**	**Group 3**	**Group 4**	**Group 5**	**Group 6**	
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.28
Planorbidae	1%	3%	0%	1%	31%	0%	0.12
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.09
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.09
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.34
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.20
Sperchontidae	17%	34%	37%	50%	23%	45%	0.32
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.03
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.49
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.50
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.22
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.13
Unionicolidae	0%	0%	0%	0%	15%	0%	0.06
Valvatidae	3%	2%	0%	3%	8%	2%	0.04

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	4.56
RIVPACS : Observed taxa P>0.50	6.00
RIVPACS : O:E (p > 0.5)	1.32
RIVPACS : Expected taxa P>0.70	3.33
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.20

Habitat Description

Variable	**21M-DS-AQ21**	**Predicted Group Reference Mean ±SD**
Bedrock Geology		
Sedimentary (%)	2.56000	15.90266 ± 33.91726
Channel		
Depth-Avg (cm)	18.5	40.5 ± 22.4
Macrophyte (PercentRange)	1	1 ± 2
Reach-%CanopyCoverage (PercentRange)	1.00	0.23 ± 0.44
Reach-%Logging (PercentRange)	0	0 ± 0
Reach-DomStreamsideVeg (Category(1-4))	2	2
Reach-Pools (Binary)	0	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	0 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0100000	0.0047331 ± 0.0082050
Veg-Coniferous (Binary)	0	0 ± 1
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.60	0.23 ± 0.24
Velocity-Max (m/s)	0.77	0.31 ± 0.35
Width-Bankfull (m)	11.7	75.1 ± 72.8
Width-Wetted (m)	10.9	50.6 ± 60.4

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
XSEC-VelMethod (Category(1-3))	1	3
Climate		
Precip02_FEB (mm)	155.11000	171.50745 ± 107.47690
Temp07_JULmax (Degrees Celsius)	18.24000	20.34230 ± 2.49485
Landcover		
Natl-SnowIce (%)	26.43000	3.62533 ± 10.17162
Natl-Water (%)	2.82000	1.80201 ± 1.29922
Natl-WetlandHerb (%)	0.00000	0.68488 ± 0.92347
Substrate Data		
%Bedrock (%)	0	0
%Boulder (%)	1	0
%Cobble (%)	3	58
%Gravel (%)	12	1
%Pebble (%)	84	41
%Sand (%)	0	0
%Silt+Clay (%)	0	0
D50 (cm)	3.00	3.30
Dg (cm)	2.8	6.6
Dominant-1st (Category(0-9))	4	4 ± 2
Dominant-2nd (Category(0-9))	5	4 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	1	3
SurroundingMaterial (Category(0-9))	3	2 ± 1
Topography		
SlopeAvg (%)	39.45000	30.12236 ± 18.75100
Water Chemistry		
General-DO (mg/L)	14.6000000	9.3400000 ± 2.0171679
General-pH (pH)	6.2	6.8 ± 1.0
General-SpCond (µS/cm)	38.1000000	176.1000000
General-TempWater (Degrees Celsius)	19.9000000	13.2730769 ± 4.7663725

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	21M-DS-AQ21
Sampling Date	Jul 30 2019
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12761 N, 122.97293 W
Altitude	643
Local Basin Name	Twenty-One Mile Creek
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	10.3%	5.3%	33.1%	24.4%	17.2%	9.8%
CABIN Assessment of 21M-DS-AQ21 on Jul 30, 2019	Mildly Divergent					

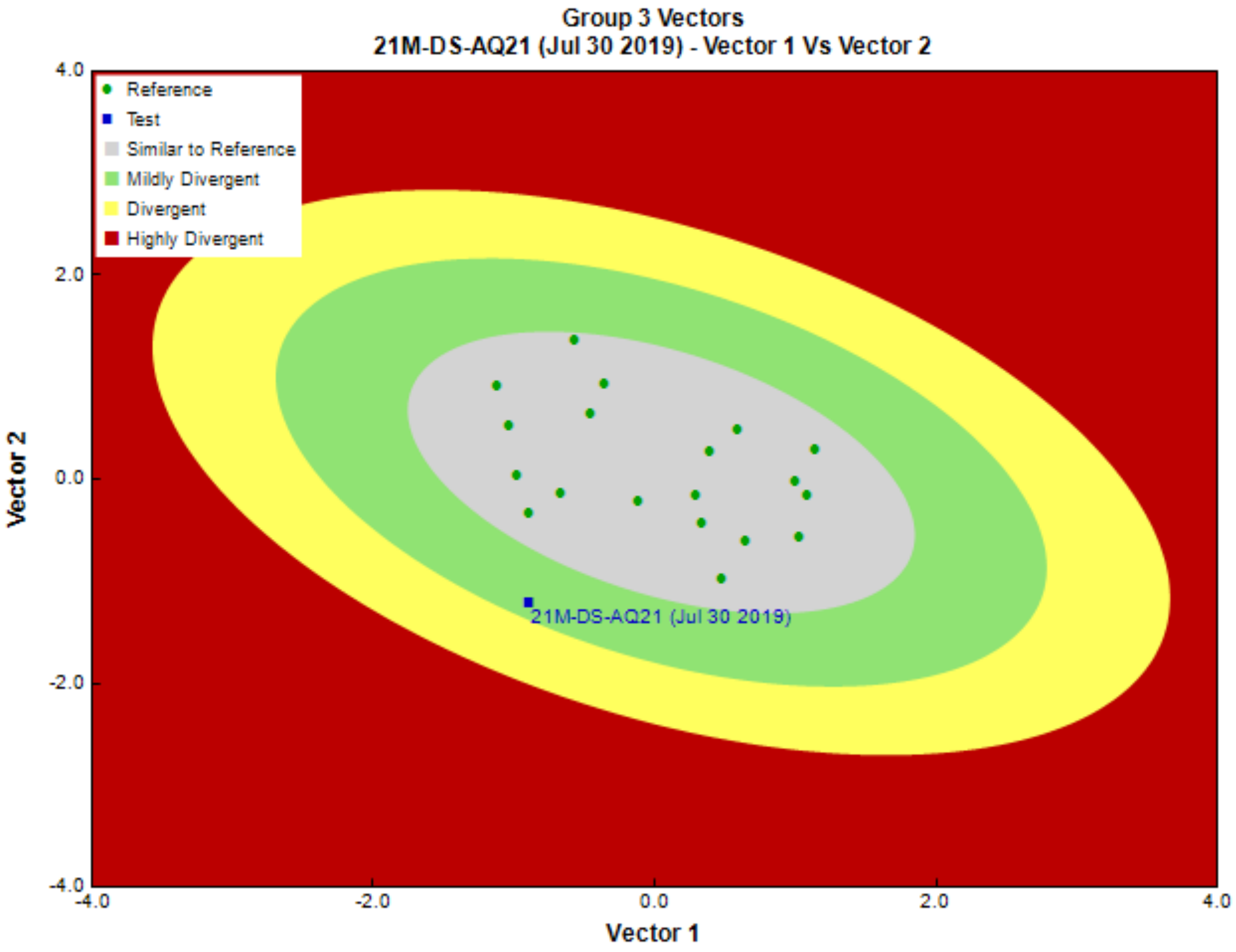


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	18/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	6	33.3
Arthropoda	Arachnida	Sarcoptiformes		1	5.6
		Trombidiformes	Hydryphantidae	1	5.6
			Hygrobatidae	2	11.1
			Lebertiidae	2	11.1
			Sperchontidae	1	5.6
			Torrenticolidae	1	5.6
	Collembola	Collembola		1	5.6

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
	Insecta	Diptera	Ceratopogonidae	2	11.1
			Chironomidae	21	116.8
			Empididae	2	11.2
			Simuliidae	41	227.8
			Tipulidae	1	5.6
		Ephemeroptera	Ameletidae	16	88.9
			Baetidae	82	455.6
			Ephemerellidae	11	61.2
			Heptageniidae	89	494.5
			Leptophlebiidae	2	11.1
		Plecoptera	Capniidae	2	11.1
			Chloroperlidae	14	77.8
			Nemouridae	8	44.5
			Perlidae	5	27.8
			Perlodidae	6	33.4
		Trichoptera	Hydropsychidae	1	5.6
			Limnephilidae	2	11.1
			Rhyacophilidae	3	16.7
			Total	323	1,795.3

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.75	0.4 ± 0.2
Functional Measures		
% Filterers	--	1.2 ± 1.0
% Gatherers	35.0	55.3 ± 17.5
% Predatores	26.6	22.0 ± 15.6
% Scrapers	66.6	53.5 ± 23.0
% Shredder	4.0	30.3 ± 22.3
No. Clinger Taxa	27.0	13.6 ± 4.4
Number Of Individuals		
% Diptera + Non-insects	24.9	20.6 ± 17.1
% EPT Individuals	75.1	78.2 ± 17.8
% of 5 dominant taxa	77.6	86.1 ± 8.2
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.8 ± 0.2
Total Abundance	1794.4	3776.0 ± 2948.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	0.0	0.2 ± 0.4
Diptera taxa	5.0	2.9 ± 1.4
Ephemeroptera taxa	5.0	3.3 ± 0.9
EPT Individuals (Sum)	1338.9	2962.4 ± 2556.9
EPT taxa (no)	13.0	9.8 ± 2.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	5.0	4.0 ± 1.2
Shannon-Wiener Diversity	2.2	1.8 ± 0.4
Simpson's Diversity	0.8	0.7 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	24.0	14.8 ± 4.3
Trichoptera taxa	3.0	2.5 ± 1.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.31
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.07

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Arrenuridae	0%	2%	0%	0%	15%	0%	0.03
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.04
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.82
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.23
Caenidae	0%	0%	0%	1%	38%	0%	0.07
Capniidae	81%	60%	37%	65%	31%	69%	0.52
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.23
Chironomidae	100%	100%	89%	99%	100%	100%	0.96
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.79
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.02
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.22
Empididae	51%	65%	47%	62%	8%	51%	0.46
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.23
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.83
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.03
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.19
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.90
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.41
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.14
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.07
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.02
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.35
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.25
Leptoceridae	1%	15%	0%	5%	62%	2%	0.13
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.25
Leuctridae	35%	26%	11%	39%	8%	25%	0.22
Limnephilidae	36%	24%	21%	26%	0%	39%	0.22
Limnesiidae	7%	13%	5%	9%	46%	25%	0.16
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.15
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.02
Naididae	26%	47%	5%	46%	85%	33%	0.36
Nemouridae	93%	73%	53%	81%	15%	73%	0.60
Oxidae	0%	2%	0%	1%	15%	0%	0.03
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.04
Perlidae	32%	29%	11%	32%	8%	20%	0.19

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Perlodidae	64%	60%	79%	75%	31%	76%	0.67
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.18
Planorbidae	1%	3%	0%	1%	31%	0%	0.06
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.10
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.06
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.45
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.24
Sperchontidae	17%	34%	37%	50%	23%	45%	0.36
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.02
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.02
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.62
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.53
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.20
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.19
Unionicolidae	0%	0%	0%	0%	15%	0%	0.03
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	7.24
RIVPACS : Observed taxa P>0.50	9.00
RIVPACS : O:E (p > 0.5)	1.24
RIVPACS : Expected taxa P>0.70	4.30
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	1.16

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	18.33344 ± 33.50703
Channel		
Depth-BankfullMinusWetted (cm)	20.00	163.00
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	2	3
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	0	0 ± 1
Slope (m/m)	0.0100000	0.0259896 ± 0.0313728
Veg-Coniferous (Binary)	0	1 ± 0
Veg-Deciduous (Binary)	0	1 ± 1
Veg-GrassesFerns (Binary)	1	0 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.70	0.49 ± 0.15
Velocity-Max (m/s)	0.89	0.67 ± 0.21
Width-Bankfull (m)	11.4	85.0 ± 66.5

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Width-Wetted (m)	11.3	23.1 ± 31.8
XSEC-VelMethod (Category(1-3))	1	3
Climate		
Precip02_FEB (mm)	155.11000	127.54903 ± 58.24882
Temp07_JULmax (Degrees Celsius)	18.24000	16.49843 ± 2.42987
Landcover		
Natl-SnowIce (%)	26.43000	30.72486 ± 23.89539
Natl-Water (%)	2.82000	0.99760 ± 0.86372
Natl-WetlandHerb (%)	0.00000	0.02638 ± 0.03974
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	9 ± 8
%Cobble (%)	3	63 ± 4
%Gravel (%)	14	3 ± 4
%Pebble (%)	82	25 ± 7
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 0
D50 (cm)	3.80	6.67 ± 3.25
Dg (cm)	2.9	8.6 ± 1.6
Dominant-1st (Category(0-9))	5	7 ± 1
Dominant-2nd (Category(0-9))	4	7 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	4 ± 2
Topography		
SlopeAvg (%)	39.45000	41.69956 ± 6.13915
Water Chemistry		
General-Conductivity (μS/cm)	36.3000000	62.9529406 ± 33.2341330
General-DO (mg/L)	9.7800000	12.6052631 ± 1.2122173
General-pH (pH)	7.0	7.4 ± 0.4
General-SpCond (μS/cm)	51.8000000	74.4000000 ± 44.3472660
General-TempWater (Degrees Celsius)	13.3000000	5.7731579 ± 1.9704316

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	CRB-DS-AQ01
Sampling Date	Aug 02 2016
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12660 N, 122.97170 W
Altitude	660
Local Basin Name	Crabapple Creek
	River of Golden Dreams
Stream Order	2

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	43.6%	26.5%	0.1%	19.1%	8.6%	2.2%
CABIN Assessment of CRB-DS-AQ01 on Aug 02, 2016	Mildly Divergent					

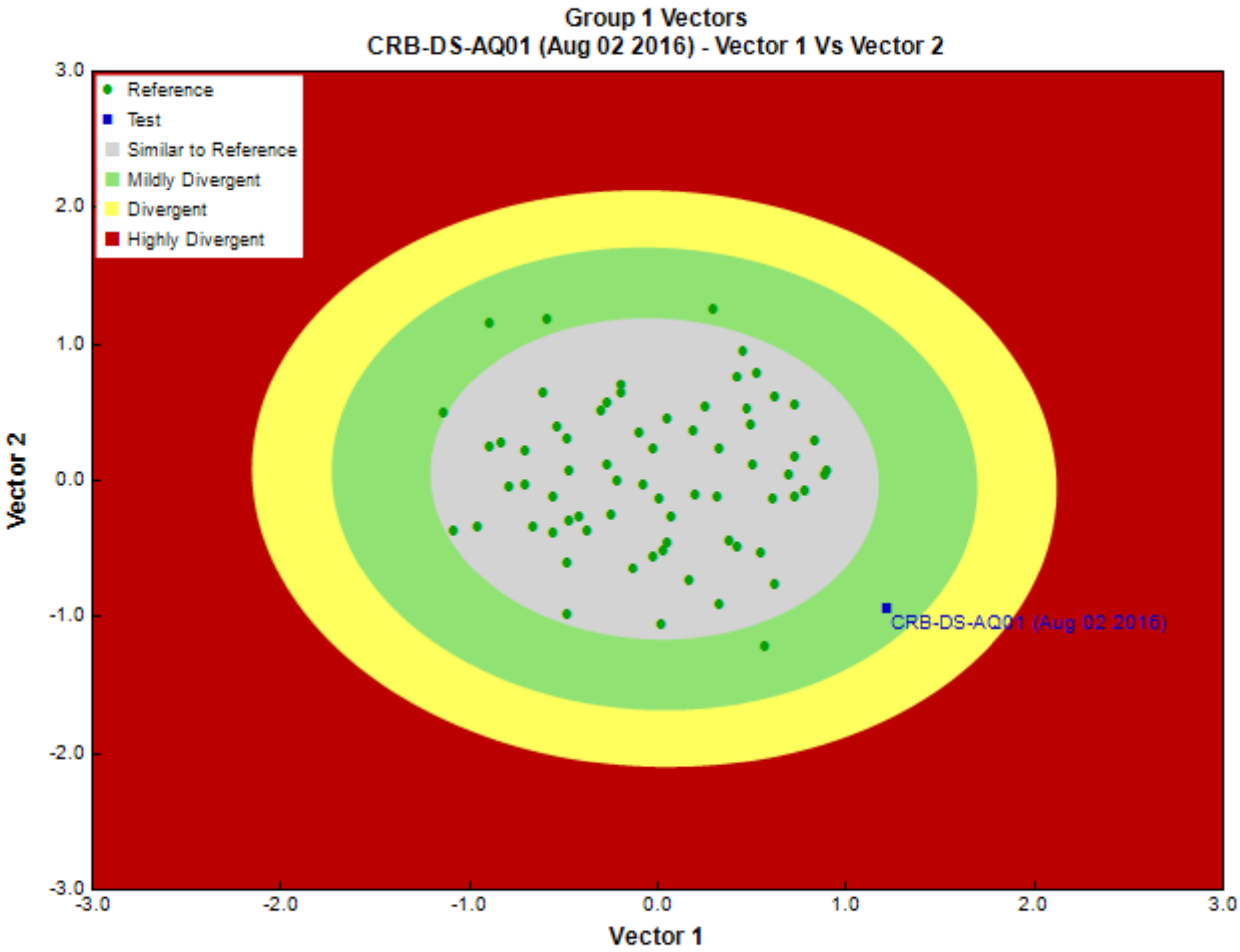


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	September 27, 2016
	Marchant Box
Sub-Sample Proportion	10/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	10	100.0
	Collembola	Collembola		1	10.0
	Insecta	Diptera	Chironomidae	18	180.0
			Empididae	5	50.0
			Simuliidae	17	170.0
			Tipulidae	2	20.0
		Ephemeroptera	Baetidae	41	410.0
			Ephemerellidae	5	50.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Megaloptera	Sialidae	1	10.0
		Plecoptera	Chloroperlidae	55	550.0
			Leuctridae	1	10.0
			Nemouridae	159	1,590.0
			Perlodidae	1	10.0
		Trichoptera	Limnephilidae	1	10.0
			Rhyacophilidae	1	10.0
			Total	318	3,180.0

Metrics

Name	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.71	0.5 ± 0.2
Functional Measures		
% Filterers	--	1.8 ± 2.9
% Gatherers	63.2	43.7 ± 17.3
% Predatores	16.7	20.9 ± 13.4
% Scrapers	18.6	54.8 ± 18.3
% Shredder	51.3	21.3 ± 13.9
No. Clinger Taxa	9.0	16.0 ± 5.6
Number Of Individuals		
% Diptera + Non-insects	16.4	19.1 ± 14.0
% EPT Individuals	83.3	79.0 ± 14.8
% of 5 dominant taxa	91.5	83.1 ± 9.3
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.9 ± 0.1
Total Abundance	3180.0	5010.8 ± 6541.9
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	0.0	0.4 ± 0.5
Diptera taxa	4.0	3.1 ± 1.3
Ephemeroptera taxa	2.0	3.6 ± 1.0
EPT Individuals (Sum)	2640.0	3855.4 ± 5103.0
EPT taxa (no)	8.0	11.0 ± 2.8
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.7 ± 0.1
Plecoptera taxa	4.0	4.5 ± 1.3
Shannon-Wiener Diversity	1.6	1.9 ± 0.4
Simpson's Diversity	0.7	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	14.0	16.8 ± 4.7
Trichoptera taxa	2.0	2.9 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.30
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.03
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.02
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.04
Aturidae	4%	6%	0%	5%	0%	2%	0.05
Baetidae	97%	92%	79%	93%	62%	84%	0.92
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.41
Caenidae	0%	0%	0%	1%	38%	0%	0.03
Capniidae	81%	60%	37%	65%	31%	69%	0.68
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.26
Chironomidae	100%	100%	89%	99%	100%	100%	1.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.76
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.02
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.03
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.47
Empididae	51%	65%	47%	62%	8%	51%	0.53
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.26
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.85
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.05
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.01
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.26
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.91
Hyalellidae	0%	5%	0%	0%	0%	0%	0.01
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.54
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.24
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.02
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.09
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.06
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.01
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.41
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.42
Leptoceridae	1%	15%	0%	5%	62%	2%	0.11
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.51
Leuctridae	35%	26%	11%	39%	8%	25%	0.31
Limnephilidae	36%	24%	21%	26%	0%	39%	0.28
Limnesiidae	7%	13%	5%	9%	46%	25%	0.13
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.12
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.03
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.02
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.41
Nemouridae	93%	73%	53%	81%	15%	73%	0.78
Oxidae	0%	2%	0%	1%	15%	0%	0.02
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.02
Perlidae	32%	29%	11%	32%	8%	20%	0.29
Perlodidae	64%	60%	79%	75%	31%	76%	0.62
Philopotamidae	1%	3%	0%	1%	0%	2%	0.02
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.28
Planorbidae	1%	3%	0%	1%	31%	0%	0.04
Poduridae	0%	3%	0%	0%	0%	2%	0.01
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.24
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.48
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.38
Sperchontidae	17%	34%	37%	50%	23%	45%	0.29
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.01
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.02
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.43
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.60
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.38
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.03
Uenoidae	9%	8%	37%	17%	0%	10%	0.09
Unionicolidae	0%	0%	0%	0%	15%	0%	0.01
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	8.70
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	0.92
RIVPACS : Expected taxa P>0.70	5.21
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	0.96

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	0.33000	25.53190 ± 36.87363
Channel		
Depth-Avg (cm)	8.6	20.6 ± 10.3
Depth-BankfullMinusWetted (cm)	58.00	37.41 ± 19.51
Depth-Max (cm)	12.5	30.1 ± 17.1
Macrophyte (PercentRange)	0	0 ± 1
Reach-%CanopyCoverage (PercentRange)	2.00	0.86 ± 1.10
Reach-DomStreamsideVeg (Category(1-4))	2	2 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0100000	0.0139981 ± 0.0172321
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.33	0.39 ± 0.19
Velocity-Max (m/s)	0.62	0.58 ± 0.28
Width-Bankfull (m)	5.2	18.4 ± 20.0
Width-Wetted (m)	3.0	7.4 ± 6.3
XSEC-VelInstrumentDirect (Category(1-3))	1	2 ± 0
XSEC-VelMethod (Category(1-3))	3	3 ± 0
Climate		
Precip02_FEB (mm)	163.00000	57.95789 ± 41.70288
Temp07_JULmax (Degrees Celsius)	20.48000	17.55944 ± 2.17158
Landcover		
Natl-SnowIce (%)	0.00000	0.55339 ± 1.25503
Natl-Water (%)	0.00000	1.38766 ± 2.38578
Natl-WetlandHerb (%)	0.00000	0.46466 ± 1.02141
Substrate Data		
%Bedrock (%)	0	1 ± 3

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
%Boulder (%)	1	6 ± 5
%Cobble (%)	68	52 ± 17
%Gravel (%)	6	6 ± 5
%Pebble (%)	25	34 ± 16
%Sand (%)	0	0 ± 1
%Silt+Clay (%)	0	1 ± 2
D50 (cm)	8.00	7.79 ± 2.83
Dg (cm)	6.7	7.0 ± 2.2
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
SlopeAvg (%)	26.12000	19.23143 ± 15.15733
Water Chemistry		
General-DO (mg/L)	9.3500000	11.6403031 ± 1.0007120
General-pH (pH)	7.6	7.6 ± 0.5
General-SpCond (μS/cm)	217.8000000	127.8461538 ± 102.3985239
General-TempAir (Degrees Celsius)	12.2	11.6 ± 4.1
General-TempWater (Degrees Celsius)	12.7000000	5.9833333 ± 2.8160802
General-Turbidity (NTU)	1.5500000	0.5285714 ± 0.3093773

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	CRB-DS-AQ01
Sampling Date	Jul 25 2017
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12639 N, 122.97167 W
Altitude	643
Local Basin Name	Crabapple Creek
	River of Golden Dreams
Stream Order	2

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	43.7%	26.6%	0.1%	19.1%	8.5%	2.1%
CABIN Assessment of CRB-DS-AQ01 on Jul 25, 2017	Similar to Reference					

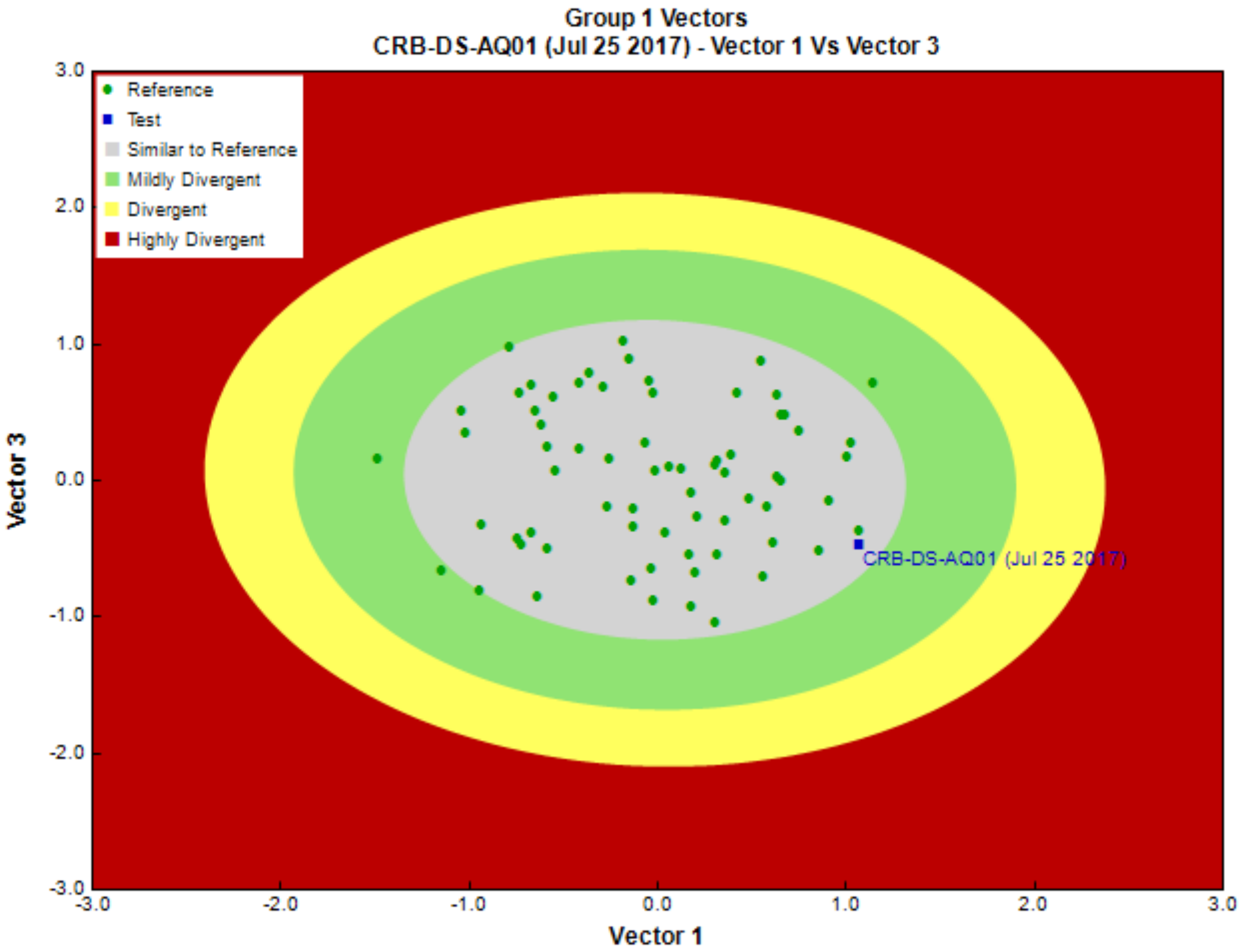


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	November 01, 2017
	Marchant Box
Sub-Sample Proportion	16/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	5	31.3
	Insecta	Diptera	Chironomidae	34	212.5
			Simuliidae	15	93.8
		Ephemeroptera	Baetidae	302	1,887.5
			Ephemerellidae	9	56.3
			Leptophlebiidae	1	6.3
		Plecoptera	Chloroperlidae	12	75.0
			Nemouridae	25	156.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Trichoptera	Limnephilidae	1	6.3
			Rhyacophilidae	8	50.0
			Total	412	2,575.3

Metrics

Name	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.37	0.5 ± 0.2
Functional Measures		
% Filterers	--	1.8 ± 2.9
% Gatherers	20.4	43.7 ± 17.3
% Predatores	15.0	20.9 ± 13.4
% Scrapers	77.2	54.8 ± 18.3
% Shredder	6.3	21.3 ± 13.9
No. Clinger Taxa	8.0	16.0 ± 5.6
Number Of Individuals		
% Diptera + Non-insects	13.1	19.1 ± 14.0
% EPT Individuals	86.9	79.0 ± 14.8
% of 5 dominant taxa	94.2	83.1 ± 9.3
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.9 ± 0.1
Total Abundance	2575.0	5010.8 ± 6541.9
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	0.0	0.4 ± 0.5
Diptera taxa	2.0	3.1 ± 1.3
Ephemeroptera taxa	3.0	3.6 ± 1.0
EPT Individuals (Sum)	2237.5	3855.4 ± 5103.0
EPT taxa (no)	7.0	11.0 ± 2.8
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.5	0.7 ± 0.1
Plecoptera taxa	2.0	4.5 ± 1.3
Shannon-Wiener Diversity	1.1	1.9 ± 0.4
Simpson's Diversity	0.4	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	10.0	16.8 ± 4.7
Trichoptera taxa	2.0	2.9 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.30
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.03
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.02
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.04
Aturidae	4%	6%	0%	5%	0%	2%	0.05
Baetidae	97%	92%	79%	93%	62%	84%	0.92
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.41
Caenidae	0%	0%	0%	1%	38%	0%	0.03
Capniidae	81%	60%	37%	65%	31%	69%	0.68
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.26
Chironomidae	100%	100%	89%	99%	100%	100%	1.00
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.76
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.02
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.03

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.47
Empididae	51%	65%	47%	62%	8%	51%	0.53
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.26
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.85
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.05
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.01
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.26
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.91
Hyalellidae	0%	5%	0%	0%	0%	0%	0.01
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.54
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.24
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.02
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.09
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.06
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.01
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.41
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.42
Leptoceridae	1%	15%	0%	5%	62%	2%	0.11
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.51
Leuctridae	35%	26%	11%	39%	8%	25%	0.31
Limnephilidae	36%	24%	21%	26%	0%	39%	0.28
Limnesiidae	7%	13%	5%	9%	46%	25%	0.13
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.12
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.03
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.02
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.41
Nemouridae	93%	73%	53%	81%	15%	73%	0.78
Oxidae	0%	2%	0%	1%	15%	0%	0.02
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.02
Perlidae	32%	29%	11%	32%	8%	20%	0.29
Perlodidae	64%	60%	79%	75%	31%	76%	0.62
Philopotamidae	1%	3%	0%	1%	0%	2%	0.02
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.28
Planorbidae	1%	3%	0%	1%	31%	0%	0.04
Poduridae	0%	3%	0%	0%	0%	2%	0.01
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.24
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.48
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.38
Sperchontidae	17%	34%	37%	50%	23%	45%	0.29
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.01
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.02
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.43
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.60
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.38
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.03
Uenoidae	9%	8%	37%	17%	0%	10%	0.09
Unionicolidae	0%	0%	0%	0%	15%	0%	0.01
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	8.70
RIVPACS : Observed taxa P>0.50	6.00
RIVPACS : O:E (p > 0.5)	0.69
RIVPACS : Expected taxa P>0.70	5.21
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	0.96

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	0.33000	25.53190 ± 36.87363
Channel		
Depth-Avg (cm)	7.0	20.6 ± 10.3
Depth-BankfullMinusWetted (cm)	30.00	37.41 ± 19.51
Depth-Max (cm)	10.0	30.1 ± 17.1
Macrophyte (PercentRange)	0	0 ± 1
Reach-%CanopyCoverage (PercentRange)	3.00	0.86 ± 1.10
Reach-DomStreamsideVeg (Category(1-4))	3	2 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0100000	0.0139981 ± 0.0172321
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.30	0.39 ± 0.19
Velocity-Max (m/s)	0.40	0.58 ± 0.28
Width-Bankfull (m)	4.4	18.4 ± 20.0
Width-Wetted (m)	3.3	7.4 ± 6.3
XSEC-VelInstrumentDirect (Category(1-3))	1	2 ± 0
XSEC-VelMethod (Category(1-3))	3	3 ± 0
Climate		
Precip02_FEB (mm)	163.00000	57.95789 ± 41.70288
Temp07_JULmax (Degrees Celsius)	20.48000	17.55944 ± 2.17158
Landcover		
Natl-SnowIce (%)	0.00000	0.55339 ± 1.25503
Natl-Water (%)	0.00000	1.38766 ± 2.38578
Natl-WetlandHerb (%)	0.00000	0.46466 ± 1.02141
Substrate Data		
%Bedrock (%)	0	1 ± 3
%Boulder (%)	0	6 ± 5
%Cobble (%)	47	52 ± 17
%Gravel (%)	11	6 ± 5
%Pebble (%)	39	34 ± 16

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
%Sand (%)	0	0 ± 1
%Silt+Clay (%)	0	1 ± 2
D50 (cm)	6.00	7.79 ± 2.83
Dg (cm)	4.6	7.0 ± 2.2
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
SlopeAvg (%)	26.12000	19.23143 ± 15.15733
Water Chemistry		
General-DO (mg/L)	11.6000000	11.6403031 ± 1.0007120
General-pH (pH)	7.4	7.6 ± 0.5
General-SpCond (µS/cm)	336.3000000	127.8461538 ± 102.3985239
General-TempAir (Degrees Celsius)	17.5	11.6 ± 4.1
General-TempWater (Degrees Celsius)	12.0000000	5.9833333 ± 2.8160802

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	CRB-DS-AQ01
Sampling Date	Aug 01 2018
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12648 N, 122.97171 W
Altitude	645
Local Basin Name	Crabapple Creek
	River of Golden Dreams
Stream Order	2

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	43.7%	26.5%	0.1%	19.1%	8.5%	2.1%
CABIN Assessment of CRB-DS-AQ01 on Aug 01, 2018	Similar to Reference					

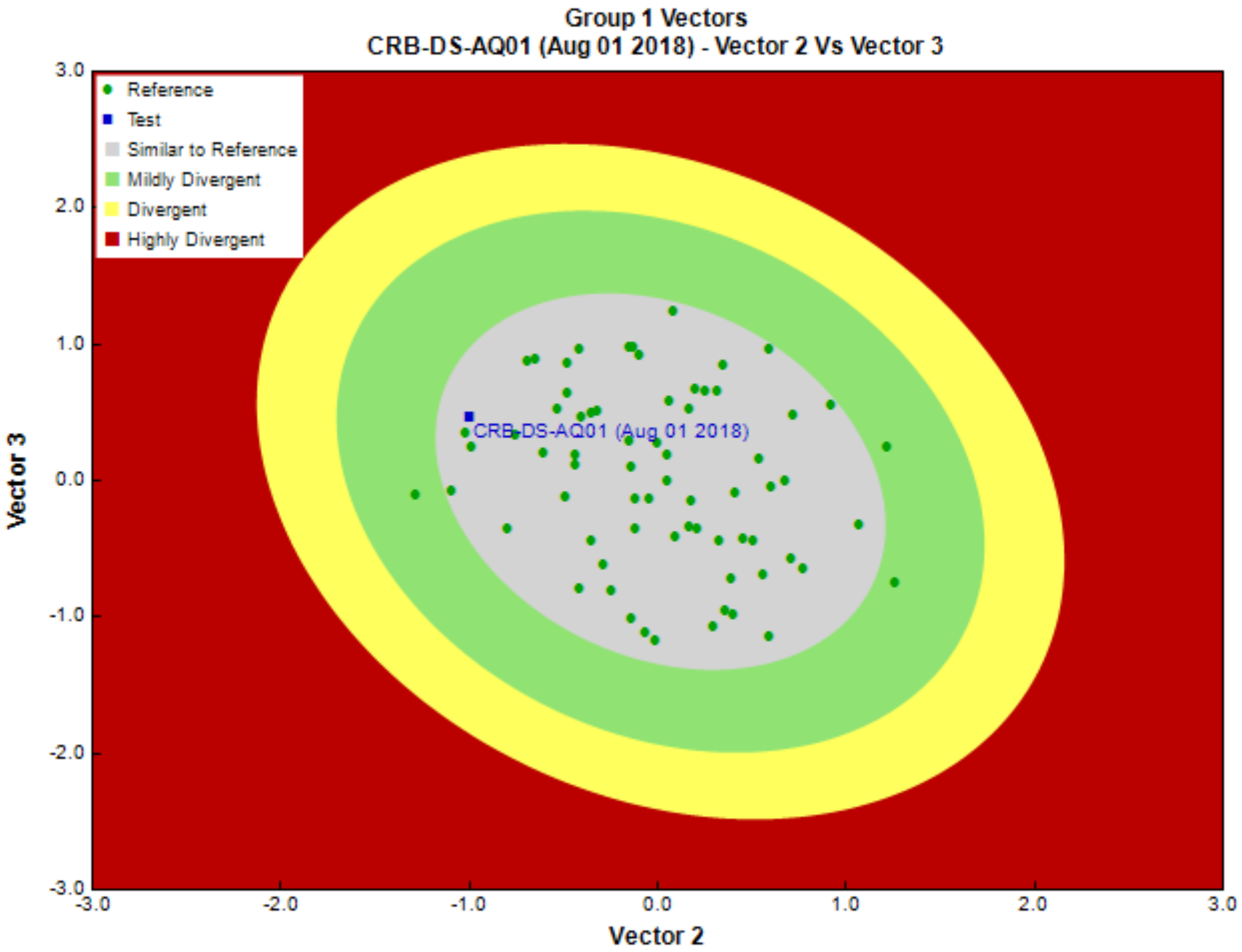


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	10/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	1	10.0
Arthropoda	Arachnida	Trombidiformes	Aturidae	1	10.0
			Hydryphantidae	1	10.0
			Hygrobatidae	3	30.0
			Lebertiidae	1	10.0
			Sperchontidae	1	10.0
			Torrenticolidae	1	10.0
	Insecta	Diptera	Chironomidae	44	440.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Empididae	4	40.0
			Simuliidae	14	140.0
			Tipulidae	4	40.0
		Ephemeroptera	Baetidae	116	1,160.0
			Ephemerellidae	1	10.0
			Heptageniidae	4	40.0
			Leptophlebiidae	24	240.0
		Plecoptera	Chloroperlidae	10	100.0
			Nemouridae	78	780.0
			Perlodidae	1	10.0
		Trichoptera	Limnephilidae	5	50.0
			Rhyacophilidae	5	50.0
			Total	319	3,190.0

Metrics

Name	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.43	0.5 ± 0.2
Functional Measures		
% Filterers	--	1.8 ± 2.9
% Gatherers	52.4	43.7 ± 17.3
% Predatores	23.8	20.9 ± 13.4
% Scrapers	43.6	54.8 ± 18.3
% Shredder	27.3	21.3 ± 13.9
No. Clinger Taxa	16.0	16.0 ± 5.6
Number Of Individuals		
% Diptera + Non-insects	23.5	19.1 ± 14.0
% EPT Individuals	76.5	79.0 ± 14.8
% of 5 dominant taxa	86.5	83.1 ± 9.3
No. EPT individuals/Chironomids+EPT Individuals	0.8	0.9 ± 0.1
Total Abundance	3190.0	5010.8 ± 6541.9
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	0.0	0.4 ± 0.5
Diptera taxa	4.0	3.1 ± 1.3
Ephemeroptera taxa	4.0	3.6 ± 1.0
EPT Individuals (Sum)	2440.0	3855.4 ± 5103.0
EPT taxa (no)	9.0	11.0 ± 2.8
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.7 ± 0.1
Plecoptera taxa	3.0	4.5 ± 1.3
Shannon-Wiener Diversity	1.9	1.9 ± 0.4
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	20.0	16.8 ± 4.7
Trichoptera taxa	2.0	2.9 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.30
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.03
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.02
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.04
Aturidae	4%	6%	0%	5%	0%	2%	0.05
Baetidae	97%	92%	79%	93%	62%	84%	0.92
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Brachycentridae	42%	53%	5%	35%	15%	27%	0.41
Caenidae	0%	0%	0%	1%	38%	0%	0.03
Capniidae	81%	60%	37%	65%	31%	69%	0.68
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.26
Chironomidae	100%	100%	89%	99%	100%	100%	1.00
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.76
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.02
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.03
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.47
Empididae	51%	65%	47%	62%	8%	51%	0.53
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.26
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.85
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.05
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.01
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.26
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.91
Hyalellidae	0%	5%	0%	0%	0%	0%	0.01
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.54
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.24
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.02
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.09
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.06
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.01
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.41
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.42
Leptoceridae	1%	15%	0%	5%	62%	2%	0.11
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.51
Leuctridae	35%	26%	11%	39%	8%	25%	0.31
Limnephilidae	36%	24%	21%	26%	0%	39%	0.28
Limnesiidae	7%	13%	5%	9%	46%	25%	0.13
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.12
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.03
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.02
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.41
Nemouridae	93%	73%	53%	81%	15%	73%	0.78
Oxidae	0%	2%	0%	1%	15%	0%	0.02
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.02
Perlidae	32%	29%	11%	32%	8%	20%	0.29
Perlodidae	64%	60%	79%	75%	31%	76%	0.62
Philopotamidae	1%	3%	0%	1%	0%	2%	0.02
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.28

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Planorbidae	1%	3%	0%	1%	31%	0%	0.04
Poduridae	0%	3%	0%	0%	0%	2%	0.01
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.24
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.48
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.38
Sperchontidae	17%	34%	37%	50%	23%	45%	0.29
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.01
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.02
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.43
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.60
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.38
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.03
Uenoidae	9%	8%	37%	17%	0%	10%	0.09
Unionicolidae	0%	0%	0%	0%	15%	0%	0.01
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	8.70
RIVPACS : Observed taxa P>0.50	10.00
RIVPACS : O:E (p > 0.5)	1.15
RIVPACS : Expected taxa P>0.70	5.21
RIVPACS : Observed taxa P>0.70	6.00
RIVPACS : O:E (p > 0.7)	1.15

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	0.33000	25.53190 ± 36.87363
Channel		
Depth-Avg (cm)	14.2	20.6 ± 10.3
Depth-BankfullMinusWetted (cm)	37.00	37.41 ± 19.51
Macrophyte (PercentRange)	0	0 ± 1
Reach-%CanopyCoverage (PercentRange)	3.00	0.86 ± 1.10
Reach-%Logging (PercentRange)	0	0 ± 0
Reach-DomStreamsideVeg (Category(1-4))	2	2 ± 1
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	0	1 ± 0
Slope (m/m)	0.0100000	0.0139981 ± 0.0172321
Veg-Coniferous (Binary)	0	1 ± 0
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.34	0.39 ± 0.19
Velocity-Max (m/s)	0.44	0.58 ± 0.28
Width-Bankfull (m)	4.5	18.4 ± 20.0
Width-Wetted (m)	3.1	7.4 ± 6.3
XSEC-VelMethod (Category(1-3))	1	3 ± 0
Climate		
Precip02_FEB (mm)	163.00000	57.95789 ± 41.70288

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Temp07_JULmax (Degrees Celsius)	20.48000	17.55944 ± 2.17158
Landcover		
Natl-SnowIce (%)	0.00000	0.55339 ± 1.25503
Natl-Water (%)	0.00000	1.38766 ± 2.38578
Natl-WetlandHerb (%)	0.00000	0.46466 ± 1.02141
Substrate Data		
%Bedrock (%)	0	1 ± 3
%Boulder (%)	1	6 ± 5
%Cobble (%)	50	52 ± 17
%Gravel (%)	18	6 ± 5
%Pebble (%)	26	34 ± 16
%Sand (%)	0	0 ± 1
%Silt+Clay (%)	5	1 ± 2
D50 (cm)	6.80	7.79 ± 2.83
Dg (cm)	3.9	7.0 ± 2.2
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	3	6 ± 1
Embeddedness (Category(1-5))	3	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
SlopeAvg (%)	26.12000	19.23143 ± 15.15733
Water Chemistry		
General-DO (mg/L)	7.5300000	11.6403031 ± 1.0007120
General-pH (pH)	7.5	7.6 ± 0.5
General-SpCond (µS/cm)	194.4000000	127.8461538 ± 102.3985239
General-TempAir (Degrees Celsius)	19.0	11.6 ± 4.1
General-TempWater (Degrees Celsius)	16.0000000	5.9833333 ± 2.8160802

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	CRB-DS-AQ01
Sampling Date	Jul 30 2019
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12654 N, 122.97168 W
Altitude	656
Local Basin Name	Crabapple Creek
	River of Golden Dreams
Stream Order	2

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	0.0%	0.0%	0.0%	16.5%	82.5%	1.0%
CABIN Assessment of CRB-DS-AQ01 on Jul 30, 2019	Mildly Divergent					

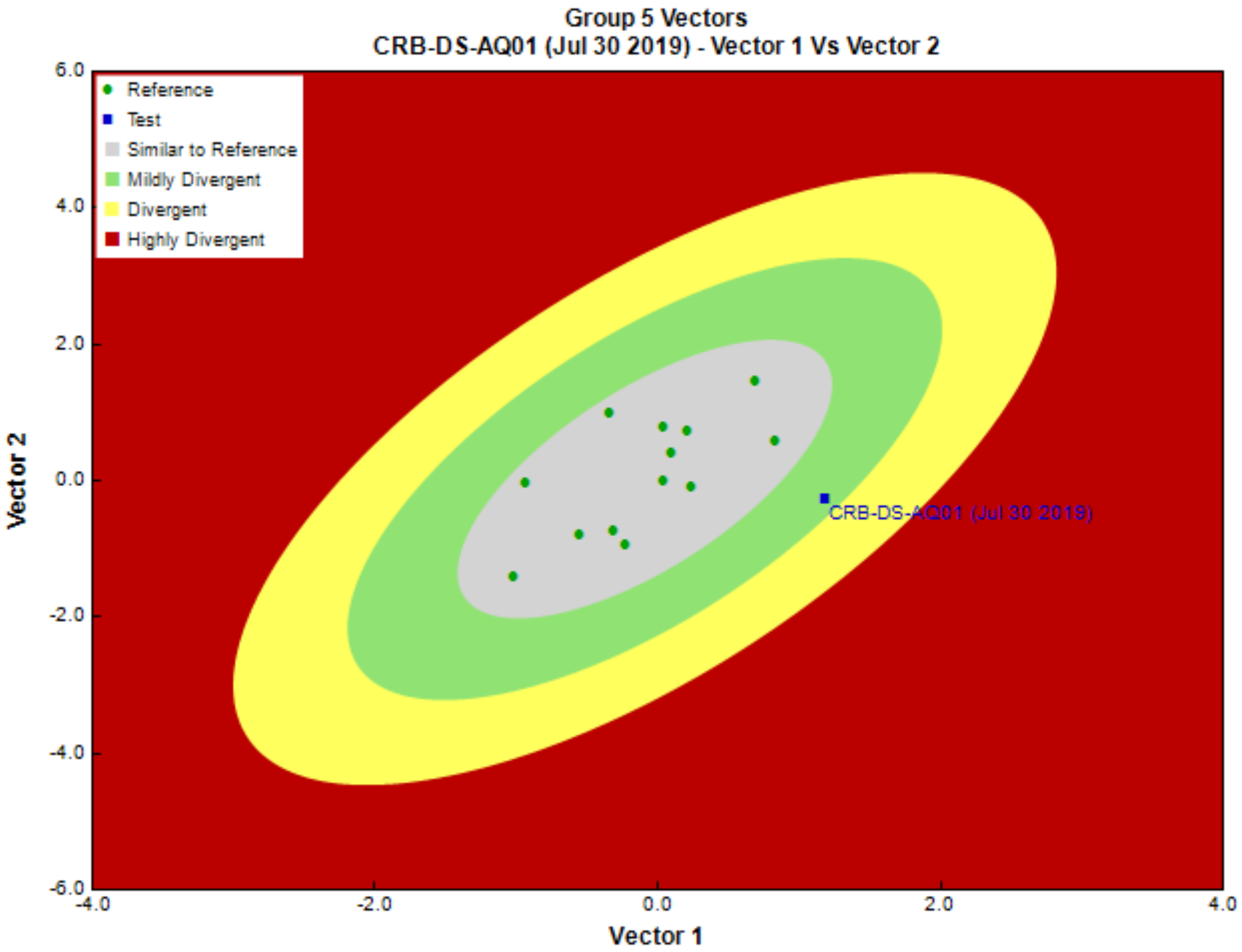


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	10/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	3	30.0
			Sperchontidae	2	20.0
			Stygothrombidiidae	1	10.0
	Collembola	Collembola		1	10.0
	Insecta	Diptera	Chironomidae	63	630.0
			Empididae	1	10.0
			Simuliidae	13	130.0
			Tipulidae	1	10.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Ephemeroptera	Baetidae	161	1,610.0
			Ephemerellidae	1	10.0
			Heptageniidae	1	10.0
			Leptophlebiidae	14	140.0
		Plecoptera	Chloroperlidae	5	50.0
			Nemouridae	77	770.0
		Trichoptera		1	10.0
			Rhyacophilidae	4	40.0
Mollusca	Bivalvia	Veneroida	Pisidiidae	1	10.0
			Total	350	3,500.0

Metrics

Name	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.72	0.6 ± 0.2
Functional Measures		
% Filterers	--	11.5 ± 10.5
% Gatherers	48.6	67.6 ± 30.3
% Predatores	24.9	41.1 ± 20.2
% Scrapers	50.0	34.3 ± 21.0
% Shredder	22.3	13.7 ± 9.2
No. Clinger Taxa	15.0	13.0 ± 5.7
Number Of Individuals		
% Diptera + Non-insects	24.4	47.4 ± 26.3
% EPT Individuals	75.6	49.6 ± 26.3
% of 5 dominant taxa	94.3	86.1 ± 8.4
No. EPT individuals/Chironomids+EPT Individuals	0.8	0.6 ± 0.2
Total Abundance	3500.0	13706.8 ± 8626.5
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	0.0	0.5 ± 0.5
Diptera taxa	4.0	2.6 ± 1.2
Ephemeroptera taxa	4.0	3.4 ± 1.2
EPT Individuals (Sum)	2630.0	7446.2 ± 6472.9
EPT taxa (no)	7.0	9.3 ± 3.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.6 ± 0.1
Plecoptera taxa	2.0	3.4 ± 1.8
Shannon-Wiener Diversity	1.5	1.7 ± 0.4
Simpson's Diversity	0.7	0.7 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	15.0	16.0 ± 4.0
Trichoptera taxa	1.0	2.5 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.08
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.00
Apataniidae	7%	2%	5%	11%	8%	8%	0.08
Arrenuridae	0%	2%	0%	0%	15%	0%	0.13
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.08
Aturidae	4%	6%	0%	5%	0%	2%	0.01
Baetidae	97%	92%	79%	93%	62%	84%	0.67
Blephariceridae	1%	0%	0%	2%	0%	2%	0.00
Brachycentridae	42%	53%	5%	35%	15%	27%	0.19
Caenidae	0%	0%	0%	1%	38%	0%	0.32
Capniidae	81%	60%	37%	65%	31%	69%	0.37

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.49
Chironomidae	100%	100%	89%	99%	100%	100%	1.00
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.41
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.06
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.00
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.00
Elmidae	48%	73%	5%	28%	15%	18%	0.18
Empididae	51%	65%	47%	62%	8%	51%	0.17
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.31
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.67
Ephemeridae	1%	0%	0%	3%	0%	0%	0.00
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.00
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.13
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.06
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.62
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.31
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.22
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.01
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.02
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.01
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.52
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.27
Leptoceridae	1%	15%	0%	5%	62%	2%	0.52
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.00
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.19
Leuctridae	35%	26%	11%	39%	8%	25%	0.13
Limnephilidae	36%	24%	21%	26%	0%	39%	0.05
Limnesiidae	7%	13%	5%	9%	46%	25%	0.40
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.41
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.07
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.00
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.78
Nemouridae	93%	73%	53%	81%	15%	73%	0.27
Oxidae	0%	2%	0%	1%	15%	0%	0.13
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.00
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.01
Perlidae	32%	29%	11%	32%	8%	20%	0.12
Perlodidae	64%	60%	79%	75%	31%	76%	0.39
Philopotamidae	1%	3%	0%	1%	0%	2%	0.00
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.00
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.46
Planorbidae	1%	3%	0%	1%	31%	0%	0.26
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Psychodidae	33%	21%	0%	22%	0%	4%	0.04
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.14
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.11
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.12
Sperchontidae	17%	34%	37%	50%	23%	45%	0.28
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.07
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.22
Tanyderidae	0%	0%	0%	3%	0%	6%	0.00
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.44
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.25
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.03
Unionicolidae	0%	0%	0%	0%	15%	0%	0.13
Valvatidae	3%	2%	0%	3%	8%	2%	0.07

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	4.77
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	0.84
RIVPACS : Expected taxa P>0.70	1.78
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	0.56

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	0.33000	15.90266 ± 33.91726
Channel		
Depth-Avg (cm)	12.8	40.5 ± 22.4
Depth-BankfullMinusWetted (cm)	35.00	188.00
Depth-Max (cm)	17.5	55.5 ± 31.7
Macrophyte (PercentRange)	0	1 ± 2
Reach-%CanopyCoverage (PercentRange)	4.00	0.23 ± 0.44
Reach-DomStreamsideVeg (Category(1-4))	2	2
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	0 ± 0
Reach-StraightRun (Binary)	0	1 ± 0
Slope (m/m)	3.0000000	0.0047331 ± 0.0082050
Veg-Coniferous (Binary)	0	0 ± 1
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.56	0.23 ± 0.24
Velocity-Max (m/s)	0.70	0.31 ± 0.35
Width-Bankfull (m)	3.4	75.1 ± 72.8
Width-Wetted (m)	2.3	50.6 ± 60.4
XSEC-VelMethod (Category(1-3))	1	3
Climate		
Precip02_FEB (mm)	163.00000	171.50745 ± 107.47690
Temp07_JULmax (Degrees Celsius)	20.48000	20.34230 ± 2.49485
Landcover		
Natl-SnowIce (%)	0.00000	3.62533 ± 10.17162

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Natl-Water (%)	0.00000	1.80201 ± 1.29922
Natl-WetlandHerb (%)	0.00000	0.68488 ± 0.92347
Substrate Data		
%Bedrock (%)	0	0
%Boulder (%)	1	0
%Cobble (%)	58	58
%Gravel (%)	2	1
%Pebble (%)	31	41
%Sand (%)	0	0
%Silt+Clay (%)	8	0
D50 (cm)	7.10	3.30
Dg (cm)	5.1	6.6
Dominant-1st (Category(0-9))	6	4 ± 2
Dominant-2nd (Category(0-9))	7	4 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	3
SurroundingMaterial (Category(0-9))	2	2 ± 1
Topography		
SlopeAvg (%)	26.12000	30.12236 ± 18.75100
Water Chemistry		
General-Conductivity (µS/cm)	184.9000000	79.0846153 ± 50.3407694
General-DO (mg/L)	10.0000000	9.3400000 ± 2.0171679
General-pH (pH)	7.6	6.8 ± 1.0
General-SpCond (µS/cm)	234.9000000	176.1000000
General-TempAir (Degrees Celsius)	13.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	13.9000000	13.2730769 ± 4.7663725

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	JOR-DS-AQ31
Sampling Date	Aug 03 2016
Know Your Watershed Basin	Strait of Georgia - East Shore
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.09545 N, 122.99735 W
Altitude	623
Local Basin Name	Jordan Creek
	Jordan Creek
Stream Order	2

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	13.7%	8.3%	0.2%	55.1%	2.4%	20.3%
CABIN Assessment of JOR-DS-AQ31 on Aug 03, 2016	Mildly Divergent					

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	October 03, 2016
	Marchant Box
Sub-Sample Proportion	16/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	4	25.0
	Insecta	Diptera	Ceratopogonidae	1	6.3
			Chironomidae	43	268.8
			Empididae	2	12.5
			Simuliidae	116	725.0
		Ephemeroptera	Baetidae	9	56.3
			Ephemerellidae	3	18.8
		Plecoptera	Chloroperlidae	1	6.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Nemouridae	145	906.3
			Perlidae	5	31.3
		Trichoptera	Hydropsychidae	5	31.3
			Rhyacophilidae	1	6.3
			Total	335	2,094.2

Metrics

Name	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.78	0.5 ± 0.1
Functional Measures		
% Filterers	--	17.2 ± 42.4
% Gatherers	93.1	57.6 ± 27.3
% Predatores	52.5	31.3 ± 20.3
% Scrapers	38.8	37.4 ± 22.0
% Shredder	43.3	16.1 ± 11.0
No. Clinger Taxa	8.0	15.8 ± 6.3
Number Of Individuals		
% Diptera + Non-insects	49.6	32.8 ± 26.0
% EPT Individuals	50.4	66.1 ± 26.2
% of 5 dominant taxa	94.9	82.2 ± 8.7
No. EPT individuals/Chironomids+EPT Individuals	0.8	0.7 ± 0.2
Total Abundance	2093.8	2646.7 ± 2772.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	0.0	0.3 ± 0.4
Diptera taxa	4.0	3.2 ± 1.3
Ephemeroptera taxa	2.0	3.6 ± 1.1
EPT Individuals (Sum)	1056.3	1501.0 ± 1294.6
EPT taxa (no)	7.0	10.8 ± 3.5
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.7 ± 0.1
Plecoptera taxa	3.0	4.1 ± 1.8
Shannon-Wiener Diversity	1.4	1.9 ± 0.4
Simpson's Diversity	0.7	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	12.0	18.0 ± 4.5
Trichoptera taxa	2.0	3.1 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.46
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.02
Apataniidae	7%	2%	5%	11%	8%	8%	0.09
Arrenuridae	0%	2%	0%	0%	15%	0%	0.00
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.06
Aturidae	4%	6%	0%	5%	0%	2%	0.04
Baetidae	97%	92%	79%	93%	62%	84%	0.91
Blephariceridae	1%	0%	0%	2%	0%	2%	0.02
Brachycentridae	42%	53%	5%	35%	15%	27%	0.35
Caenidae	0%	0%	0%	1%	38%	0%	0.01
Capniidae	81%	60%	37%	65%	31%	69%	0.67
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.24
Chironomidae	100%	100%	89%	99%	100%	100%	1.00
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.84
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.01
Curculionidae	0%	0%	0%	1%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.01
Dixidae	1%	6%	0%	1%	0%	2%	0.02
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.32
Empididae	51%	65%	47%	62%	8%	51%	0.57
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.33
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.90
Ephemeridae	1%	0%	0%	3%	0%	0%	0.02
Feltriidae	0%	0%	0%	2%	0%	0%	0.01
Gammaridae	7%	6%	0%	0%	0%	0%	0.02
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.00
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.27
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.95
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.61
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.16
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.10
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.04
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.43
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.39
Leptoceridae	1%	15%	0%	5%	62%	2%	0.06
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.38
Leuctridae	35%	26%	11%	39%	8%	25%	0.34
Limnephilidae	36%	24%	21%	26%	0%	39%	0.29
Limnesiidae	7%	13%	5%	9%	46%	25%	0.14
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.15
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.04
Naididae	26%	47%	5%	46%	85%	33%	0.42
Nemouridae	93%	73%	53%	81%	15%	73%	0.79
Oxidae	0%	2%	0%	1%	15%	0%	0.01
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.05
Perlidae	32%	29%	11%	32%	8%	20%	0.28
Perlodidae	64%	60%	79%	75%	31%	76%	0.72
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.02
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.16
Planorbidae	1%	3%	0%	1%	31%	0%	0.02
Poduridae	0%	3%	0%	0%	0%	2%	0.01
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.01
Psychodidae	33%	21%	0%	22%	0%	4%	0.19
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.60
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.32

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Sperchontidae	17%	34%	37%	50%	23%	45%	0.43
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.01
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.03
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.53
Tanyderidae	0%	0%	0%	3%	0%	6%	0.03
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.01
Tipulidae	67%	50%	42%	68%	38%	63%	0.65
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.31
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.02
Uenoidae	9%	8%	37%	17%	0%	10%	0.13
Unionicolidae	0%	0%	0%	0%	15%	0%	0.00
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	9.71
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	0.82
RIVPACS : Expected taxa P>0.70	6.09
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	0.82

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	60.51000	28.74839 ± 35.48825
Channel		
Depth-Avg (cm)	18.5	28.0 ± 13.9
Depth-BankfullMinusWetted (cm)	74.00	47.88 ± 26.69
Depth-Max (cm)	24.0	41.3 ± 21.8
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	3.00	0.92 ± 1.11
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
Reach-Pools (Binary)	1	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0300000	0.0249850 ± 0.0294369
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	0 ± 1
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.40	0.45 ± 0.21
Velocity-Max (m/s)	0.77	0.67 ± 0.25
Width-Bankfull (m)	7.1	35.9 ± 41.6
Width-Wetted (m)	4.2	17.8 ± 20.2
XSEC-VelInstrumentDirect (Category(1-3))	1	2 ± 0
XSEC-VelMethod (Category(1-3))	3	3 ± 1
Climate		
Precip02_FEB (mm)	163.27000	94.95103 ± 61.64910
Temp07_JULmax (Degrees Celsius)	18.72000	17.48320 ± 2.57900
Landcover		
Natl-SnowIce (%)	3.08000	4.62982 ± 9.77010
Natl-Water (%)	1.45000	1.55060 ± 2.36345
Natl-WetlandHerb (%)	0.00000	0.18446 ± 0.50703
Substrate Data		
%Bedrock (%)	0	0 ± 1
%Boulder (%)	15	11 ± 11

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
%Cobble (%)	52	53 ± 11
%Gravel (%)	8	5 ± 4
%Pebble (%)	25	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	1 ± 3
D50 (cm)	12.00	8.04 ± 4.60
Dg (cm)	9.2	8.2 ± 3.1
Dominant-1st (Category(0-9))	7	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
SlopeAvg (%)	40.36000	31.09165 ± 12.51836
Water Chemistry		
General-DO (mg/L)	9.3200000	11.4180702 ± 1.2821697
General-pH (pH)	7.1	7.7 ± 0.7
General-SpCond (µS/cm)	63.6000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	17.4	12.1 ± 4.3
General-TempWater (Degrees Celsius)	15.8000000	7.6535897 ± 3.4680513
General-Turbidity (NTU)	0.6300000	0.5500000 ± 0.6138116

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	JOR-DS-AQ31
Sampling Date	Jul 26 2017
Know Your Watershed Basin	Strait of Georgia - East Shore
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.09528 N, 122.99778 W
Altitude	602
Local Basin Name	Jordan Creek
	Jordan Creek
Stream Order	2

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	18.0%	9.7%	0.2%	51.5%	2.1%	18.5%
CABIN Assessment of JOR-DS-AQ31 on Jul 26, 2017	Mildly Divergent					

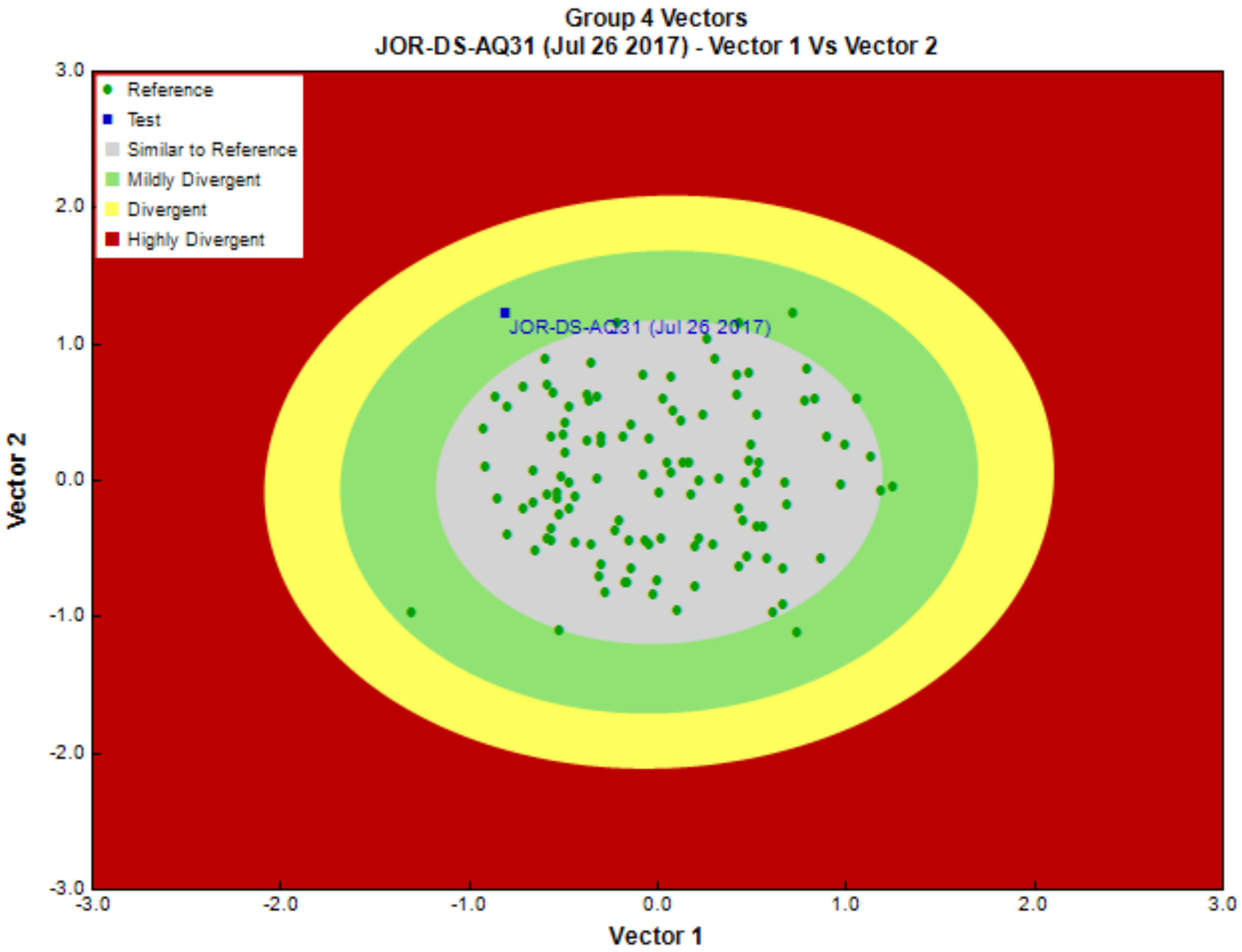


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	November 03, 2017
	Marchant Box
Sub-Sample Proportion	14/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	1	7.1
	Collembola	Collembola		1	7.1
	Insecta	Diptera	Chironomidae	49	350.0
			Empididae	4	28.6
			Simuliidae	233	1,664.3
			Tipulidae	1	7.1
		Ephemeroptera	Baetidae	41	292.9
			Ephemerellidae	3	21.4

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Leptophlebiidae	3	21.4
		Plecoptera	Chloroperlidae	1	7.1
			Leuctridae	1	7.1
			Nemouridae	20	142.9
			Perlidae	1	7.1
		Trichoptera	Rhyacophilidae	1	7.1
			Total	360	2,571.2

Metrics

Name	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.76	0.5 ± 0.1
Functional Measures		
% Filterers	--	17.2 ± 42.4
% Gatherers	85.8	57.6 ± 27.3
% Predatores	80.3	31.3 ± 20.3
% Scrapers	76.1	37.4 ± 22.0
% Shredder	6.1	16.1 ± 11.0
No. Clinger Taxa	9.0	15.8 ± 6.3
Number Of Individuals		
% Diptera + Non-insects	80.2	32.8 ± 26.0
% EPT Individuals	19.8	66.1 ± 26.2
% of 5 dominant taxa	96.7	82.2 ± 8.7
No. EPT individuals/Chironomids+EPT Individuals	0.6	0.7 ± 0.2
Total Abundance	2571.4	2646.7 ± 2772.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	0.0	0.3 ± 0.4
Diptera taxa	4.0	3.2 ± 1.3
Ephemeroptera taxa	3.0	3.6 ± 1.1
EPT Individuals (Sum)	507.1	1501.0 ± 1294.6
EPT taxa (no)	8.0	10.8 ± 3.5
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.5	0.7 ± 0.1
Plecoptera taxa	4.0	4.1 ± 1.8
Shannon-Wiener Diversity	1.2	1.9 ± 0.4
Simpson's Diversity	0.5	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	13.0	18.0 ± 4.5
Trichoptera taxa	1.0	3.1 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.44
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.02
Apataniidae	7%	2%	5%	11%	8%	8%	0.09
Arrenuridae	0%	2%	0%	0%	15%	0%	0.00
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.05
Aturidae	4%	6%	0%	5%	0%	2%	0.04
Baetidae	97%	92%	79%	93%	62%	84%	0.91
Blephariceridae	1%	0%	0%	2%	0%	2%	0.02
Brachycentridae	42%	53%	5%	35%	15%	27%	0.36
Caenidae	0%	0%	0%	1%	38%	0%	0.01
Capniidae	81%	60%	37%	65%	31%	69%	0.67
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.24
Chironomidae	100%	100%	89%	99%	100%	100%	1.00
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.84

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.01
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.01
Dixidae	1%	6%	0%	1%	0%	2%	0.02
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.34
Empididae	51%	65%	47%	62%	8%	51%	0.57
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.32
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.89
Ephemeridae	1%	0%	0%	3%	0%	0%	0.02
Feltriidae	0%	0%	0%	2%	0%	0%	0.01
Gammaridae	7%	6%	0%	0%	0%	0%	0.02
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.00
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.28
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.95
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.61
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.17
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.10
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.03
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.42
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.40
Leptoceridae	1%	15%	0%	5%	62%	2%	0.06
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.40
Leuctridae	35%	26%	11%	39%	8%	25%	0.34
Limnephilidae	36%	24%	21%	26%	0%	39%	0.29
Limnesiidae	7%	13%	5%	9%	46%	25%	0.13
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.15
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.03
Naididae	26%	47%	5%	46%	85%	33%	0.41
Nemouridae	93%	73%	53%	81%	15%	73%	0.79
Oxidae	0%	2%	0%	1%	15%	0%	0.01
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.05
Perlidae	32%	29%	11%	32%	8%	20%	0.29
Perlodidae	64%	60%	79%	75%	31%	76%	0.71
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.17
Planorbidae	1%	3%	0%	1%	31%	0%	0.02
Poduridae	0%	3%	0%	0%	0%	2%	0.01
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.01
Psychodidae	33%	21%	0%	22%	0%	4%	0.20
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.59

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.33
Sperchontidae	17%	34%	37%	50%	23%	45%	0.41
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.01
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.03
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.52
Tanyderidae	0%	0%	0%	3%	0%	6%	0.02
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.01
Tipulidae	67%	50%	42%	68%	38%	63%	0.65
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.31
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.02
Uenoidae	9%	8%	37%	17%	0%	10%	0.13
Unionicolidae	0%	0%	0%	0%	15%	0%	0.00
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	9.70
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	0.82
RIVPACS : Expected taxa P>0.70	6.09
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	0.82

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	60.51000	28.74839 ± 35.48825
Channel		
Depth-Avg (cm)	16.3	28.0 ± 13.9
Depth-BankfullMinusWetted (cm)	45.00	47.88 ± 26.69
Depth-Max (cm)	30.0	41.3 ± 21.8
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	4.00	0.92 ± 1.11
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0200000	0.0249850 ± 0.0294369
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	0 ± 1
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.96	0.45 ± 0.21
Velocity-Max (m/s)	1.69	0.67 ± 0.25
Width-Bankfull (m)	5.7	35.9 ± 41.6
Width-Wetted (m)	3.4	17.8 ± 20.2
XSEC-VelInstrumentDirect (Category(1-3))	1	2 ± 0
XSEC-VelMethod (Category(1-3))	3	3 ± 1
Climate		
Precip02_FEB (mm)	163.27000	94.95103 ± 61.64910
Temp07_JULmax (Degrees Celsius)	18.72000	17.48320 ± 2.57900
Landcover		
Natl-SnowIce (%)	3.08000	4.62982 ± 9.77010
Natl-Water (%)	1.45000	1.55060 ± 2.36345
Natl-WetlandHerb (%)	0.00000	0.18446 ± 0.50703
Substrate Data		
%Bedrock (%)	0	0 ± 1

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
%Boulder (%)	14	11 ± 11
%Cobble (%)	53	53 ± 11
%Gravel (%)	6	5 ± 4
%Pebble (%)	27	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	1 ± 3
D50 (cm)	11.00	8.04 ± 4.60
Dg (cm)	8.9	8.2 ± 3.1
Dominant-1st (Category(0-9))	7	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
SlopeAvg (%)	40.36000	31.09165 ± 12.51836
Water Chemistry		
General-DO (mg/L)	8.9000000	11.4180702 ± 1.2821697
General-pH (pH)	7.1	7.7 ± 0.7
General-SpCond (µS/cm)	105.1000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	16.0	12.1 ± 4.3
General-TempWater (Degrees Celsius)	14.9000000	7.6535897 ± 3.4680513

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	JOR-DS-AQ31
Sampling Date	Aug 01 2018
Know Your Watershed Basin	Strait of Georgia - East Shore
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.09561 N, 122.99744 W
Altitude	644
Local Basin Name	Jordan Creek
	Jordan Creek
Stream Order	2

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	10.3%	7.0%	0.1%	57.0%	7.5%	18.1%
CABIN Assessment of JOR-DS-AQ31 on Aug 01, 2018	Mildly Divergent					

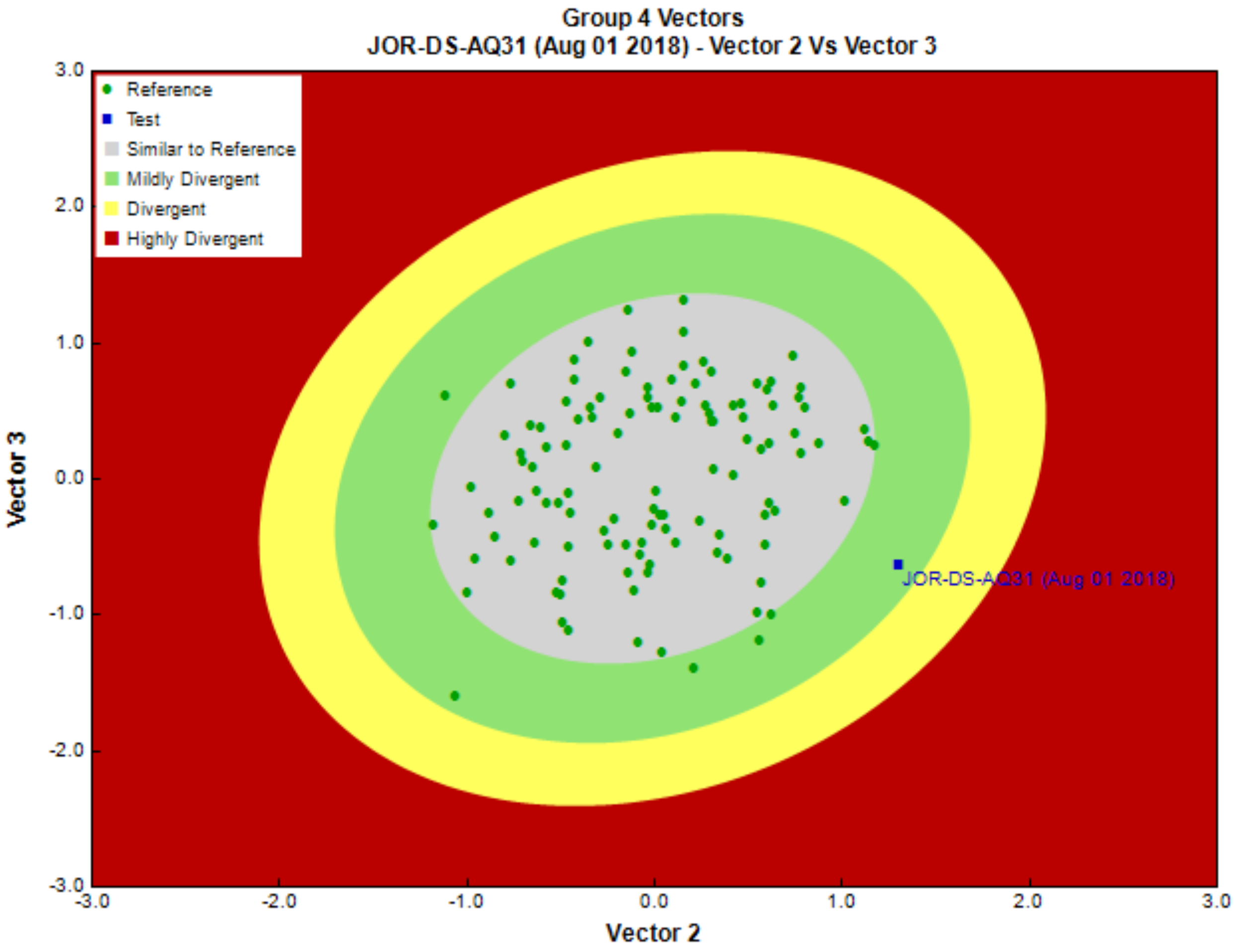


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	17/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	1	5.9
	Insecta	Diptera	Chironomidae	46	270.5
			Simuliidae	223	1,311.8
			Tipulidae	1	5.9
		Ephemeroptera	Ameletidae	1	5.9
			Baetidae	24	141.2
			Ephemerellidae	4	23.5
			Leptophlebiidae	9	52.9

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera	Chloroperlidae	1	5.9
			Nemouridae	40	235.3
			Perlidae	5	29.4
		Trichoptera	Hydropsychidae	2	11.8
			Lepidostomatidae	2	11.8
			Rhyacophilidae	4	23.5
Mollusca	Bivalvia	Veneroida	Pisidiidae	2	11.8
			Total	365	2,147.1

Metrics

Name	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.73	0.5 ± 0.1
Functional Measures		
% Filterers	--	17.2 ± 42.4
% Gatherers	89.9	57.6 ± 27.3
% Predatores	77.0	31.3 ± 20.3
% Scrapers	68.2	37.4 ± 22.0
% Shredder	11.8	16.1 ± 11.0
No. Clinger Taxa	15.0	15.8 ± 6.3
Number Of Individuals		
% Diptera + Non-insects	74.8	32.8 ± 26.0
% EPT Individuals	25.2	66.1 ± 26.2
% of 5 dominant taxa	93.7	82.2 ± 8.7
No. EPT individuals/Chironomids+EPT Individuals	0.7	0.7 ± 0.2
Total Abundance	2147.1	2646.7 ± 2772.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	0.0	0.3 ± 0.4
Diptera taxa	3.0	3.2 ± 1.3
Ephemeroptera taxa	4.0	3.6 ± 1.1
EPT Individuals (Sum)	541.2	1501.0 ± 1294.6
EPT taxa (no)	10.0	10.8 ± 3.5
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.5	0.7 ± 0.1
Plecoptera taxa	3.0	4.1 ± 1.8
Shannon-Wiener Diversity	1.4	1.9 ± 0.4
Simpson's Diversity	0.6	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	15.0	18.0 ± 4.5
Trichoptera taxa	3.0	3.1 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.44
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.09
Arrenuridae	0%	2%	0%	0%	15%	0%	0.01
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.06
Aturidae	4%	6%	0%	5%	0%	2%	0.04
Baetidae	97%	92%	79%	93%	62%	84%	0.90
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.34
Caenidae	0%	0%	0%	1%	38%	0%	0.03
Capniidae	81%	60%	37%	65%	31%	69%	0.64
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.26
Chironomidae	100%	100%	89%	99%	100%	100%	1.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.82
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.01
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.01
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.30
Empididae	51%	65%	47%	62%	8%	51%	0.55
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.33
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.89
Ephemeridae	1%	0%	0%	3%	0%	0%	0.02
Feltriidae	0%	0%	0%	2%	0%	0%	0.01
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.01
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.26
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.93
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.60
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.16
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.10
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.04
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.44
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.39
Leptoceridae	1%	15%	0%	5%	62%	2%	0.09
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.37
Leuctridae	35%	26%	11%	39%	8%	25%	0.33
Limnephilidae	36%	24%	21%	26%	0%	39%	0.27
Limnesiidae	7%	13%	5%	9%	46%	25%	0.15
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.17
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.04
Naididae	26%	47%	5%	46%	85%	33%	0.45
Nemouridae	93%	73%	53%	81%	15%	73%	0.75
Oxidae	0%	2%	0%	1%	15%	0%	0.02
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.05
Perlidae	32%	29%	11%	32%	8%	20%	0.27
Perlodidae	64%	60%	79%	75%	31%	76%	0.70
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.02
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.18
Planorbidae	1%	3%	0%	1%	31%	0%	0.03
Poduridae	0%	3%	0%	0%	0%	2%	0.01
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.01
Psychodidae	33%	21%	0%	22%	0%	4%	0.18
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.57
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.31
Sperchontidae	17%	34%	37%	50%	23%	45%	0.43
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.01
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.03
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.51
Tanyderidae	0%	0%	0%	3%	0%	6%	0.03
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.01
Tipulidae	67%	50%	42%	68%	38%	63%	0.64
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.31
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.02
Uenoidae	9%	8%	37%	17%	0%	10%	0.13
Unionicolidae	0%	0%	0%	0%	15%	0%	0.01
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	9.48
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	0.84
RIVPACS : Expected taxa P>0.70	5.28
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	0.95

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	60.51000	28.74839 ± 35.48825
Channel		
Depth-Avg (cm)	30.3	28.0 ± 13.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	4.00	0.92 ± 1.11
Reach-%Logging (PercentRange)	0	0 ± 1
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0500000	0.0249850 ± 0.0294369
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	0 ± 1
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.55	0.45 ± 0.21
Velocity-Max (m/s)	0.83	0.67 ± 0.25
Width-Bankfull (m)	4.4	35.9 ± 41.6
Width-Wetted (m)	4.2	17.8 ± 20.2
XSEC-VelMethod (Category(1-3))	1	3 ± 1
Climate		
Precip02_FEB (mm)	163.27000	94.95103 ± 61.64910
Temp07_JULmax (Degrees Celsius)	18.72000	17.48320 ± 2.57900
Landcover		
Natl-SnowIce (%)	3.08000	4.62982 ± 9.77010
Natl-Water (%)	1.45000	1.55060 ± 2.36345
Natl-WetlandHerb (%)	0.00000	0.18446 ± 0.50703
Substrate Data		

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
%Bedrock (%)	0	0 ± 1
%Boulder (%)	2	11 ± 11
%Cobble (%)	58	53 ± 11
%Gravel (%)	5	5 ± 4
%Pebble (%)	34	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	1	1 ± 3
D50 (cm)	8.00	8.04 ± 4.60
Dg (cm)	6.6	8.2 ± 3.1
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 1
Embeddedness (Category(1-5))	3	4 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
SlopeAvg (%)	40.36000	31.09165 ± 12.51836
Water Chemistry		
General-DO (mg/L)	7.7400000	11.4180702 ± 1.2821697
General-pH (pH)	7.1	7.7 ± 0.7
General-SpCond (µS/cm)	65.4000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	23.5	12.1 ± 4.3
General-TempWater (Degrees Celsius)	18.8000000	7.6535897 ± 3.4680513
General-Turbidity (NTU)	36.0000000	0.5500000 ± 0.6138116

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	JOR-DS-AQ31
Sampling Date	Jul 30 2019
Know Your Watershed Basin	Strait of Georgia - East Shore
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.09550 N, 122.99729 W
Altitude	0
Local Basin Name	Jordan Creek
	Jordan Creek
Stream Order	2

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	7.9%	6.1%	0.1%	61.9%	2.6%	21.4%
CABIN Assessment of JOR-DS-AQ31 on Jul 30, 2019	Similar to Reference					

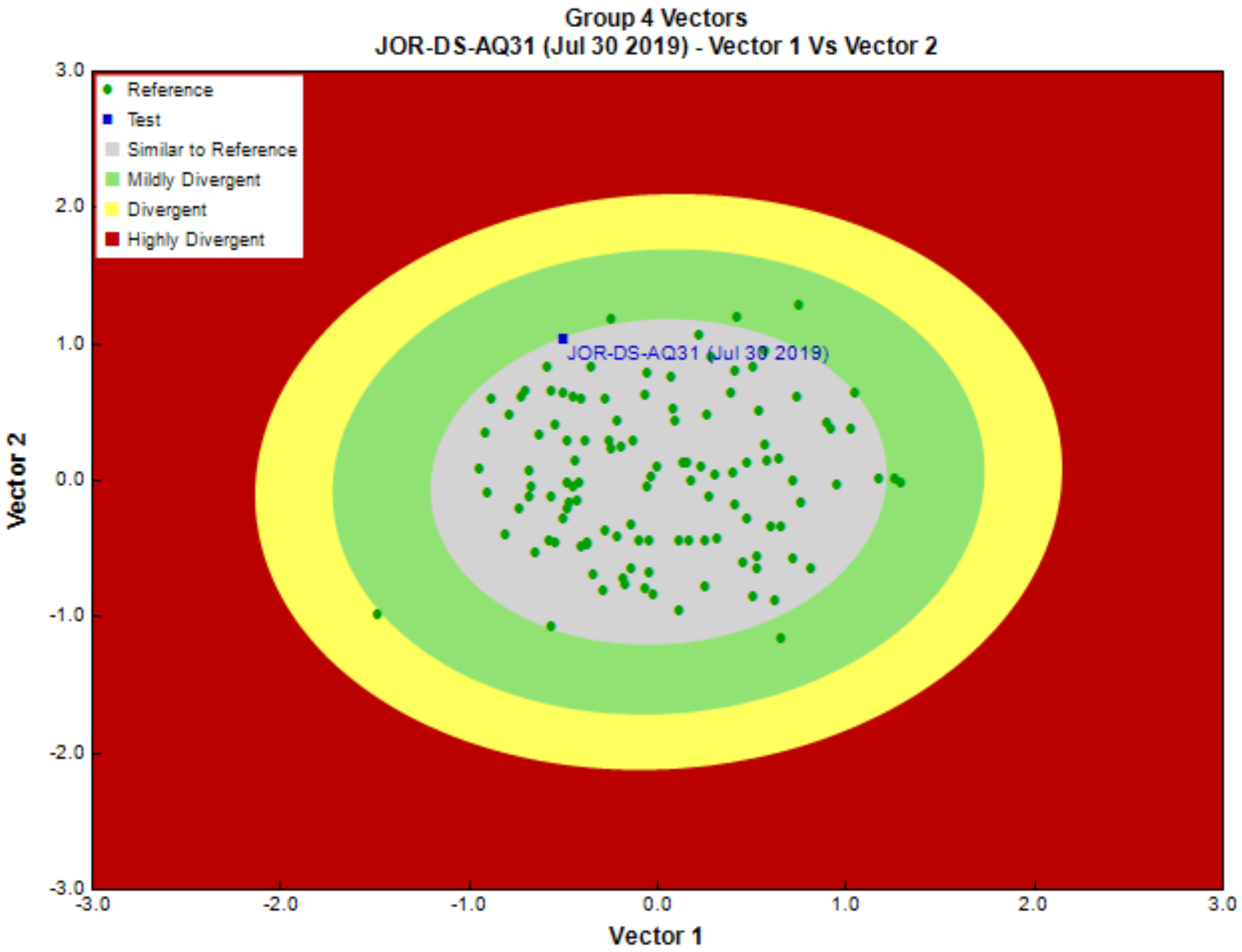


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	35/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	2	5.7
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	1	2.9
	Collembola	Collembola		1	2.9
	Insecta	Diptera	Chironomidae	160	457.3
			Simuliidae	10	28.6
			Tipulidae	1	2.9
		Ephemeroptera	Baetidae	74	211.5
			Ephemerellidae	7	20.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Leptophlebiidae	2	5.7
		Plecoptera	Chloroperlidae	1	2.9
			Nemouridae	48	137.2
			Perlidae	3	8.6
		Trichoptera	Glossosomatidae	1	2.9
			Hydropsychidae	1	2.9
			Lepidostomatidae	4	11.4
			Philopotamidae	1	2.9
Cnidaria	Hydrozoa	Anthoathecatae	Hydridae	1	2.9
Mollusca	Bivalvia	Veneroida	Pisidiidae	8	22.9
	Gastropoda	Basommatophora	Physidae	2	5.7
			Total	328	937.8

Metrics

Name	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.57	0.5 ± 0.1
Functional Measures		
% Filterers	0.3	17.2 ± 42.4
% Gatherers	73.7	57.6 ± 27.3
% Predatores	53.8	31.3 ± 20.3
% Scrapers	26.9	37.4 ± 22.0
% Shredder	16.2	16.1 ± 11.0
No. Clinger Taxa	18.0	15.8 ± 6.3
Number Of Individuals		
% Diptera + Non-insects	56.4	32.8 ± 26.0
% EPT Individuals	43.6	66.1 ± 26.2
% of 5 dominant taxa	92.0	82.2 ± 8.7
No. EPT individuals/Chironomids+EPT Individuals	0.5	0.7 ± 0.2
Total Abundance	934.3	2646.7 ± 2772.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	0.0	0.3 ± 0.4
Diptera taxa	3.0	3.2 ± 1.3
Ephemeroptera taxa	3.0	3.6 ± 1.1
EPT Individuals (Sum)	405.7	1501.0 ± 1294.6
EPT taxa (no)	10.0	10.8 ± 3.5
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.5	0.7 ± 0.1
Plecoptera taxa	3.0	4.1 ± 1.8
Shannon-Wiener Diversity	1.5	1.9 ± 0.4
Simpson's Diversity	0.7	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	18.0	18.0 ± 4.5
Trichoptera taxa	4.0	3.1 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.47
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.09
Arrenuridae	0%	2%	0%	0%	15%	0%	0.00
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.06
Aturidae	4%	6%	0%	5%	0%	2%	0.04
Baetidae	97%	92%	79%	93%	62%	84%	0.91
Blephariceridae	1%	0%	0%	2%	0%	2%	0.02
Brachycentridae	42%	53%	5%	35%	15%	27%	0.35

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Caenidae	0%	0%	0%	1%	38%	0%	0.02
Capniidae	81%	60%	37%	65%	31%	69%	0.66
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.24
Chironomidae	100%	100%	89%	99%	100%	100%	0.99
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.85
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.00
Curculionidae	0%	0%	0%	1%	0%	0%	0.01
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.01
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.30
Empididae	51%	65%	47%	62%	8%	51%	0.57
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.34
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.90
Ephemeridae	1%	0%	0%	3%	0%	0%	0.02
Feltriidae	0%	0%	0%	2%	0%	0%	0.01
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.00
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.27
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.95
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.62
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.15
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.10
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.04
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.43
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.39
Leptoceridae	1%	15%	0%	5%	62%	2%	0.06
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.36
Leuctridae	35%	26%	11%	39%	8%	25%	0.34
Limnephilidae	36%	24%	21%	26%	0%	39%	0.29
Limnesiidae	7%	13%	5%	9%	46%	25%	0.14
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.16
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.04
Naididae	26%	47%	5%	46%	85%	33%	0.43
Nemouridae	93%	73%	53%	81%	15%	73%	0.78
Oxidae	0%	2%	0%	1%	15%	0%	0.01
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.05
Perlidae	32%	29%	11%	32%	8%	20%	0.28
Perlodidae	64%	60%	79%	75%	31%	76%	0.73
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.01
Pionidae	0%	2%	0%	3%	0%	0%	0.02
Piscicolidae	0%	0%	0%	1%	0%	0%	0.01
Pisidiidae	16%	53%	0%	11%	54%	12%	0.15
Planorbidae	1%	3%	0%	1%	31%	0%	0.02

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at JOR-DS-AQ31
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Poduridae	0%	3%	0%	0%	0%	2%	0.01
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.01
Psychodidae	33%	21%	0%	22%	0%	4%	0.18
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.60
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.31
Sperchontidae	17%	34%	37%	50%	23%	45%	0.45
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.01
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.03
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.53
Tanyderidae	0%	0%	0%	3%	0%	6%	0.03
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.01
Tipulidae	67%	50%	42%	68%	38%	63%	0.65
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.30
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.03
Uenoidae	9%	8%	37%	17%	0%	10%	0.14
Unionicolidae	0%	0%	0%	0%	15%	0%	0.00
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	9.74
RIVPACS : Observed taxa P>0.50	7.00
RIVPACS : O:E (p > 0.5)	0.72
RIVPACS : Expected taxa P>0.70	6.11
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	0.82

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	60.51000	28.74839 ± 35.48825
Channel		
Depth-BankfullMinusWetted (cm)	14.00	47.88 ± 26.69
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	3.00	0.92 ± 1.11
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0500000	0.0249850 ± 0.0294369
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	0 ± 1
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.67	0.45 ± 0.21
Velocity-Max (m/s)	0.89	0.67 ± 0.25
Width-Bankfull (m)	4.2	35.9 ± 41.6
Width-Wetted (m)	4.4	17.8 ± 20.2
XSEC-VelMethod (Category(1-3))	1	3 ± 1
Climate		
Precip02_FEB (mm)	163.27000	94.95103 ± 61.64910
Temp07_JULmax (Degrees Celsius)	18.72000	17.48320 ± 2.57900
Landcover		
Natl-SnowIce (%)	3.08000	4.62982 ± 9.77010

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Natl-Water (%)	1.45000	1.55060 ± 2.36345
Natl-WetlandHerb (%)	0.00000	0.18446 ± 0.50703
Substrate Data		
%Bedrock (%)	0	0 ± 1
%Boulder (%)	15	11 ± 11
%Cobble (%)	72	53 ± 11
%Gravel (%)	2	5 ± 4
%Pebble (%)	11	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	1 ± 3
D50 (cm)	14.50	8.04 ± 4.60
Dg (cm)	12.6	8.2 ± 3.1
Dominant-1st (Category(0-9))	7	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	4	3 ± 1
Topography		
SlopeAvg (%)	40.36000	31.09165 ± 12.51836
Water Chemistry		
General-Conductivity (μS/cm)	67.1000000	92.7298969 ± 75.6979499
General-DO (mg/L)	9.4400000	11.4180702 ± 1.2821697
General-pH (pH)	7.7	7.7 ± 0.7
General-SpCond (μS/cm)	78.4000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	12.0	12.1 ± 4.3
General-TempWater (Degrees Celsius)	17.4000000	7.6535897 ± 3.4680513

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-DS-AQ12
Sampling Date	Aug 05 2016
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.14432 N, 122.95758 W
Altitude	631
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	17.2%	8.4%	16.0%	26.5%	22.7%	9.2%
CABIN Assessment of RGD-DS-AQ12 on Aug 05, 2016	Similar to Reference					

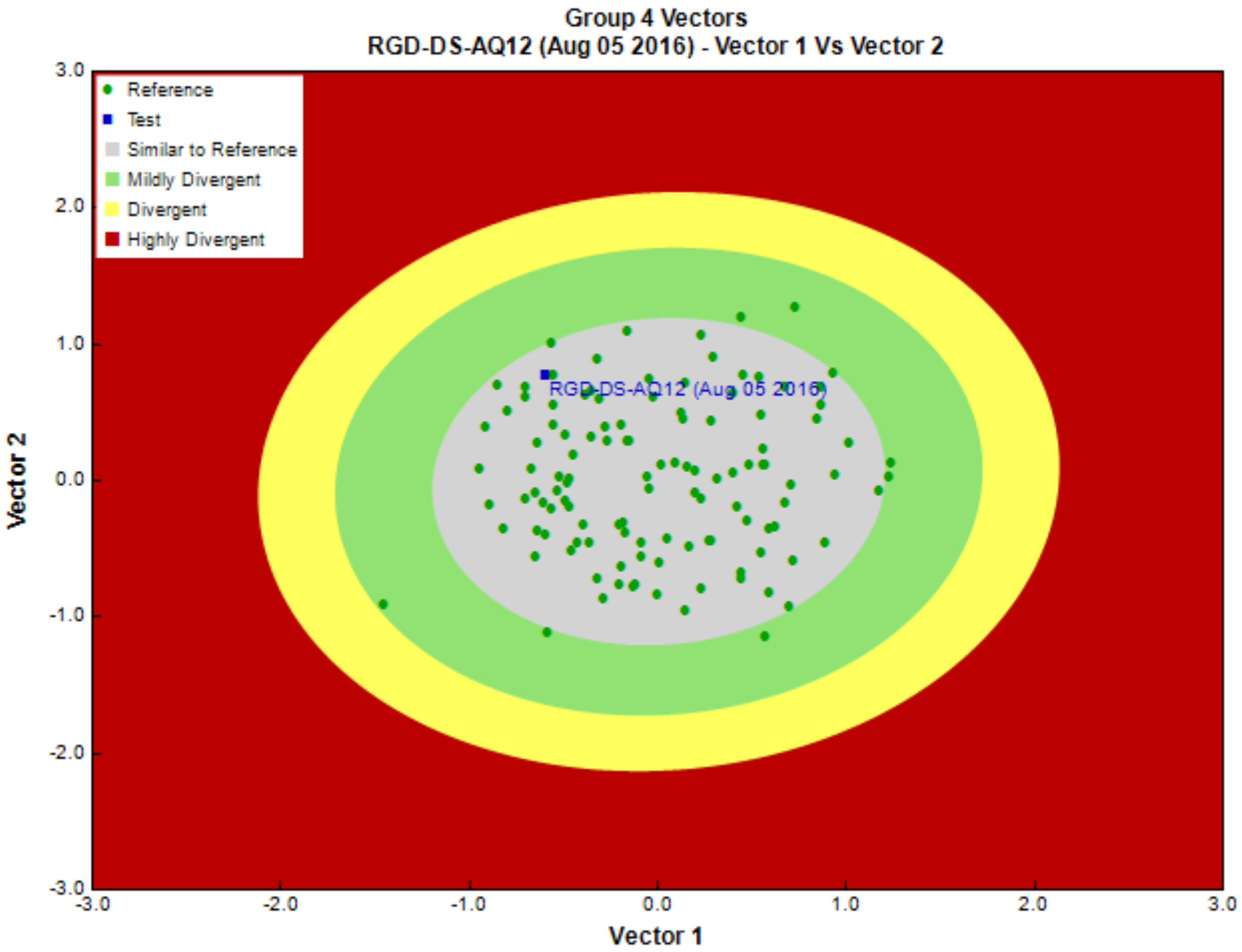


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	October 20, 2016
	Marchant Box
Sub-Sample Proportion	19/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	16	84.2
	Insecta	Coleoptera	Dytiscidae	2	10.5
		Diptera	Ceratopogonidae	2	10.5
			Chironomidae	45	236.8
			Empididae	4	21.0
			Simuliidae	3	15.8
		Ephemeroptera	Baetidae	80	421.0
			Ephemerellidae	71	373.7

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Heptageniidae	2	10.5
		Plecoptera	Chloroperlidae	1	5.3
			Leuctridae	5	26.3
			Nemouridae	73	384.2
			Perlodidae	1	5.3
		Trichoptera	Hydropsychidae	5	26.3
			Limnephilidae	1	5.3
			Rhyacophilidae	1	5.3
			Total	312	1,642.0

Metrics

Name	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.57	0.5 ± 0.1
Functional Measures		
% Filterers	--	17.2 ± 42.4
% Gatherers	63.1	57.6 ± 27.3
% Predatores	24.7	31.3 ± 20.3
% Scrapers	29.2	37.4 ± 22.0
% Shredder	25.3	16.1 ± 11.0
No. Clinger Taxa	11.0	15.8 ± 6.3
Number Of Individuals		
% Diptera + Non-insects	22.4	32.8 ± 26.0
% EPT Individuals	76.9	66.1 ± 26.2
% of 5 dominant taxa	91.3	82.2 ± 8.7
No. EPT individuals/Chironomids+EPT Individuals	0.8	0.7 ± 0.2
Total Abundance	1642.1	2646.7 ± 2772.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.3 ± 0.4
Diptera taxa	4.0	3.2 ± 1.3
Ephemeroptera taxa	3.0	3.6 ± 1.1
EPT Individuals (Sum)	1263.1	1501.0 ± 1294.6
EPT taxa (no)	10.0	10.8 ± 3.5
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	4.0	4.1 ± 1.8
Shannon-Wiener Diversity	1.9	1.9 ± 0.4
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	16.0	18.0 ± 4.5
Trichoptera taxa	3.0	3.1 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.30
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.08
Arrenuridae	0%	2%	0%	0%	15%	0%	0.04
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.05
Aturidae	4%	6%	0%	5%	0%	2%	0.03
Baetidae	97%	92%	79%	93%	62%	84%	0.83
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.28
Caenidae	0%	0%	0%	1%	38%	0%	0.09
Capniidae	81%	60%	37%	65%	31%	69%	0.55
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.27

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Chironomidae	100%	100%	89%	99%	100%	100%	0.98
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.74
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.02
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.28
Empididae	51%	65%	47%	62%	8%	51%	0.44
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.26
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.82
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.02
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.03
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.20
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.87
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.45
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.17
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.07
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.02
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.40
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.31
Leptoceridae	1%	15%	0%	5%	62%	2%	0.17
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.31
Leuctridae	35%	26%	11%	39%	8%	25%	0.24
Limnephilidae	36%	24%	21%	26%	0%	39%	0.22
Limnesiidae	7%	13%	5%	9%	46%	25%	0.18
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.18
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.03
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.02
Naididae	26%	47%	5%	46%	85%	33%	0.44
Nemouridae	93%	73%	53%	81%	15%	73%	0.62
Oxidae	0%	2%	0%	1%	15%	0%	0.04
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.03
Perlidae	32%	29%	11%	32%	8%	20%	0.22
Perlodidae	64%	60%	79%	75%	31%	76%	0.63
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.23
Planorbidae	1%	3%	0%	1%	31%	0%	0.08
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.14

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.44
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.26
Sperchontidae	17%	34%	37%	50%	23%	45%	0.34
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.02
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.02
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.51
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.55
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.26
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.02
Uenoidae	9%	8%	37%	17%	0%	10%	0.13
Unionicolidae	0%	0%	0%	0%	15%	0%	0.03
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	7.11
RIVPACS : Observed taxa P>0.50	7.00
RIVPACS : O:E (p > 0.5)	0.99
RIVPACS : Expected taxa P>0.70	4.24
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	1.18

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.17000	28.74839 ± 35.48825
Channel		
Depth-Avg (cm)	11.5	28.0 ± 13.9
Depth-BankfullMinusWetted (cm)	62.00	47.88 ± 26.69
Depth-Max (cm)	16.0	41.3 ± 21.8
Macrophyte (PercentRange)	1	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.92 ± 1.11
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0050000	0.0249850 ± 0.0294369
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	0 ± 1
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.27	0.45 ± 0.21
Velocity-Max (m/s)	0.31	0.67 ± 0.25
Width-Bankfull (m)	14.8	35.9 ± 41.6
Width-Wetted (m)	13.3	17.8 ± 20.2
XSEC-VelInstrumentDirect (Category(1-3))	1	2 ± 0
XSEC-VelMethod (Category(1-3))	3	3 ± 1
Climate		
Precip02_FEB (mm)	156.00000	94.95103 ± 61.64910
Temp07_JULmax (Degrees Celsius)	18.66000	17.48320 ± 2.57900
Landcover		
Natl-SnowIce (%)	22.06000	4.62982 ± 9.77010
Natl-Water (%)	2.36000	1.55060 ± 2.36345
Natl-WetlandHerb (%)	0.00000	0.18446 ± 0.50703

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Substrate Data		
%Bedrock (%)	0	0 ± 1
%Boulder (%)	0	11 ± 11
%Cobble (%)	2	53 ± 11
%Gravel (%)	23	5 ± 4
%Pebble (%)	75	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	1 ± 3
D50 (cm)	3.00	8.04 ± 4.60
Dg (cm)	2.5	8.2 ± 3.1
Dominant-1st (Category(0-9))	5	6 ± 1
Dominant-2nd (Category(0-9))	4	6 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
SlopeAvg (%)	36.72000	31.09165 ± 12.51836
Water Chemistry		
General-DO (mg/L)	9.8900000	11.4180702 ± 1.2821697
General-pH (pH)	7.8	7.7 ± 0.7
General-SpCond (µS/cm)	69.0000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	22.0	12.1 ± 4.3
General-TempWater (Degrees Celsius)	15.2000000	7.6535897 ± 3.4680513
General-Turbidity (NTU)	0.3000000	0.5500000 ± 0.6138116

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-DS-AQ12
Sampling Date	Jul 25 2017
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.14417 N, 122.95750 W
Altitude	194
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	15.6%	6.7%	9.6%	16.9%	45.8%	5.4%
CABIN Assessment of RGD-DS-AQ12 on Jul 25, 2017	Similar to Reference					

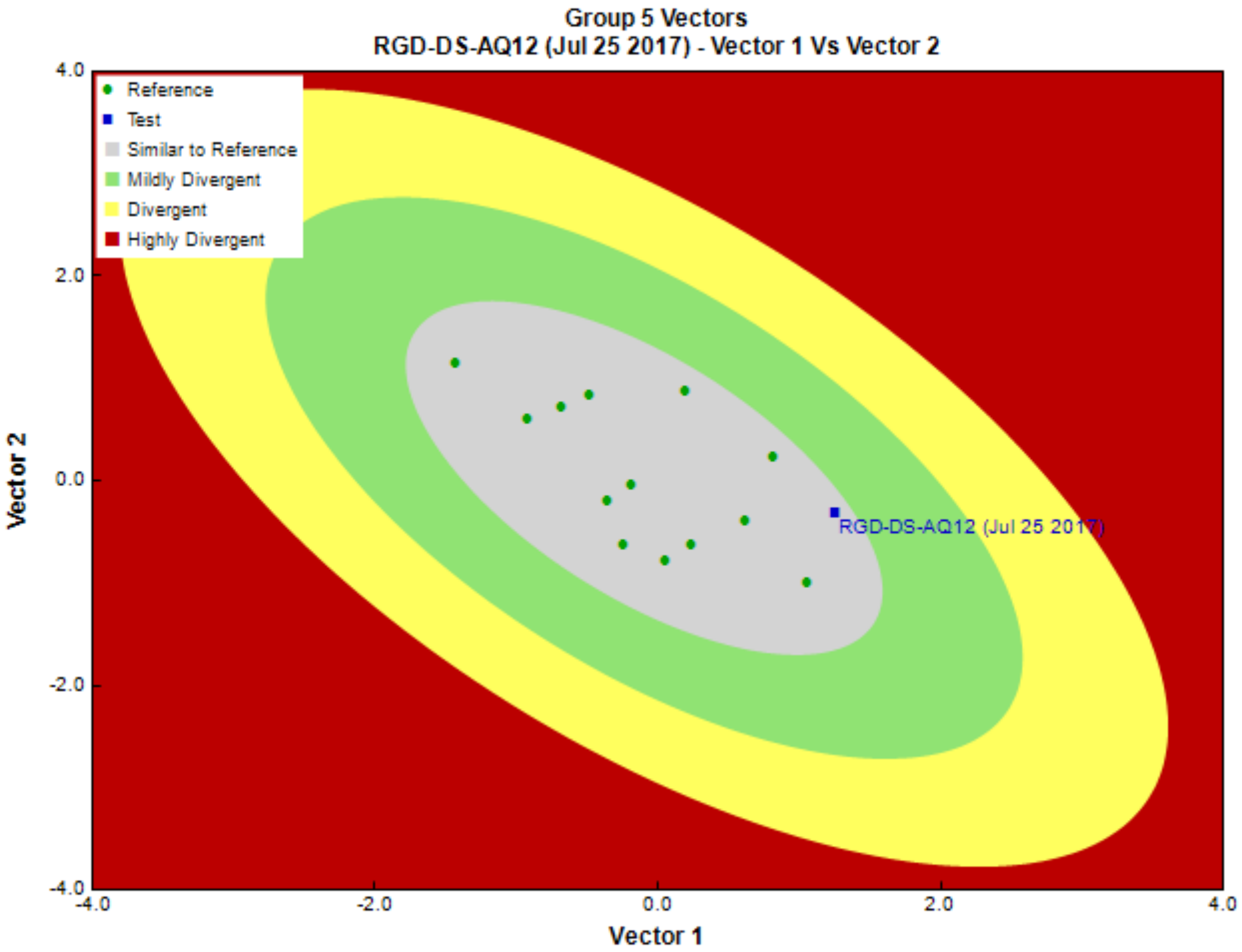


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	November 02, 2017
	Marchant Box
Sub-Sample Proportion	35/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	9	25.7
	Insecta	Coleoptera	Dytiscidae	2	5.7
		Diptera	Chironomidae	91	260.0
			Empididae	2	5.7
			Simuliidae	24	68.6
		Ephemeroptera	Ameletidae	2	5.7
			Baetidae	86	245.7
			Ephemerellidae	28	80.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Heptageniidae	93	265.7
		Plecoptera	Chloroperlidae	5	14.3
		Trichoptera	Limnephilidae	1	2.9
			Rhyacophilidae	7	20.0
			Total	350	1,000.0

Metrics

Name	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.72	0.6 ± 0.2
Functional Measures		
% Filterers	--	11.5 ± 10.5
% Gatherers	41.4	67.6 ± 30.3
% Predatores	38.6	41.1 ± 20.2
% Scrapers	58.3	34.3 ± 21.0
% Shredder	0.3	13.7 ± 9.2
No. Clinger Taxa	7.0	13.0 ± 5.7
Number Of Individuals		
% Diptera + Non-insects	36.0	47.4 ± 26.3
% EPT Individuals	63.4	49.6 ± 26.3
% of 5 dominant taxa	92.0	86.1 ± 8.4
No. EPT individuals/Chironomids+EPT Individuals	0.7	0.6 ± 0.2
Total Abundance	1000.0	13706.8 ± 8626.5
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	1.0	0.5 ± 0.5
Diptera taxa	3.0	2.6 ± 1.2
Ephemeroptera taxa	4.0	3.4 ± 1.2
EPT Individuals (Sum)	634.3	7446.2 ± 6472.9
EPT taxa (no)	7.0	9.3 ± 3.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.6 ± 0.1
Plecoptera taxa	1.0	3.4 ± 1.8
Shannon-Wiener Diversity	1.8	1.7 ± 0.4
Simpson's Diversity	0.8	0.7 ± 0.1
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	12.0	16.0 ± 4.0
Trichoptera taxa	2.0	2.5 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.20
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.08
Arrenuridae	0%	2%	0%	0%	15%	0%	0.07
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.06
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.77
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.25
Caenidae	0%	0%	0%	1%	38%	0%	0.18
Capniidae	81%	60%	37%	65%	31%	69%	0.49
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.36
Chironomidae	100%	100%	89%	99%	100%	100%	0.99
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.61
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.04
Curculionidae	0%	0%	0%	1%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.00
Elmidae	48%	73%	5%	28%	15%	18%	0.26
Empididae	51%	65%	47%	62%	8%	51%	0.33
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.28
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.76
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.02
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.07
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.14
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.77
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.39
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.20
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.02
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.05
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.01
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.44
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.29
Leptoceridae	1%	15%	0%	5%	62%	2%	0.30
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.28
Leuctridae	35%	26%	11%	39%	8%	25%	0.20
Limnephilidae	36%	24%	21%	26%	0%	39%	0.16
Limnesiidae	7%	13%	5%	9%	46%	25%	0.27
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.26
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.04
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.56
Nemouridae	93%	73%	53%	81%	15%	73%	0.49
Oxidae	0%	2%	0%	1%	15%	0%	0.07
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.02
Perlidae	32%	29%	11%	32%	8%	20%	0.18
Perlodidae	64%	60%	79%	75%	31%	76%	0.52
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.33
Planorbidae	1%	3%	0%	1%	31%	0%	0.15
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.11
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.10
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.30
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.22

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Sperchontidae	17%	34%	37%	50%	23%	45%	0.30
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.04
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.39
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.50
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.26
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.09
Unionicolidae	0%	0%	0%	0%	15%	0%	0.07
Valvatidae	3%	2%	0%	3%	8%	2%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	5.48
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	0.91
RIVPACS : Expected taxa P>0.70	3.29
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.22

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.17000	15.90266 ± 33.91726
Channel		
Depth-Avg (cm)	32.2	40.5 ± 22.4
Depth-BankfullMinusWetted (cm)	50.00	188.00
Depth-Max (cm)	39.0	55.5 ± 31.7
Macrophyte (PercentRange)	1	1 ± 2
Reach-%CanopyCoverage (PercentRange)	1.00	0.23 ± 0.44
Reach-DomStreamsideVeg (Category(1-4))	3	2
Reach-Riffles (Binary)	1	0 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0050000	0.0047331 ± 0.0082050
Veg-Coniferous (Binary)	1	0 ± 1
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.33	0.23 ± 0.24
Velocity-Max (m/s)	0.47	0.31 ± 0.35
Width-Bankfull (m)	15.4	75.1 ± 72.8
Width-Wetted (m)	15.4	50.6 ± 60.4
XSEC-VelInstrumentDirect (Category(1-3))	1	2
XSEC-VelMethod (Category(1-3))	3	3
Climate		
Precip02_FEB (mm)	156.00000	171.50745 ± 107.47690
Temp07_JULmax (Degrees Celsius)	18.66000	20.34230 ± 2.49485
Landcover		
Natl-SnowIce (%)	22.06000	3.62533 ± 10.17162
Natl-Water (%)	2.36000	1.80201 ± 1.29922
Natl-WetlandHerb (%)	0.00000	0.68488 ± 0.92347
Substrate Data		
%Bedrock (%)	0	0
%Boulder (%)	0	0
%Cobble (%)	0	58

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
%Gravel (%)	38	1
%Pebble (%)	62	41
%Sand (%)	0	0
%Silt+Clay (%)	0	0
D50 (cm)	2.00	3.30
Dg (cm)	1.7	6.6
Dominant-1st (Category(0-9))	4	4 ± 2
Dominant-2nd (Category(0-9))	3	4 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	1	3
SurroundingMaterial (Category(0-9))	2	2 ± 1
Topography		
SlopeAvg (%)	36.72000	30.12236 ± 18.75100
Water Chemistry		
General-DO (mg/L)	9.7700000	9.3400000 ± 2.0171679
General-pH (pH)	7.0	6.8 ± 1.0
General-SpCond (µS/cm)	73.3000000	176.1000000
General-TempAir (Degrees Celsius)	26.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	13.0000000	13.2730769 ± 4.7663725

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-DS-AQ12
Sampling Date	Aug 01 2018
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.14440 N, 122.95752 W
Altitude	641
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	12.2%	4.4%	4.7%	7.9%	68.5%	2.4%
CABIN Assessment of RGD-DS-AQ12 on Aug 01, 2018	Similar to Reference					

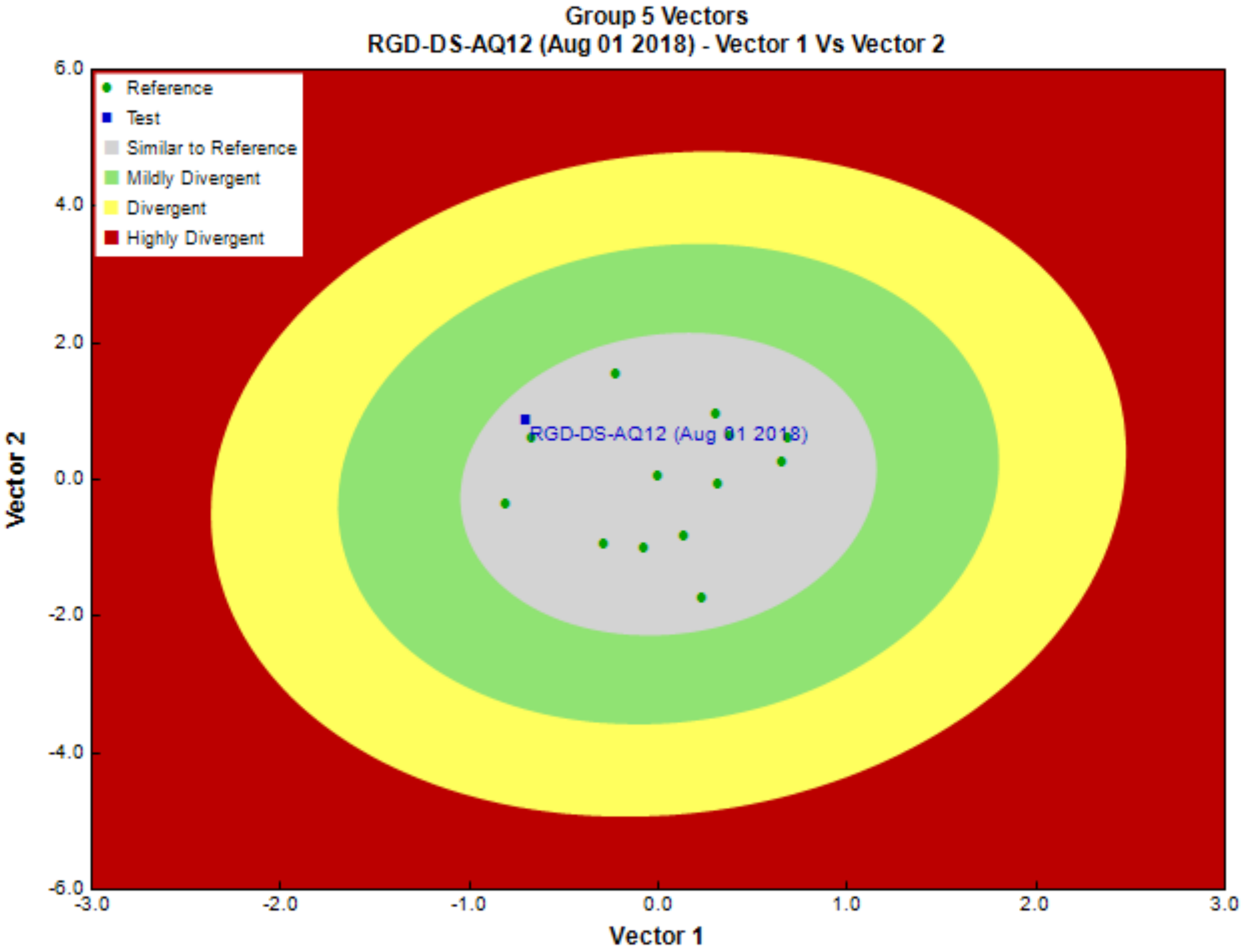


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	100/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	9	9.1
		Tubificida	Naididae	161	161.4
Arthropoda	Arachnida	Trombidiformes		2	2.3
			Hygrobatidae	22	22.8
			Lebertiidae	9	9.1
			Sperchontidae	5	4.5
	Insecta	Coleoptera	Dytiscidae	78	77.2
		Diptera	Ceratopogonidae	2	2.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Chironomidae	188	188.7
			Empididae	2	2.3
			Simuliidae	15	14.6
			Tipulidae	4	4.6
		Ephemeroptera	Ameletidae	14	13.6
			Baetidae	85	84.0
			Ephemerellidae	96	95.4
			Leptophlebiidae	34	34.1
		Megaloptera	Sialidae	2	2.3
		Plecoptera	Chloroperlidae	15	16.0
			Nemouridae	40	38.5
		Trichoptera	Lepidostomatidae	2	2.3
			Limnephilidae	4	4.6
			Rhyacophilidae	5	4.5
	Malacostraca	Amphipoda		2	2.3
			Crangonyctidae	2	2.3
Mollusca	Bivalvia	Veneroida	Pisidiidae	7	6.8
			Total	805	805.6

Metrics

Name	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.59	0.6 ± 0.2
Functional Measures		
% Filterers	--	11.5 ± 10.5
% Gatherers	90.7	67.6 ± 30.3
% Predatores	40.5	41.1 ± 20.2
% Scrapers	12.8	34.3 ± 21.0
% Shredder	6.2	13.7 ± 9.2
No. Clinger Taxa	20.0	13.0 ± 5.7
Number Of Individuals		
% Diptera + Non-insects	53.5	47.4 ± 26.3
% EPT Individuals	36.6	49.6 ± 26.3
% of 5 dominant taxa	75.8	86.1 ± 8.4
No. EPT individuals/Chironomids+EPT Individuals	0.6	0.6 ± 0.2
Total Abundance	805.5	13706.8 ± 8626.5
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	1.0	0.5 ± 0.5
Diptera taxa	5.0	2.6 ± 1.2
Ephemeroptera taxa	4.0	3.4 ± 1.2
EPT Individuals (Sum)	293.2	7446.2 ± 6472.9
EPT taxa (no)	9.0	9.3 ± 3.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.6 ± 0.1
Plecoptera taxa	2.0	3.4 ± 1.8
Shannon-Wiener Diversity	2.3	1.7 ± 0.4
Simpson's Diversity	0.9	0.7 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	23.0	16.0 ± 4.0
Trichoptera taxa	3.0	2.5 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.11
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.08
Arrenuridae	0%	2%	0%	0%	15%	0%	0.11

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.06
Aturidae	4%	6%	0%	5%	0%	2%	0.01
Baetidae	97%	92%	79%	93%	62%	84%	0.71
Blephariceridae	1%	0%	0%	2%	0%	2%	0.00
Brachycentridae	42%	53%	5%	35%	15%	27%	0.22
Caenidae	0%	0%	0%	1%	38%	0%	0.26
Capniidae	81%	60%	37%	65%	31%	69%	0.42
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.43
Chironomidae	100%	100%	89%	99%	100%	100%	0.99
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.48
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.06
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.00
Elmidae	48%	73%	5%	28%	15%	18%	0.22
Empididae	51%	65%	47%	62%	8%	51%	0.23
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.29
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.70
Ephemeridae	1%	0%	0%	3%	0%	0%	0.00
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.11
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.09
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.67
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.32
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.21
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.01
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.03
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.00
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.48
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.27
Leptoceridae	1%	15%	0%	5%	62%	2%	0.43
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.00
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.24
Leuctridae	35%	26%	11%	39%	8%	25%	0.15
Limnephilidae	36%	24%	21%	26%	0%	39%	0.09
Limnesiidae	7%	13%	5%	9%	46%	25%	0.35
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.34
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.06
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.00
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.68
Nemouridae	93%	73%	53%	81%	15%	73%	0.36
Oxidae	0%	2%	0%	1%	15%	0%	0.11
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.00
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.01
Perlidae	32%	29%	11%	32%	8%	20%	0.14
Perlodidae	64%	60%	79%	75%	31%	76%	0.43

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Philopotamidae	1%	3%	0%	1%	0%	2%	0.00
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.00
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.42
Planorbidae	1%	3%	0%	1%	31%	0%	0.21
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.07
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.13
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.18
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.17
Sperchontidae	17%	34%	37%	50%	23%	45%	0.26
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.05
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.29
Tanyderidae	0%	0%	0%	3%	0%	6%	0.00
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.46
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.25
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.05
Unionicolidae	0%	0%	0%	0%	15%	0%	0.11
Valvatidae	3%	2%	0%	3%	8%	2%	0.06

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.75
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.07
RIVPACS : Expected taxa P>0.70	1.71
RIVPACS : Observed taxa P>0.70	2.00
RIVPACS : O:E (p > 0.7)	1.17

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.17000	15.90266 ± 33.91726
Channel		
Depth-Avg (cm)	28.9	40.5 ± 22.4
Macrophyte (PercentRange)	1	1 ± 2
Reach-%CanopyCoverage (PercentRange)	1.00	0.23 ± 0.44
Reach-%Logging (PercentRange)	0	0 ± 0
Reach-DomStreamsideVeg (Category(1-4))	2	2
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	0 ± 0
Reach-StraightRun (Binary)	0	1 ± 0
Slope (m/m)	0.0000000	0.0047331 ± 0.0082050
Veg-Coniferous (Binary)	0	0 ± 1
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.26	0.23 ± 0.24
Velocity-Max (m/s)	0.31	0.31 ± 0.35
Width-Bankfull (m)	16.6	75.1 ± 72.8

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Width-Wetted (m)	16.4	50.6 ± 60.4
XSEC-VelMethod (Category(1-3))	1	3
Climate		
Precip02_FEB (mm)	156.00000	171.50745 ± 107.47690
Temp07_JULmax (Degrees Celsius)	18.66000	20.34230 ± 2.49485
Landcover		
Natl-SnowIce (%)	22.06000	3.62533 ± 10.17162
Natl-Water (%)	2.36000	1.80201 ± 1.29922
Natl-WetlandHerb (%)	0.00000	0.68488 ± 0.92347
Substrate Data		
%Bedrock (%)	0	0
%Boulder (%)	0	0
%Cobble (%)	1	58
%Gravel (%)	36	1
%Pebble (%)	47	41
%Sand (%)	0	0
%Silt+Clay (%)	16	0
D50 (cm)	1.30	3.30
Dg (cm)	0.9	6.6
Dominant-1st (Category(0-9))	3	4 ± 2
Dominant-2nd (Category(0-9))	4	4 ± 2
Embeddedness (Category(1-5))	3	4 ± 1
PeriphytonCoverage (Category(1-5))	1	3
SurroundingMaterial (Category(0-9))	2	2 ± 1
Topography		
SlopeAvg (%)	36.72000	30.12236 ± 18.75100
Water Chemistry		
General-DO (mg/L)	8.1600000	9.3400000 ± 2.0171679
General-pH (pH)	6.7	6.8 ± 1.0
General-SpCond (µS/cm)	48.3000000	176.1000000
General-TempAir (Degrees Celsius)	29.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	17.8000000	13.2730769 ± 4.7663725
General-Turbidity (NTU)	31.0000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-DS-AQ12
Sampling Date	Jul 31 2019
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.14430 N, 122.95764 W
Altitude	614
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	17.6%	7.2%	10.0%	16.2%	43.8%	5.2%
CABIN Assessment of RGD-DS-AQ12 on Jul 31, 2019	Similar to Reference					

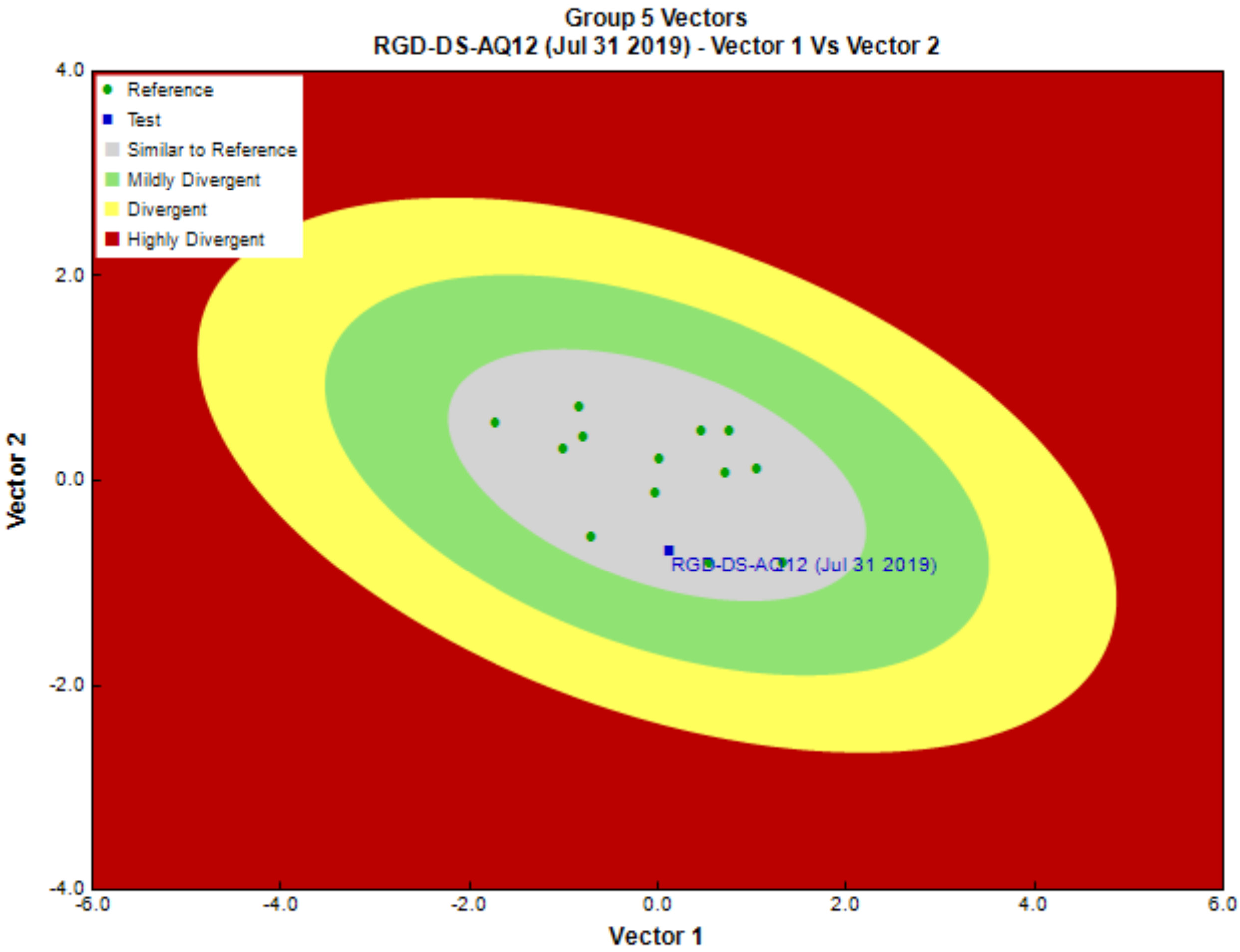


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	23/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	3	13.0
		Tubificida	Naididae	80	347.8
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	8	34.7
			Lebertiidae	1	4.3
			Sperchontidae	2	8.7
	Insecta	Coleoptera	Dytiscidae	37	160.9
		Diptera	Chironomidae	80	347.5
			Simuliidae	1	4.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Tipulidae	1	4.3
		Ephemeroptera	Ameletidae	1	4.3
			Baetidae	25	108.7
			Ephemerellidae	55	239.1
			Heptageniidae	1	4.3
			Leptophlebiidae	4	17.4
		Plecoptera	Chloroperlidae	3	13.0
			Nemouridae	4	17.3
		Trichoptera	Limnephilidae	2	8.6
			Rhyacophilidae	1	4.3
	Malacostraca	Amphipoda		2	8.7
			Crangonyctidae	1	4.3
Mollusca	Bivalvia	Veneroida	Pisidiidae	1	4.3
			Total	313	1,359.8

Metrics

Name	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.39	0.6 ± 0.2
Functional Measures		
% Filterers	--	11.5 ± 10.5
% Gatherers	99.4	67.6 ± 30.3
% Predatores	41.5	41.1 ± 20.2
% Scrapers	9.3	34.3 ± 21.0
% Shredder	2.2	13.7 ± 9.2
No. Clinger Taxa	18.0	13.0 ± 5.7
Number Of Individuals		
% Diptera + Non-insects	57.2	47.4 ± 26.3
% EPT Individuals	30.9	49.6 ± 26.3
% of 5 dominant taxa	89.1	86.1 ± 8.4
No. EPT individuals/Chironomids+EPT Individuals	0.5	0.6 ± 0.2
Total Abundance	1360.9	13706.8 ± 8626.5
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	1.0	0.5 ± 0.5
Diptera taxa	3.0	2.6 ± 1.2
Ephemeroptera taxa	5.0	3.4 ± 1.2
EPT Individuals (Sum)	417.4	7446.2 ± 6472.9
EPT taxa (no)	9.0	9.3 ± 3.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.6 ± 0.1
Plecoptera taxa	2.0	3.4 ± 1.8
Shannon-Wiener Diversity	2.0	1.7 ± 0.4
Simpson's Diversity	0.8	0.7 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	20.0	16.0 ± 4.0
Trichoptera taxa	2.0	2.5 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.21
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.07
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.05
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.78

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.26
Caenidae	0%	0%	0%	1%	38%	0%	0.17
Capniidae	81%	60%	37%	65%	31%	69%	0.50
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.35
Chironomidae	100%	100%	89%	99%	100%	100%	0.99
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.62
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.04
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.00
Elmidae	48%	73%	5%	28%	15%	18%	0.26
Empididae	51%	65%	47%	62%	8%	51%	0.34
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.27
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.76
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.02
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.07
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.15
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.78
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.39
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.20
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.02
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.05
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.01
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.44
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.30
Leptoceridae	1%	15%	0%	5%	62%	2%	0.29
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.29
Leuctridae	35%	26%	11%	39%	8%	25%	0.20
Limnephilidae	36%	24%	21%	26%	0%	39%	0.16
Limnesiidae	7%	13%	5%	9%	46%	25%	0.26
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.25
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.04
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.55
Nemouridae	93%	73%	53%	81%	15%	73%	0.50
Oxidae	0%	2%	0%	1%	15%	0%	0.07
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.01
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.02
Perlidae	32%	29%	11%	32%	8%	20%	0.18
Perlodidae	64%	60%	79%	75%	31%	76%	0.53
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-DS-AQ12
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Pisidiidae	16%	53%	0%	11%	54%	12%	0.33
Planorbidae	1%	3%	0%	1%	31%	0%	0.14
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.11
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.10
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.31
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.23
Sperchontidae	17%	34%	37%	50%	23%	45%	0.30
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.04
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.40
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.51
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.26
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.09
Unionicolidae	0%	0%	0%	0%	15%	0%	0.07
Valvatidae	3%	2%	0%	3%	8%	2%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	6.01
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	1.33
RIVPACS : Expected taxa P>0.70	3.31
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.17000	15.90266 ± 33.91726
Channel		
Depth-Avg (cm)	33.9	40.5 ± 22.4
Depth-BankfullMinusWetted (cm)	7.00	188.00
Depth-Max (cm)	54.5	55.5 ± 31.7
Macrophyte (PercentRange)	1	1 ± 2
Reach-%CanopyCoverage (PercentRange)	1.00	0.23 ± 0.44
Reach-DomStreamsideVeg (Category(1-4))	3	2
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	0 ± 0
Reach-StraightRun (Binary)	0	1 ± 0
Slope (m/m)	0.0000000	0.0047331 ± 0.0082050
Veg-Coniferous (Binary)	0	0 ± 1
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.22	0.23 ± 0.24
Velocity-Max (m/s)	0.54	0.31 ± 0.35
Width-Bankfull (m)	15.6	75.1 ± 72.8
Width-Wetted (m)	15.5	50.6 ± 60.4
XSEC-VelMethod (Category(1-3))	1	3
Climate		

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Precip02_FEB (mm)	156.00000	171.50745 ± 107.47690
Precip03_MAR (mm)	156.00000	152.05098 ± 91.49370
Temp07_JULmax (Degrees Celsius)	18.66000	20.34230 ± 2.49485
Landcover		
Natl-SnowIce (%)	22.06000	3.62533 ± 10.17162
Natl-Water (%)	2.36000	1.80201 ± 1.29922
Natl-WetlandHerb (%)	0.00000	0.68488 ± 0.92347
Substrate Data		
%Bedrock (%)	0	0
%Boulder (%)	0	0
%Cobble (%)	0	58
%Gravel (%)	29	1
%Pebble (%)	71	41
%Sand (%)	0	0
%Silt+Clay (%)	0	0
D50 (cm)	2.35	3.30
Dg (cm)	2.1	6.6
Dominant-1st (Category(0-9))	4	4 ± 2
Dominant-2nd (Category(0-9))	5	4 ± 2
Embeddedness (Category(1-5))	2	4 ± 1
PeriphytonCoverage (Category(1-5))	4	3
SurroundingMaterial (Category(0-9))	2	2 ± 1
Topography		
SlopeAvg (%)	36.72000	30.12236 ± 18.75100
Water Chemistry		
General-Conductivity (μS/cm)	60.6000000	79.0846153 ± 50.3407694
General-DO (mg/L)	9.9300000	9.3400000 ± 2.0171679
General-pH (pH)	7.6	6.8 ± 1.0
General-SpCond (μS/cm)	78.4000000	176.1000000
General-TempAir (Degrees Celsius)	17.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	13.1000000	13.2730769 ± 4.7663725

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-AQ11
Sampling Date	Aug 03 2016
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12703 N, 122.97202 W
Altitude	642
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	9.1%	4.7%	37.9%	21.9%	16.7%	9.7%
CABIN Assessment of RGD-AQ11 on Aug 03, 2016	Mildly Divergent					

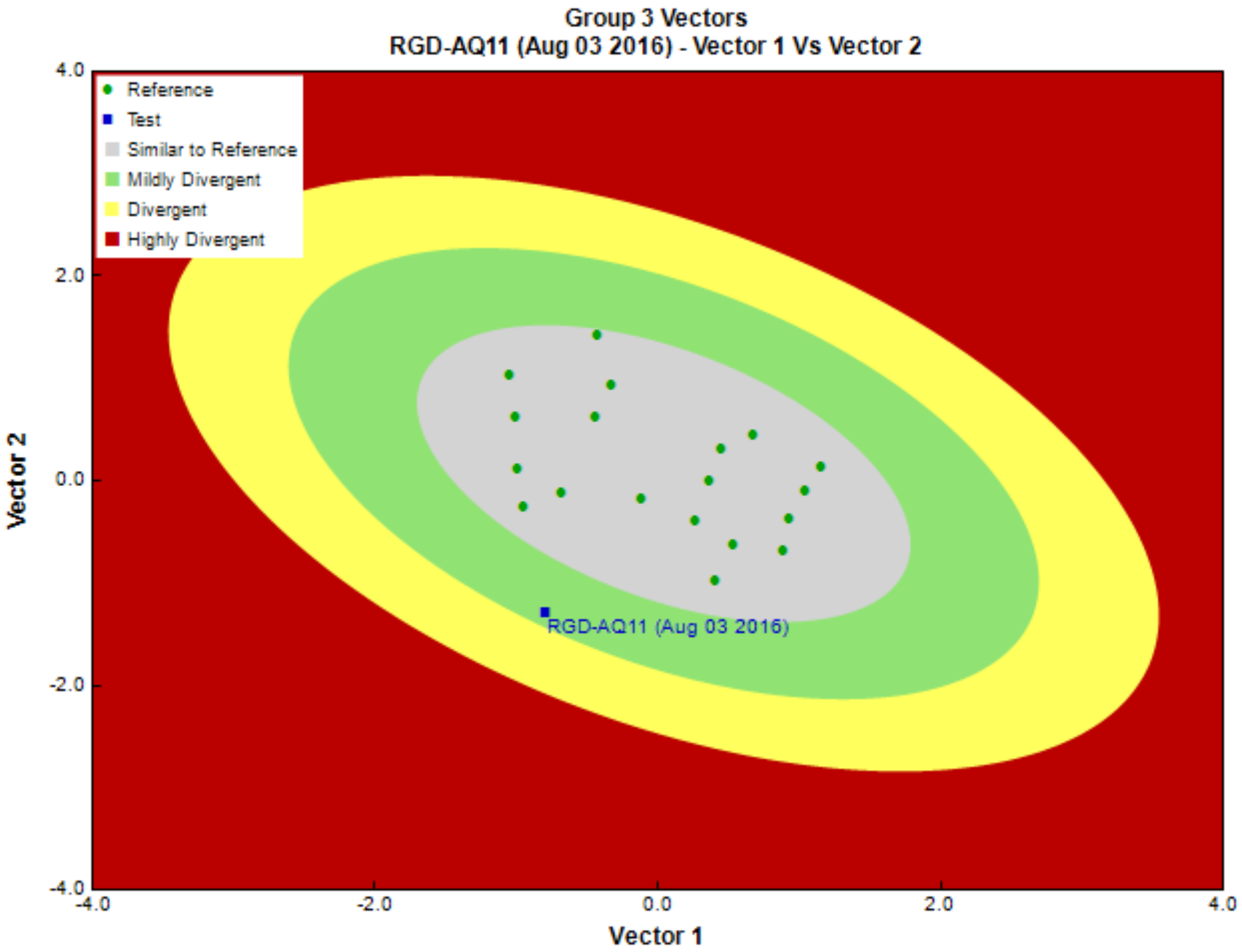


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	September 29, 2016
	Marchant Box
Sub-Sample Proportion	26/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	5	19.2
	Insecta	Diptera	Ceratopogonidae	8	30.8
			Chironomidae	8	30.8
			Empididae	5	19.2
			Simuliidae	30	115.4
		Ephemeroptera	Baetidae	102	392.3
			Ephemerellidae	7	26.9
			Heptageniidae	71	273.1

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera	Chloroperlidae	34	130.8
			Nemouridae	26	100.0
			Perlodidae	5	19.2
		Trichoptera	Rhyacophilidae	1	3.8
			Total	302	1,161.5

Metrics

Name	RGD-AQ11	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.7	0.4 ± 0.2
Functional Measures		
% Filterers	--	1.2 ± 1.0
% Gatherers	23.5	55.3 ± 17.5
% Predatores	17.9	22.0 ± 15.6
% Scrapers	67.2	53.5 ± 23.0
% Shredder	8.6	30.3 ± 22.3
No. Clinger Taxa	9.0	13.6 ± 4.4
Number Of Individuals		
% Diptera + Non-insects	18.5	20.6 ± 17.1
% EPT Individuals	81.5	78.2 ± 17.8
% of 5 dominant taxa	87.1	86.1 ± 8.2
No. EPT individuals/Chironomids+EPT Individuals	1.0	0.8 ± 0.2
Total Abundance	1161.5	3776.0 ± 2948.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	0.0	0.2 ± 0.4
Diptera taxa	4.0	2.9 ± 1.4
Ephemeroptera taxa	3.0	3.3 ± 0.9
EPT Individuals (Sum)	946.2	2962.4 ± 2556.9
EPT taxa (no)	7.0	9.8 ± 2.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.8	0.7 ± 0.1
Plecoptera taxa	3.0	4.0 ± 1.2
Shannon-Wiener Diversity	1.9	1.8 ± 0.4
Simpson's Diversity	0.8	0.7 ± 0.1
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	12.0	14.8 ± 4.3
Trichoptera taxa	1.0	2.5 ± 1.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.31
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.03
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.04
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.82
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.21
Caenidae	0%	0%	0%	1%	38%	0%	0.07
Capniidae	81%	60%	37%	65%	31%	69%	0.50
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.21
Chironomidae	100%	100%	89%	99%	100%	100%	0.96
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.79
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.01
Curculionidae	0%	0%	0%	1%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.20
Empididae	51%	65%	47%	62%	8%	51%	0.45
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.22
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.83
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.03
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.18
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.90
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.39
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.13
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.07
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.02
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.34
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.24
Leptoceridae	1%	15%	0%	5%	62%	2%	0.12
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.23
Leuctridae	35%	26%	11%	39%	8%	25%	0.21
Limnephilidae	36%	24%	21%	26%	0%	39%	0.22
Limnesiidae	7%	13%	5%	9%	46%	25%	0.16
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.14
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.02
Naididae	26%	47%	5%	46%	85%	33%	0.34
Nemouridae	93%	73%	53%	81%	15%	73%	0.59
Oxidae	0%	2%	0%	1%	15%	0%	0.03
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.00
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.04
Perlidae	32%	29%	11%	32%	8%	20%	0.18
Perlodidae	64%	60%	79%	75%	31%	76%	0.68
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.17
Planorbidae	1%	3%	0%	1%	31%	0%	0.06
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.09
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.06
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.45
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.23

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Sperchontidae	17%	34%	37%	50%	23%	45%	0.36
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.02
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.65
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.52
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.18
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.20
Unionicolidae	0%	0%	0%	0%	15%	0%	0.03
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	7.24
RIVPACS : Observed taxa P>0.50	7.00
RIVPACS : O:E (p > 0.5)	0.97
RIVPACS : Expected taxa P>0.70	4.30
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	1.16

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	18.33344 ± 33.50703
Channel		
Depth-Avg (cm)	18.7	28.5 ± 10.6
Depth-BankfullMinusWetted (cm)	37.00	163.00
Depth-Max (cm)	28.0	44.5 ± 18.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	2	3
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0100000	0.0259896 ± 0.0313728
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 1
Veg-GrassesFerns (Binary)	1	0 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.55	0.49 ± 0.15
Velocity-Max (m/s)	0.89	0.67 ± 0.21
Width-Bankfull (m)	16.5	85.0 ± 66.5
Width-Wetted (m)	6.8	23.1 ± 31.8
XSEC-VelInstrumentDirect (Category(1-3))	1	2
XSEC-VelMethod (Category(1-3))	3	3
Climate		
Precip02_FEB (mm)	155.11000	127.54903 ± 58.24882
Temp07_JULmax (Degrees Celsius)	18.25000	16.49843 ± 2.42987
Landcover		
Natl-SnowIce (%)	26.42000	30.72486 ± 23.89539
Natl-Water (%)	2.82000	0.99760 ± 0.86372
Natl-WetlandHerb (%)	0.00000	0.02638 ± 0.03974
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	9 ± 8
%Cobble (%)	8	63 ± 4
%Gravel (%)	6	3 ± 4

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
%Pebble (%)	86	25 ± 7
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 0
D50 (cm)	3.50	6.67 ± 3.25
Dg (cm)	3.4	8.6 ± 1.6
Dominant-1st (Category(0-9))	5	7 ± 1
Dominant-2nd (Category(0-9))	4	7 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	2	4 ± 2
Topography		
SlopeAvg (%)	39.43000	41.69956 ± 6.13915
Water Chemistry		
General-DO (mg/L)	8.2700000	12.6052631 ± 1.2122173
General-pH (pH)	7.4	7.4 ± 0.4
General-SpCond (µS/cm)	64.0000000	74.4000000 ± 44.3472660
General-TempAir (Degrees Celsius)	14.8	0.0 ± 0.0
General-TempWater (Degrees Celsius)	11.7000000	5.7731579 ± 1.9704316
General-Turbidity (NTU)	1.3400000	1.3000000 ± 0.9899495

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-AQ11
Sampling Date	Jul 25 2017
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12722 N, 122.97194 W
Altitude	190
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	8.4%	4.4%	40.7%	20.5%	16.4%	9.7%
CABIN Assessment of RGD-AQ11 on Jul 25, 2017	Mildly Divergent					

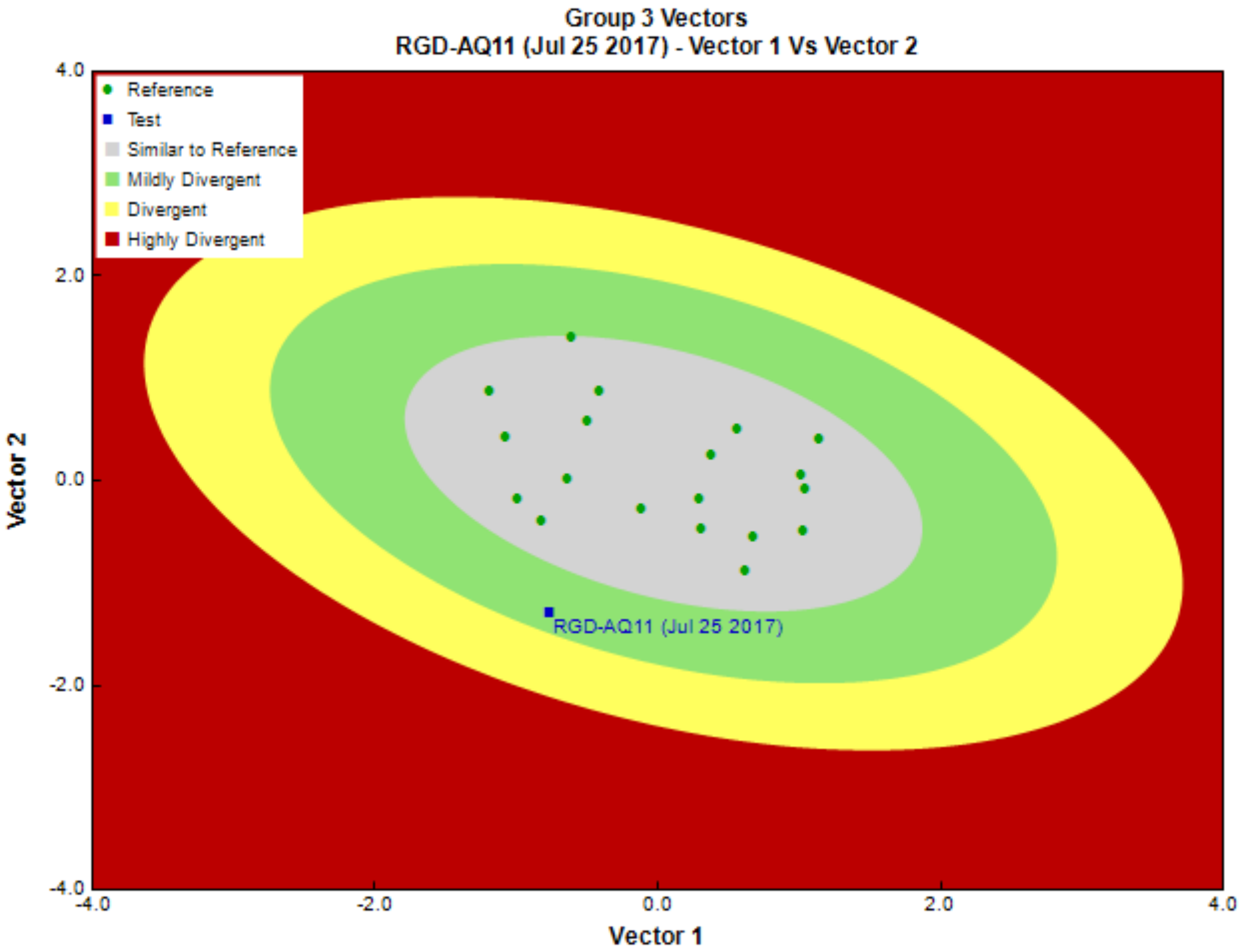


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
Date Taxonomy Completed	November 01, 2017
	Marchant Box
Sub-Sample Proportion	31/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydrachnidae	3	9.7
	Insecta	Diptera	Ceratopogonidae	3	9.7
			Chironomidae	18	58.1
			Simuliidae	46	148.4
			Tipulidae	1	3.2
		Ephemeroptera	Baetidae	35	112.9
			Ephemerellidae	2	6.4
			Heptageniidae	205	661.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera	Chloroperlidae	23	74.2
			Nemouridae	2	6.4
			Perlidae	2	6.4
			Perlodidae	1	3.2
		Trichoptera	Rhyacophilidae	4	12.9
			Total	345	1,112.8

Metrics

Name	RGD-AQ11	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.7	0.4 ± 0.2
Functional Measures		
% Filterers	--	1.2 ± 1.0
% Gatherers	20.0	55.3 ± 17.5
% Predatores	21.4	22.0 ± 15.6
% Scrapers	82.9	53.5 ± 23.0
% Shredder	0.9	30.3 ± 22.3
No. Clinger Taxa	9.0	13.6 ± 4.4
Number Of Individuals		
% Diptera + Non-insects	20.6	20.6 ± 17.1
% EPT Individuals	79.4	78.2 ± 17.8
% of 5 dominant taxa	94.8	86.1 ± 8.2
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.8 ± 0.2
Total Abundance	1112.9	3776.0 ± 2948.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	0.0	0.2 ± 0.4
Diptera taxa	4.0	2.9 ± 1.4
Ephemeroptera taxa	3.0	3.3 ± 0.9
EPT Individuals (Sum)	883.9	2962.4 ± 2556.9
EPT taxa (no)	8.0	9.8 ± 2.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.5	0.7 ± 0.1
Plecoptera taxa	4.0	4.0 ± 1.2
Shannon-Wiener Diversity	1.4	1.8 ± 0.4
Simpson's Diversity	0.6	0.7 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	13.0	14.8 ± 4.3
Trichoptera taxa	1.0	2.5 ± 1.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.30
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.03
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.03
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.82
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.20
Caenidae	0%	0%	0%	1%	38%	0%	0.06
Capniidae	81%	60%	37%	65%	31%	69%	0.49
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.21
Chironomidae	100%	100%	89%	99%	100%	100%	0.96
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.80
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.01

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.19
Empididae	51%	65%	47%	62%	8%	51%	0.45
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.21
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.83
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.03
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.18
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.90
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.38
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.13
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.06
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.02
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.33
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.23
Leptoceridae	1%	15%	0%	5%	62%	2%	0.12
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.00
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.22
Leuctridae	35%	26%	11%	39%	8%	25%	0.20
Limnephilidae	36%	24%	21%	26%	0%	39%	0.22
Limnesiidae	7%	13%	5%	9%	46%	25%	0.15
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.14
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.02
Naididae	26%	47%	5%	46%	85%	33%	0.33
Nemouridae	93%	73%	53%	81%	15%	73%	0.59
Oxidae	0%	2%	0%	1%	15%	0%	0.03
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.00
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.04
Perlidae	32%	29%	11%	32%	8%	20%	0.18
Perlodidae	64%	60%	79%	75%	31%	76%	0.68
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.16
Planorbidae	1%	3%	0%	1%	31%	0%	0.05
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.09
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.06
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.45
Sialidae	0%	2%	0%	0%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Simuliidae	52%	29%	16%	32%	8%	24%	0.22
Sperchontidae	17%	34%	37%	50%	23%	45%	0.36
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.02
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.66
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.51
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.17
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.21
Unionicolidae	0%	0%	0%	0%	15%	0%	0.03
Valvatidae	3%	2%	0%	3%	8%	2%	0.02

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	6.74
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	1.19
RIVPACS : Expected taxa P>0.70	4.30
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	1.16

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	18.33344 ± 33.50703
Channel		
Depth-Avg (cm)	0.4	28.5 ± 10.6
Depth-BankfullMinusWetted (cm)	40.00	163.00
Depth-Max (cm)	0.5	44.5 ± 18.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	3	3
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	0 ± 1
Slope (m/m)	0.0100000	0.0259896 ± 0.0313728
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 1
Veg-GrassesFerns (Binary)	1	0 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.84	0.49 ± 0.15
Velocity-Max (m/s)	1.06	0.67 ± 0.21
Width-Bankfull (m)	19.4	85.0 ± 66.5
Width-Wetted (m)	9.2	23.1 ± 31.8
XSEC-VelInstrumentDirect (Category(1-3))	1	2
XSEC-VelMethod (Category(1-3))	3	3
Climate		
Precip02_FEB (mm)	155.11000	127.54903 ± 58.24882
Temp07_JULmax (Degrees Celsius)	18.25000	16.49843 ± 2.42987
Landcover		
Natl-SnowIce (%)	26.42000	30.72486 ± 23.89539
Natl-Water (%)	2.82000	0.99760 ± 0.86372
Natl-WetlandHerb (%)	0.00000	0.02638 ± 0.03974
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	9 ± 8

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
%Cobble (%)	8	63 ± 4
%Gravel (%)	12	3 ± 4
%Pebble (%)	78	25 ± 7
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 0
D50 (cm)	3.50	6.67 ± 3.25
Dg (cm)	3.0	8.6 ± 1.6
Dominant-1st (Category(0-9))	5	7 ± 1
Dominant-2nd (Category(0-9))	4	7 ± 1
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	2	4 ± 2
Topography		
SlopeAvg (%)	39.43000	41.69956 ± 6.13915
Water Chemistry		
General-DO (mg/L)	11.0200000	12.6052631 ± 1.2122173
General-pH (pH)	7.1	7.4 ± 0.4
General-SpCond (µS/cm)	50.5000000	74.4000000 ± 44.3472660
General-TempAir (Degrees Celsius)	23.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	10.5000000	5.7731579 ± 1.9704316

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-AQ11
Sampling Date	Jul 31 2018
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12714 N, 122.97202 W
Altitude	0
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	9.0%	4.1%	26.5%	15.5%	38.2%	6.5%
CABIN Assessment of RGD-AQ11 on Jul 31, 2018	Divergent					

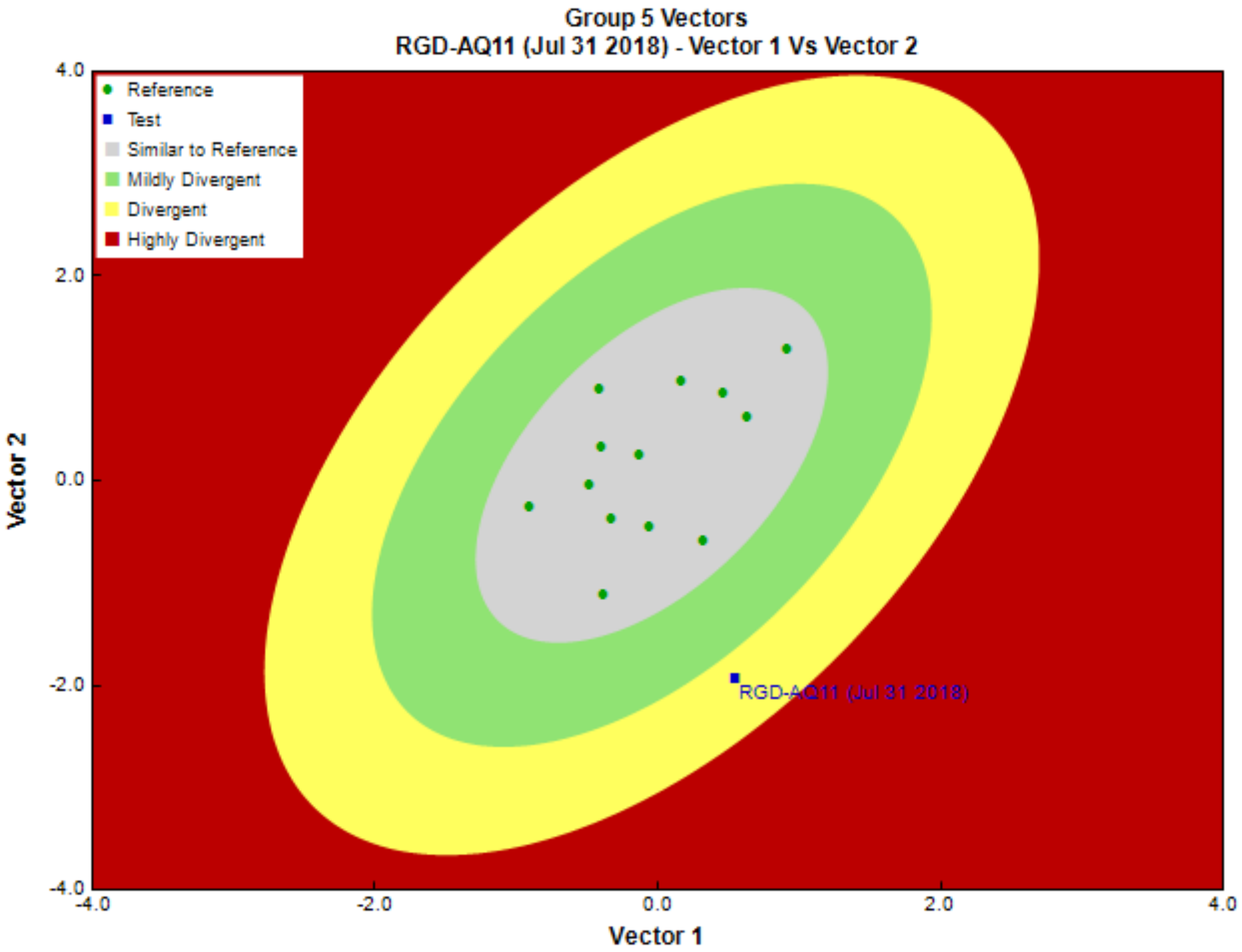


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	100/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	6	6.0
Arthropoda	Arachnida	Sarcoptiformes		2	2.0
		Trombidiformes		2	2.0
			Hydryphantidae	1	1.0
			Hygrobatidae	8	8.0
			Lebertiidae	2	2.0
			Sperchontidae	8	8.0
			Torrenticolidae	1	1.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
	Collembola	Collembola	Sminthuridae	2	2.0
	Insecta	Diptera	Chironomidae	27	27.0
			Simuliidae	282	282.0
			Tipulidae	1	1.0
		Ephemeroptera	Ameletidae	31	31.0
			Baetidae	164	164.0
			Ephemerellidae	14	14.0
			Heptageniidae	119	119.0
			Leptophlebiidae	12	12.0
		Lepidoptera		1	1.0
		Plecoptera	Capniidae	4	4.0
			Chloroperlidae	80	80.0
			Leuctridae	1	1.0
			Nemouridae	7	7.0
			Perlidae	51	51.0
			Perlodidae	11	11.0
		Trichoptera	Brachycentridae	1	1.0
			Rhyacophilidae	6	6.0
	Malacostraca	Amphipoda	Crangonyctidae	1	1.0
Mollusca	Gastropoda	Basommatophora	Planorbidae	1	1.0
			Total	846	846.0

Metrics

Name	RGD-AQ11	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.94	0.6 ± 0.2
Functional Measures		
% Filterers	--	11.5 ± 10.5
% Gatherers	45.2	67.6 ± 30.3
% Predatores	47.0	41.1 ± 20.2
% Scrapers	66.9	34.3 ± 21.0
% Shredder	1.7	13.7 ± 9.2
No. Clinger Taxa	31.0	13.0 ± 5.7
Number Of Individuals		
% Diptera + Non-insects	40.2	47.4 ± 26.3
% EPT Individuals	59.6	49.6 ± 26.3
% of 5 dominant taxa	82.8	86.1 ± 8.4
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.6 ± 0.2
Total Abundance	846.0	13706.8 ± 8626.5
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.0
Coleoptera taxa	0.0	0.5 ± 0.5
Diptera taxa	3.0	2.6 ± 1.2
Ephemeroptera taxa	5.0	3.4 ± 1.2
EPT Individuals (Sum)	501.0	7446.2 ± 6472.9
EPT taxa (no)	13.0	9.3 ± 3.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.6 ± 0.1
Plecoptera taxa	6.0	3.4 ± 1.8
Shannon-Wiener Diversity	2.1	1.7 ± 0.4
Simpson's Diversity	0.8	0.7 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	25.0	16.0 ± 4.0
Trichoptera taxa	2.0	2.5 ± 1.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.22
Ametropodidae	0%	0%	0%	0%	0%	6%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.06
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.05
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.77
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.21
Caenidae	0%	0%	0%	1%	38%	0%	0.15
Capniidae	81%	60%	37%	65%	31%	69%	0.46
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.30
Chironomidae	100%	100%	89%	99%	100%	100%	0.97
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.67
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.03
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.00
Elmidae	48%	73%	5%	28%	15%	18%	0.20
Empididae	51%	65%	47%	62%	8%	51%	0.36
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.24
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.77
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.06
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.14
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.81
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.36
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.16
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.02
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.05
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.01
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.39
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.24
Leptoceridae	1%	15%	0%	5%	62%	2%	0.25
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.00
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.22
Leuctridae	35%	26%	11%	39%	8%	25%	0.18
Limnephilidae	36%	24%	21%	26%	0%	39%	0.16
Limnesiidae	7%	13%	5%	9%	46%	25%	0.23
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.22
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.04
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.00
Muscidae	0%	2%	0%	4%	0%	6%	0.01
Naididae	26%	47%	5%	46%	85%	33%	0.47
Nemouridae	93%	73%	53%	81%	15%	73%	0.49
Oxidae	0%	2%	0%	1%	15%	0%	0.06
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.03
Perlidae	32%	29%	11%	32%	8%	20%	0.16
Perlodidae	64%	60%	79%	75%	31%	76%	0.58
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.00
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.27
Planorbidae	1%	3%	0%	1%	31%	0%	0.12
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.08
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.09
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.33
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.20
Sperchontidae	17%	34%	37%	50%	23%	45%	0.32
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.03
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.51
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.49
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.20
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.14
Unionicolidae	0%	0%	0%	0%	15%	0%	0.06
Valvatidae	3%	2%	0%	3%	8%	2%	0.04

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	5.07
RIVPACS : Observed taxa P>0.50	6.00
RIVPACS : O:E (p > 0.5)	1.18
RIVPACS : Expected taxa P>0.70	3.32
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.20

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	15.90266 ± 33.91726
Channel		
Depth-Avg (cm)	20.7	40.5 ± 22.4
Macrophyte (PercentRange)	0	1 ± 2
Reach-%CanopyCoverage (PercentRange)	1.00	0.23 ± 0.44
Reach-%Logging (PercentRange)	0	0 ± 0
Reach-DomStreamsideVeg (Category(1-4))	2	2
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	0 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0100000	0.0047331 ± 0.0082050
Veg-Coniferous (Binary)	0	0 ± 1
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	0	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
Velocity-Avg (m/s)	0.62	0.23 ± 0.24
Velocity-Max (m/s)	1.13	0.31 ± 0.35
Width-Bankfull (m)	18.1	75.1 ± 72.8
Width-Wetted (m)	6.7	50.6 ± 60.4
XSEC-VelMethod (Category(1-3))	1	3
Climate		
Precip02_FEB (mm)	155.11000	171.50745 ± 107.47690
Temp07_JULmax (Degrees Celsius)	18.25000	20.34230 ± 2.49485
Landcover		
Natl-SnowIce (%)	26.42000	3.62533 ± 10.17162
Natl-Water (%)	2.82000	1.80201 ± 1.29922
Natl-WetlandHerb (%)	0.00000	0.68488 ± 0.92347
Substrate Data		
%Bedrock (%)	0	0
%Boulder (%)	0	0
%Cobble (%)	2	58
%Gravel (%)	12	1
%Pebble (%)	86	41
%Sand (%)	0	0
%Silt+Clay (%)	0	0
D50 (cm)	2.75	3.30
Dg (cm)	2.6	6.6
Dominant-1st (Category(0-9))	4	4 ± 2
Dominant-2nd (Category(0-9))	5	4 ± 2
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	1	3
SurroundingMaterial (Category(0-9))	3	2 ± 1
Topography		
SlopeAvg (%)	39.43000	30.12236 ± 18.75100
Water Chemistry		
General-DO (mg/L)	7.5000000	9.3400000 ± 2.0171679
General-pH (pH)	7.2	6.8 ± 1.0
General-SpCond (µS/cm)	35.6000000	176.1000000
General-TempAir (Degrees Celsius)	34.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	15.5000000	13.2730769 ± 4.7663725

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-AQ11
Sampling Date	Jul 30 2019
Know Your Watershed Basin	Harrison
Province / Territory	British Columbia
Terrestrial Ecological Classification	Pacific Maritime EcoZone Pacific Ranges EcoRegion
Coordinates (decimal degrees)	50.12711 N, 122.97198 W
Altitude	647
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Field Sheet (No image found)
Miscellaneous (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	January 28, 2020
Taxonomic Level	Family
Predictive Model Variables	Dominant-1st Natl-SnowIce Natl-Water Natl-WetlandHerb Precip02_FEB Reach-Riffles Sedimentary Slope SlopeAvg stream order Temp07_Julmax Width-Bankfull

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**

Number of Reference Sites	64	57	19	103	13	46
Group Error Rate	47.8%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.3%					
Probability of Group Membership	8.9%	4.6%	38.6%	21.6%	16.6%	9.7%
CABIN Assessment of RGD-AQ11 on Jul 30, 2019	Mildly Divergent					

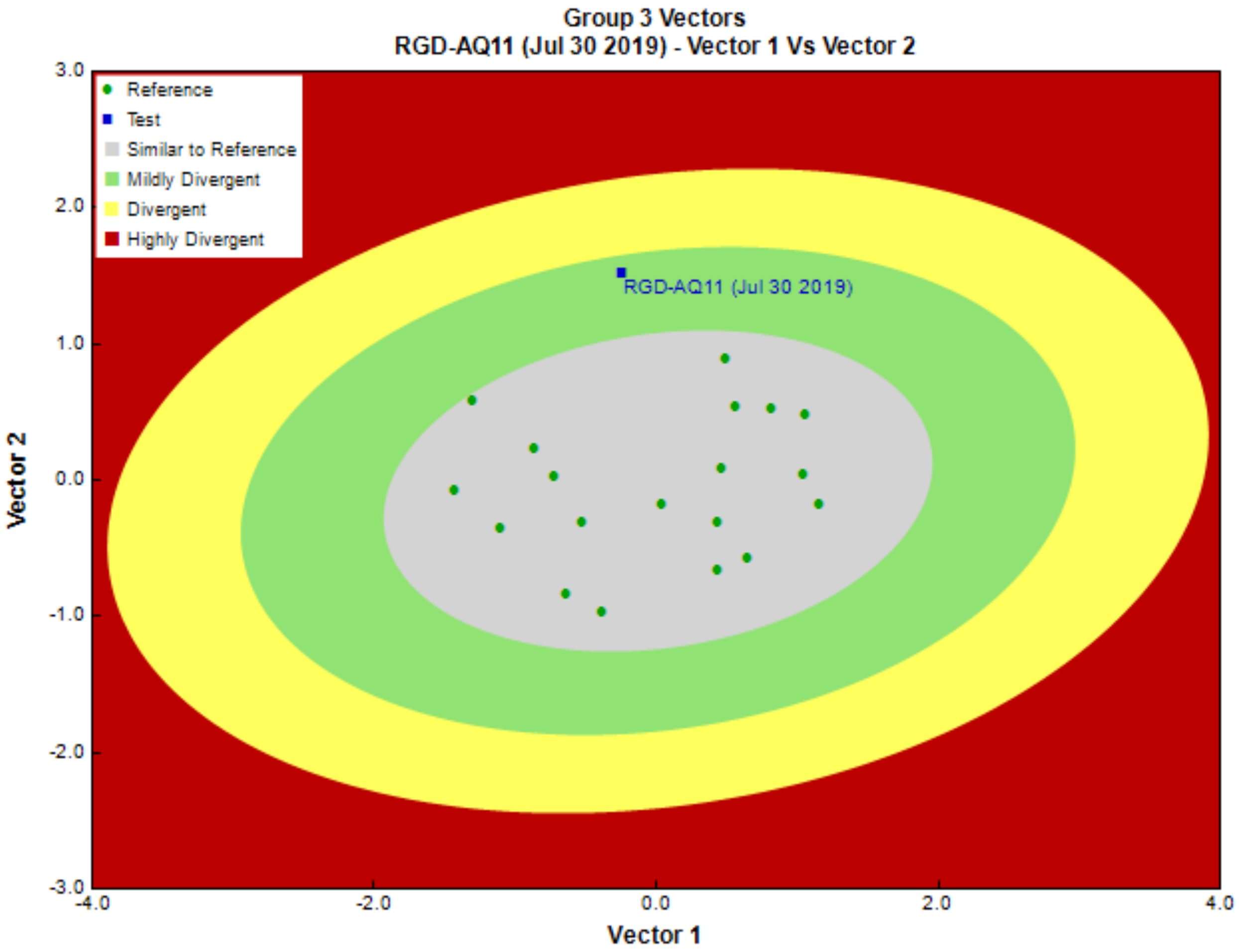


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	27/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	2	7.4
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	3	11.1
			Sperchontidae	6	22.2
	Insecta	Coleoptera	Dytiscidae	2	7.4
		Diptera	Chironomidae	17	62.9
			Simuliidae	54	200.0
			Tipulidae	1	3.7
		Ephemeroptera	Ameletidae	14	51.9

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Baetidae	97	359.3
			Ephemerellidae	2	7.4
			Heptageniidae	69	255.5
			Leptophlebiidae	2	7.4
		Plecoptera	Capniidae	5	18.5
			Chloroperlidae	28	103.7
			Nemouridae	5	18.5
			Perlidae	5	18.5
			Perlodidae	3	11.1
		Trichoptera	Rhyacophilidae	1	3.7
	Malacostraca	Amphipoda	Crangonyctidae	4	14.8
			Total	320	1,185.0

Metrics

Name	RGD-AQ11	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.71	0.4 ± 0.2
Functional Measures		
% Filterers	--	1.2 ± 1.0
% Gatherers	32.2	55.3 ± 17.5
% Predatores	28.4	22.0 ± 15.6
% Scrapers	68.8	53.5 ± 23.0
% Shredder	3.4	30.3 ± 22.3
No. Clinger Taxa	23.0	13.6 ± 4.4
Number Of Individuals		
% Diptera + Non-insects	27.2	20.6 ± 17.1
% EPT Individuals	72.2	78.2 ± 17.8
% of 5 dominant taxa	82.8	86.1 ± 8.2
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.8 ± 0.2
Total Abundance	1185.2	3776.0 ± 2948.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	1.0	0.2 ± 0.4
Diptera taxa	3.0	2.9 ± 1.4
Ephemeroptera taxa	5.0	3.3 ± 0.9
EPT Individuals (Sum)	855.6	2962.4 ± 2556.9
EPT taxa (no)	11.0	9.8 ± 2.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	5.0	4.0 ± 1.2
Shannon-Wiener Diversity	2.1	1.8 ± 0.4
Simpson's Diversity	0.8	0.7 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	19.0	14.8 ± 4.3
Trichoptera taxa	1.0	2.5 ± 1.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.31
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.01
Apataniidae	7%	2%	5%	11%	8%	8%	0.07
Arrenuridae	0%	2%	0%	0%	15%	0%	0.03
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.03
Aturidae	4%	6%	0%	5%	0%	2%	0.02
Baetidae	97%	92%	79%	93%	62%	84%	0.82
Blephariceridae	1%	0%	0%	2%	0%	2%	0.01
Brachycentridae	42%	53%	5%	35%	15%	27%	0.21

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Caenidae	0%	0%	0%	1%	38%	0%	0.07
Capniidae	81%	60%	37%	65%	31%	69%	0.50
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.21
Chironomidae	100%	100%	89%	99%	100%	100%	0.96
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.80
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.01
Curculionidae	0%	0%	0%	1%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	1%	0%	2%	0.00
Dixidae	1%	6%	0%	1%	0%	2%	0.01
Dugesiidae	0%	2%	0%	0%	0%	0%	0.00
Dytiscidae	0%	2%	0%	1%	0%	4%	0.01
Elmidae	48%	73%	5%	28%	15%	18%	0.20
Empididae	51%	65%	47%	62%	8%	51%	0.45
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.21
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.83
Ephemeridae	1%	0%	0%	3%	0%	0%	0.01
Feltriidae	0%	0%	0%	2%	0%	0%	0.00
Gammaridae	7%	6%	0%	0%	0%	0%	0.01
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.03
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.18
Gomphidae	0%	2%	0%	0%	0%	0%	0.00
Halacaridae	0%	2%	0%	0%	0%	0%	0.00
Haliplidae	0%	2%	0%	0%	0%	0%	0.00
Heptageniidae	99%	84%	100%	99%	54%	88%	0.90
Hyalellidae	0%	5%	0%	0%	0%	0%	0.00
Hydraenidae	0%	2%	0%	0%	0%	0%	0.00
Hydrophilidae	0%	2%	0%	0%	0%	0%	0.00
Hydropsychidae	52%	56%	21%	70%	23%	49%	0.39
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.13
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.03
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.07
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.07
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.02
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.34
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.23
Leptoceridae	1%	15%	0%	5%	62%	2%	0.12
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.22
Leuctridae	35%	26%	11%	39%	8%	25%	0.21
Limnephilidae	36%	24%	21%	26%	0%	39%	0.22
Limnesiidae	7%	13%	5%	9%	46%	25%	0.15
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.14
Lymnaeidae	1%	3%	0%	2%	8%	2%	0.02
Margaritiferidae	0%	2%	0%	0%	0%	0%	0.00
Mideopsidae	1%	5%	0%	0%	0%	2%	0.01
Muscidae	0%	2%	0%	4%	0%	6%	0.02
Naididae	26%	47%	5%	46%	85%	33%	0.34
Nemouridae	93%	73%	53%	81%	15%	73%	0.59
Oxidae	0%	2%	0%	1%	15%	0%	0.03
Pelecorhynchidae	3%	0%	0%	1%	0%	0%	0.00
Peltoperlidae	1%	0%	5%	7%	0%	4%	0.04
Perlidae	32%	29%	11%	32%	8%	20%	0.18
Perlodidae	64%	60%	79%	75%	31%	76%	0.68
Philopotamidae	1%	3%	0%	1%	0%	2%	0.01
Physidae	0%	0%	0%	1%	0%	0%	0.00
Pionidae	0%	2%	0%	3%	0%	0%	0.01
Piscicolidae	0%	0%	0%	1%	0%	0%	0.00
Pisidiidae	16%	53%	0%	11%	54%	12%	0.16
Planorbidae	1%	3%	0%	1%	31%	0%	0.06

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at RGD-AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.00
Psychodidae	33%	21%	0%	22%	0%	4%	0.09
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.06
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.45
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.23
Sperchontidae	17%	34%	37%	50%	23%	45%	0.36
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.02
Stygothrombidiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.65
Tanyderidae	0%	0%	0%	3%	0%	6%	0.01
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.00
Tipulidae	67%	50%	42%	68%	38%	63%	0.52
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.18
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.01
Uenoidae	9%	8%	37%	17%	0%	10%	0.20
Unionicolidae	0%	0%	0%	0%	15%	0%	0.03
Valvatidae	3%	2%	0%	3%	8%	2%	0.03

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	6.74
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	1.19
RIVPACS : Expected taxa P>0.70	4.30
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	1.16

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	18.33344 ± 33.50703
Channel		
Depth-Avg (cm)	23.4	28.5 ± 10.6
Depth-BankfullMinusWetted (cm)	33.00	163.00
Depth-Max (cm)	31.0	44.5 ± 18.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	2	3
Reach-Pools (Binary)	1	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	0	0 ± 1
Slope (m/m)	0.0100000	0.0259896 ± 0.0313728
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 1
Veg-GrassesFerns (Binary)	0	0 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.80	0.49 ± 0.15
Velocity-Max (m/s)	1.17	0.67 ± 0.21
Width-Bankfull (m)	17.3	85.0 ± 66.5
Width-Wetted (m)	6.6	23.1 ± 31.8
XSEC-VelMethod (Category(1-3))	1	3
Climate		
Precip02_FEB (mm)	155.11000	127.54903 ± 58.24882
Temp07_JULmax (Degrees Celsius)	18.25000	16.49843 ± 2.42987

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
Landcover		
Natl-SnowIce (%)	26.42000	30.72486 ± 23.89539
Natl-Water (%)	2.82000	0.99760 ± 0.86372
Natl-WetlandHerb (%)	0.00000	0.02638 ± 0.03974
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	9 ± 8
%Cobble (%)	4	63 ± 4
%Gravel (%)	19	3 ± 4
%Pebble (%)	77	25 ± 7
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 0
D50 (cm)	3.00	6.67 ± 3.25
Dg (cm)	2.7	8.6 ± 1.6
Dominant-1st (Category(0-9))	5	7 ± 1
Dominant-2nd (Category(0-9))	4	7 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	3	4 ± 2
Topography		
SlopeAvg (%)	39.43000	41.69956 ± 6.13915
Water Chemistry		
General-Conductivity (µS/cm)	33.3000000	62.9529406 ± 33.2341330
General-DO (mg/L)	9.8100000	12.6052631 ± 1.2122173
General-pH (pH)	6.8	7.4 ± 0.4
General-SpCond (µS/cm)	44.3000000	74.4000000 ± 44.3472660
General-TempAir (Degrees Celsius)	12.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	12.8000000	5.7731579 ± 1.9704316

Cordillera
Consulting

Project: 16025 Whistler 2018
Palmer Environmental Group, Alyssa Murdoch, May Mason Irene Mencke,
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Year:	**2018**	**2018**	**2018**	**2018**	**2018**
Sample:	**21M-DS-AQ21**	**JOR-DS-AQ31**	**CRB-DS-AQ01**	**RGD-AQ11**	**RDG-DS-AQ12**
Sample Collection Date:	**31-Jul-18**	**01-Aug-18**	**01-Aug-18**	**31-Jul-18**	**01-Aug-18**
CC#:	**CC191659**	**CC191661**	**CC191663**	**CC191664**	**CC191665**
Phylum: Arthropoda	0	0	0	0	0
| Order: Collembola	0	0	0	0	0
| Family: Sminthuridae	0	0	0	2	0
Subphylum: Hexapoda	0	0	0	0	0
| Class: Insecta	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0
Ameletus	28	6	0	31	14
| Family: Baetidae	217	12	380	23	11
Baetis	128	35	680	58	32
Baetis rhodani group	17	94	100	81	34
Baetis bicaudatus	0	0	0	2	5
Centroptilum	0	0	0	0	0
Anafroptilum	0	0	0	0	14
Diphetor hageni	0	0	0	0	0
| Family: Ephemerellidae	6	6	0	3	18
Caudatella	0	0	0	0	0
Drunella	0	0	0	0	0
Drunella grandis group	0	0	0	0	16
Drunella doddsii	33	0	0	9	5

Year:	**2018**	**2018**	**2018**	**2018**	**2018**
Sample:	**21M-DS-AQ21**	**JOR-DS-AQ31**	**CRB-DS-AQ01**	**RGD-AQ11**	**RDG-DS-AQ12**
Sample Collection Date:	**31-Jul-18**	**01-Aug-18**	**01-Aug-18**	**31-Jul-18**	**01-Aug-18**
CC#:	**CC191659**	**CC191661**	**CC191663**	**CC191664**	**CC191665**
Drunella spinifera	11	0	10	1	57
Serratella	0	18	0	1	0
| Family: Heptageniidae	28	0	40	20	0
Cinygmula	117	0	0	30	0
Epeorus	239	0	0	46	0
Rhithrogena	28	0	0	23	0
| Family: Leptophlebiidae	6	53	240	12	34
| Order: Plecoptera	0	0	0	0	0
| Family: Capniidae	6	0	0	4	0
| Family: Chloroperlidae	0	0	10	7	2
Neaviperla	0	0	0	1	0
Paraperla	0	0	0	5	0
Suwallia	0	0	0	5	2
Sweltsa	128	6	90	62	11
| Family: Leuctridae	0	0	0	1	0
Paraleuctra	6	0	0	0	0
| Family: Nemouridae	0	0	0	0	0
Malenka	0	0	10	1	5
Zapada	6	153	630	4	30
Zapada oregonensis group	0	0	10	0	0
Zapada cinctipes	6	82	130	0	5
Zapada columbiana	11	0	0	2	0
| Family: Perlidae	78	12	0	47	0
Doroneuria	17	0	0	3	0
Hesperoperla	0	18	0	1	0
| Family: Perlodidae	28	0	10	3	0
Megarcys	11	0	0	8	0
| Order: Trichoptera	0	0	0	0	0
| Family: Brachycentridae	0	0	0	0	0

Year:	**2018**	**2018**	**2018**	**2018**	**2018**
Sample:	**21M-DS-AQ21**	**JOR-DS-AQ31**	**CRB-DS-AQ01**	**RGD-AQ11**	**RDG-DS-AQ12**
Sample Collection Date:	**31-Jul-18**	**01-Aug-18**	**01-Aug-18**	**31-Jul-18**	**01-Aug-18**
CC#:	**CC191659**	**CC191661**	**CC191663**	**CC191664**	**CC191665**
Micrasema	0	0	0	1	0
| Family: Hydropsychidae	0	12	0	0	0
Arctopsyche	0	0	0	0	0
| Family: Hydroptilidae	0	0	0	0	0
Oxyethira	6	0	0	0	0
| Family: Lepidostomatidae	0	0	0	0	0
Lepidostoma	0	12	0	0	2
| Family: Limnephilidae	0	0	0	0	0
Dicosmoecus	0	0	0	0	2
Onocosmoecus	0	0	50	0	2
| Family: Rhyacophilidae	0	0	0	0	0
Rhyacophila	22	18	10	3	5
Rhyacophila angelita group	0	6	10	0	0
Rhyacophila betteni group	0	0	0	1	0
Rhyacophila brunnea/vemna group	17	0	0	1	0
Rhyacophila hyalinata group	0	0	0	0	0
Rhyacophila vagrita group	6	0	0	1	0
Rhyacophila arnaudi	0	0	30	0	0
| Order: Coleoptera	0	0	0	0	0
| Family: Dytiscidae	0	0	0	0	0
Oreodytes	0	0	0	0	39
| Subfamily: Hydroporinae	0	0	0	0	39
| Order: Diptera	0	0	0	0	0
| Family: Ceratopogonidae	0	0	0	0	0
Bezzia/ Palpomyia	39	0	0	0	2
Mallochohelea	6	0	0	0	0
| Family: Chironomidae	17	24	30	6	43
| Subfamily: Chironominae	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0

Year:	**2018**	**2018**	**2018**	**2018**	**2018**
Sample:	**21M-DS-AQ21**	**JOR-DS-AQ31**	**CRB-DS-AQ01**	**RGD-AQ11**	**RDG-DS-AQ12**
Sample Collection Date:	**31-Jul-18**	**01-Aug-18**	**01-Aug-18**	**31-Jul-18**	**01-Aug-18**
CC#:	**CC191659**	**CC191661**	**CC191663**	**CC191664**	**CC191665**
Polypedilum	17	0	0	1	2
Saetheria	0	0	0	0	20
| Tribe: Tanytarsini	17	0	0	0	0
Micropsectra	22	59	30	6	14
Rheotanytarsus	0	0	0	0	0
Stempellinella	0	0	0	0	2
| Subfamily: Orthocladiinae	6	6	20	0	0
Brillia	0	29	20	0	0
Eukiefferiella	22	53	150	3	0
Heterotrissocladius	0	0	0	0	2
Hydrobaenus	6	0	0	0	0
Metriocnemus	0	0	0	1	0
Orthocladius complex	0	0	30	2	5
Parakiefferiella	0	0	0	0	9
Parametriocnemus	11	0	0	2	2
Psectrocladius	0	0	0	0	2
Rheocricotopus	0	0	0	0	9
Thienemanniella	0	0	30	0	7
Tvetenia	0	100	130	1	30
| Subfamily: Tanypodinae	0	0	0	0	0
Zavrelimyia	0	0	0	2	0
| Tribe: Pentaneurini	0	0	0	0	0
Thienemannimyia group	28	0	0	3	41
| Family: Deuterophlebiidae	0	0	0	0	0
Deuterophlebia	6	0	0	0	0
| Family: Empididae	0	0	10	0	0
Chelifera/ Metachela	0	0	30	0	2
Oreogeton	0	0	0	0	0
| Family: Simuliidae	11	41	20	5	0
Prosimulium	0	0	0	1	0
Prosimulium/Helodon	0	0	0	1	0

Year:	**2018**	**2018**	**2018**	**2018**	**2018**
Sample:	**21M-DS-AQ21**	**JOR-DS-AQ31**	**CRB-DS-AQ01**	**RGD-AQ11**	**RDG-DS-AQ12**
Sample Collection Date:	**31-Jul-18**	**01-Aug-18**	**01-Aug-18**	**31-Jul-18**	**01-Aug-18**
CC#:	**CC191659**	**CC191661**	**CC191663**	**CC191664**	**CC191665**
Simulium	478	1271	120	275	14
| Family: Tipulidae	0	0	0	0	2
Dicranota	0	0	0	1	2
Erioptera	0	0	20	0	0
Hexatoma	0	6	20	0	0
| Order: Lepidoptera	0	0	0	1	0
| Order: Megaloptera	0	0	0	0	0
| Family: Sialidae	0	0	0	0	0
Sialis	0	0	0	0	2
Subphylum: Chelicerata	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0
| Order: Trombidiformes	0	0	0	2	2
| Family: Aturidae	0	0	0	0	0
Aturus	0	0	10	0	0
| Family: Hydryphantidae	0	0	0	0	0
Protzia	0	0	10	1	0
| Family: Hygrobatidae	0	0	0	0	0
Atractides	33	0	10	8	2
Hygrobates	0	0	20	0	20
| Family: Lebertiidae	0	0	0	0	0
Lebertia	11	0	10	2	9
| Family: Sperchontidae	0	0	0	0	0
Sperchon	22	0	10	8	5
Sperchonopsis	0	6	0	0	0
| Family: Torrenticolidae	0	0	0	0	0
Testudacarus	6	0	10	1	0
Torrenticola	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0

Year:	2018	2018	2018	2018	2018
Sample:	21M-DS-AQ21	JOR-DS-AQ31	CRB-DS-AQ01	RGD-AQ11	RDG-DS-AQ12
Sample Collection Date:	31-Jul-18	01-Aug-18	01-Aug-18	31-Jul-18	01-Aug-18
CC#:	CC191659	CC191661	CC191663	CC191664	CC191665
| Order: Oribatida	0	0	0	2	0
| Class: Malacostraca	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	2
| Family: Crangonyctidae	0	0	0	0	0
Crangonyx	0	0	0	1	2
Phylum: Mollusca	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0
| Family: Pisidiidae	0	6	0	0	2
Pisidium	0	6	0	0	5
| Class: Gastropoda	0	0	0	0	0
| Order: Basommatophora	0	0	0	0	0
| Family: Planorbidae	0	0	0	1	0
Phylum: Annelida	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0
| Family: Lumbriculidae	22	0	0	0	0
Lumbriculus	6	0	0	6	9
| Order: Tubificida	0	0	0	0	0
| Family: Naididae	0	0	0	0	0
Nais	0	0	10	0	0
| Subfamily: Tubificinae with hair chaetae	0	0	0	0	161
Totals:	**1992**	**2150**	**3190**	**846**	**815**
Taxa present but not included:					

Year:	**2018**	**2018**	**2018**	**2018**	**2018**
Sample:	**21M-DS-AQ21**	**JOR-DS-AQ31**	**CRB-DS-AQ01**	**RGD-AQ11**	**RDG-DS-AQ12**
Sample Collection Date:	**31-Jul-18**	**01-Aug-18**	**01-Aug-18**	**31-Jul-18**	**01-Aug-18**
CC#:	**CC191659**	**CC191661**	**CC191663**	**CC191664**	**CC191665**
Terrestrials	0	0	0	0	2
Phylum: Arthropoda	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0
| Class: Insecta	0	0	0	0	0
| Order: Psocodea	0	0	0	1	0
Subphylum: Crustacea	0	0	0	0	0
| Class: Ostracoda	0	0	0	1	0
| Class: Maxillipoda	0	0	0	0	0
| Class: Copepoda	0	0	10	0	0
Phylum: Nemata	0	6	0	1	2
Phylum: Platyhelminthes	0	0	0	0	0
| Class: Turbellaria	0	6	0	1	0
Totals:	**0**	**12**	**10**	**4**	**4**

Cordillera
Consulting

Project: Whistler 160255 2019
Palmer Environmental Group, Alyssa Murdoch, May Mason Irene Mencke,
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Year:	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200372	CC200373	CC200374	CC200375
Phylum: Arthropoda	0	0	0	0	0
| Order: Collembola	0	10	0	3	6
Subphylum: Hexapoda	0	0	0	0	0
| Class: Insecta	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0
Ameletus	52	0	4	0	89
| Family: Baetidae	63	530	26	34	111
Baetis	78	1040	35	154	139
Baetis rhodani group	219	40	9	20	178
Baetis bicaudatus	0	0	13	0	28
Centroptilum	0	0	0	0	0
Anafroptilum	0	0	26	0	0
Diphetor hageni	0	0	0	3	0
| Family: Ephemerellidae	0	0	100	11	17
Drunella	0	0	0	0	0
Drunella grandis group	4	10	109	6	0
Drunella coloradensis	0	0	0	0	6
Drunella doddsii	0	0	0	0	22
Drunella spinifera	4	0	4	0	17

Year:	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200372	CC200373	CC200374	CC200375
Ephemerella	0	0	17	0	0
Serratella	0	0	9	3	0
| Family: Heptageniidae	48	10	4	0	67
Cinygmula	74	0	0	0	139
Epeorus	107	0	0	0	283
Rhithrogena	26	0	0	0	6
| Family: Leptophlebiidae	7	140	17	6	11
| Order: Plecoptera	0	0	0	0	0
| Family: Capniidae	19	0	0	0	11
| Family: Chloroperlidae	22	20	0	0	22
Sweltsa	81	30	13	3	56
| Family: Nemouridae	0	90	0	3	0
Malenka	4	10	4	0	6
Zapada	11	440	4	80	33
Zapada oregonensis group	0	50	0	0	0
Zapada cinctipes	0	180	9	54	6
Zapada columbiana	4	0	0	0	0
| Family: Perlidae	11	0	0	6	17
Calineuria californica	4	0	0	0	0
Doroneuria	4	0	0	0	11
Hesperoperla	0	0	0	3	0
| Family: Perlodidae	7	0	0	0	17
Megarcys	4	0	0	0	17
| Order: Trichoptera	0	10	0	0	0
| Family: Glossosomatidae	0	0	0	0	0
Glossosoma	0	0	0	3	0
| Family: Hydropsychidae	0	0	0	3	6
| Family: Lepidostomatidae	0	0	0	0	0
Lepidostoma	0	0	0	11	0

Year:	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200372	CC200373	CC200374	CC200375
| Family: Limnephilidae	0	0	0	0	11
Onocosmoecus	0	0	4	0	0
Psychoglypha	0	0	4	0	0
| Family: Philopotamidae	0	0	0	0	0
Wormaldia	0	0	0	3	0
| Family: Rhyacophilidae	0	0	0	0	0
Rhyacophila	0	20	4	0	6
Rhyacophila angelita group	4	0	0	0	0
Rhyacophila brunnea/vemna group	0	0	0	0	11
Rhyacophila arnaudi	0	20	0	0	0
| Order: Coleoptera	0	0	0	0	0
| Family: Dytiscidae	0	0	0	0	0
Oreodytes	7	0	83	0	0
| Subfamily: Hydroporinae	0	0	78	0	0
| Order: Diptera	0	0	0	0	0
| Family: Ceratopogonidae	0	0	0	0	0
Bezzia/ Palpomyia	0	0	0	0	11
| Family: Chironomidae	4	30	135	11	28
| Subfamily: Chironominae	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0
Microtendipes	4	10	0	0	6
Paracladopelma	0	0	4	0	0
Polypedilum	4	0	9	0	33
| Tribe: Tanytarsini	0	10	0	0	0
Micropsectra	22	80	22	40	6
Stempellinella	0	0	0	3	6
Tanytarsus	4	0	30	3	0
| Subfamily: Diamesinae	0	0	0	0	0
| Tribe: Diamesini	0	0	0	0	0

Year:	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200372	CC200373	CC200374	CC200375
Diamesa	0	0	0	0	6
| Subfamily: Orthocladiinae	0	40	4	80	6
Brillia	0	70	4	80	6
Corynoneura	0	20	0	0	0
Eukiefferiella	15	150	4	23	11
Heterotanytarsus	0	0	4	0	0
Heterotrissocladius	0	0	17	0	0
Orthocladius complex	0	30	30	3	6
Parakiefferiella	0	0	17	3	0
Parametriocnemus	0	20	0	0	0
Rheocricotopus	0	20	4	0	0
Synorthocladius	0	0	0	6	0
Thienemanniella	0	0	13	0	0
Tvetenia	4	150	0	200	0
| Subfamily: Tanypodinae	4	0	0	0	0
Nilotanypus	0	0	0	3	0
| Tribe: Pentaneurini	0	0	0	0	0
Thienemannimyia group	4	0	48	3	6
| Family: Empididae	0	0	0	0	6
Neoplasta	0	10	0	0	0
Oreogeton	0	0	0	0	6
| Family: Simuliidae	4	10	0	0	6
Helodon	4	0	0	0	6
Simulium	193	120	4	29	217
| Family: Tipulidae	0	0	0	0	0
Dicranota	4	10	4	3	0
Hexatoma	0	0	0	0	6
Subphylum: Chelicerata	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0

Year:	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200372	CC200373	CC200374	CC200375
| Family: Hydryphantidae	0	0	0	0	0
Protzia	0	0	0	0	6
| Family: Hygrobatidae	0	0	0	0	0
Atractides	11	0	4	3	11
Hygrobates	0	30	30	0	0
| Family: Lebertiidae	0	0	0	0	0
Lebertia	0	0	4	0	11
| Family: Sperchontidae	0	0	0	0	0
Sperchon	22	20	9	0	6
| Family: Torrenticolidae	0	0	0	0	0
Testudacarus	0	0	0	0	6
Suborder: Prostigmata	0	0	0	0	0
| Family: Stygothrombidiidae	0	0	0	0	0
Stygothrombium	0	10	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0
| Order: Oribatida	0	0	0	0	6
| Class: Malacostraca	0	0	0	0	0
| Order: Amphipoda	0	0	9	0	0
| Family: Crangonyctidae	0	0	0	0	0
Crangonyx	15	0	4	0	0
Phylum: Mollusca	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0
| Family: Pisidiidae	0	10	0	14	0
Pisidium	0	0	4	9	0
| Class: Gastropoda	0	0	0	0	0

Year:	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200372	CC200373	CC200374	CC200375
| Order: Basommatophora	0	0	0	0	0
| Family: Physidae	0	0	0	6	0
Phylum: Annelida	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0
| Family: Lumbriculidae	0	0	0	0	0
Lumbriculus	0	0	13	0	0
| Order: Tubificida	0	0	0	0	0
| Family: Naididae	0	0	0	0	0
| Subfamily: Tubificinae with hair chaetae	4	0	335	3	0
| Subfamily: Tubificinae without hair chaetae	4	0	13	3	33
Phylum: Cnidaria	0	0	0	0	0
| Class: Hydrozoa	0	0	0	0	0
| Order: Anthoathecatae	0	0	0	0	0
| Family: Hydridae	0	0	0	0	0
Hydra	0	0	0	3	0
Totals:	**1190**	**3500**	**1354**	**940**	**1806**
Taxa present but not included:					
Terrestrials	0	0	0	6	0
Phylum: Arthropoda	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0
| Class: Insecta	0	0	0	0	0
| Order: Diptera	0	0	0	0	0
| Family: Cecidomyiidae	0	10	0	0	0

Year:	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200372	CC200373	CC200374	CC200375
| Order: Psocodea	4	0	0	0	0
| Class: Maxillipoda	0	0	0	0	0
| Class: Copepoda	0	0	4	3	0
Totals:	**4**	**10**	**4**	**9**	**0**

Appendix C

Benthic Invertebrate (CABIN) Sampling Datasheets

Field Crew: MS. J. Site Code: 21M-DS-AQ21

Sampling Date: (DD/MM/YYYY) 30/07/2019 (1320 – 1445)

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: ______ Local Basin Name: Twenty One Mile

River/Stream Name: Twenty One Mile Stream Order: (map scale 1:50,000) ______

Select one: ☑ Test Site ☐ Potential Reference Site

Geographical Description/Notes:
Cross bridge @ Ladner Parking lot - follow gravel path to 1st tline clearing - go S-SW to stream (follow t line)

Surrounding Land Use: (check those present) Information Source: ______

☑ Forest ☐ Field/Pasture ☐ Agriculture ☑ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☑ Other T lines

Dominant Surrounding Land Use: (check one) Information Source: ______

☑ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

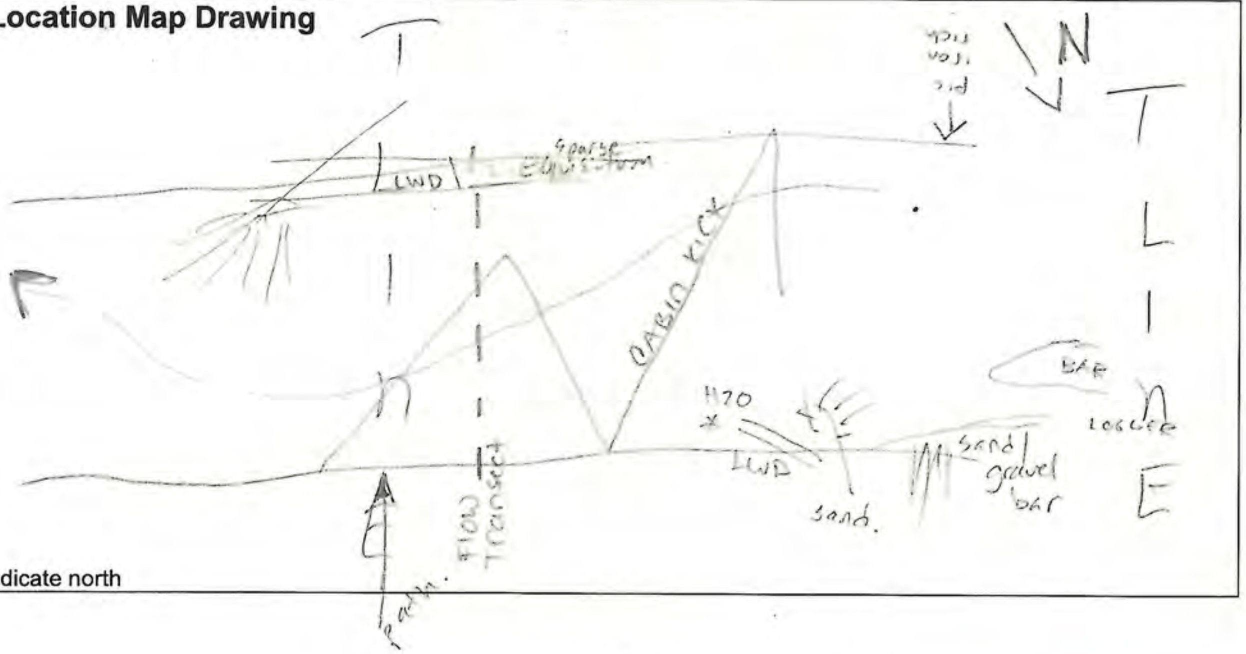
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other Tline clearing

Location Data 10U 0501935 5552826

Latitude: ______N Longitude: - ______W (DMS or DD)

Elevation: 643 (fasl *or* masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: ______

Site Location Map Drawing



Note: Indicate north

Field Crew: MS + J Site Code: 21M-DS-AQZ1

Sampling Date: (DD/MM/YYYY) 30/07/2019

Photos

☑ Field Sheet ☑ Upstream ☑ Downstream ☑ Across Site ☐ Aerial View

☐ Substrate (exposed) ☑ Substrate (aquatic) ☐ Other + 2 od log w/ shroom?

+ 2 rock w/ green algae

+ 2 od rock w/ diatom

+ 1 logger. + 1 [illegible]

+ 1 logger

+ 2 iron rich inflows

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   ☑ Riffle ☐ Rapids ☐ Straight run ☑ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   ☐ 0 % ☑ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   ☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
   ☑ ferns/grasses ☑ shrubs ☐ deciduous trees ☐ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   ☐ ferns/grasses ☑ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one*)

   ☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)

   ☑ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)

   ☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)

   ☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)

   ☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

- sporadic patches of green algae on rocks.

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	M.S.
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	15cm.

Preservative used: Ethanol.

Sampled sieved on site using "Bucket Swirling Method":
☑ YES ☐ NO

If YES, debris collected for QAQC ☐

+ 2 sculpin

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: MS + J Site Code: 21N-DS-AQ21

Sampling Date: (DD/MM/YYYY) 30/07/2019

WATER CHEMISTRY DATA **Time:** 1400 (24 hr clock) **Time zone:** ______

Air Temp: ______ (ºC) Water Temp: 13.3 (ºC) pH: 6.97

Specific Conductance: 51.8 (µs/cm) DO: 9.78 (mg/L) Turbidity: – (NTU)

Conductivity 36.3 us/cm

93.6%

32.5 TDS mg/L

706.1 mmHd

Check if water samples were collected for the following analyses:

☐ TSS (Total Suspended Solids)

☐ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)

☐ Phosphorus (Total, Ortho, and/or Dissolved)

☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☐ Other______

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

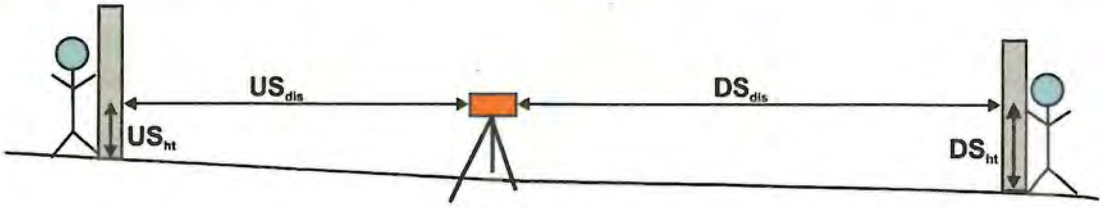
Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ______ (m),
distance between contour intervals (horizontal distance) ______ (m)
slope = vertical distance/horizontal distance =______

OR

☑ **Measured in field** Clinometer = 20.5m ; < 1%

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
^{a}Top Hairline (T)			
^{a}Mid Hairline (ht) OR ^{b}Height of rod			
^{a}Bottom Hairline (B)			
^{b}Distance (dis) OR ^{a}T-B x 100	$^a US_{dis}$=T-B	$^a DS_{dis}$=T-B	$US_{dis}+DS_{dis}$=
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			



Field Crew: ______________________ Site Code: ____________

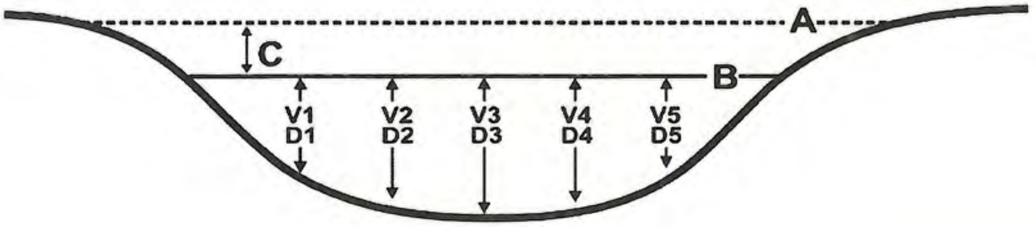
Sampling Date: (DD/MM/YYYY) ______________________

Widths and Depth

Location at site: 5m u/s of 'base' @ bankfull site (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 11.4 (m) B - Wetted Stream Width: 11.3 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 20cm (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☑ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other________

@ Base →

	1	2	3	4	5	6	AVG
Distance from Shore (m)	1m	2.5m	4m	5.5m	7m.	8.5	
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (**D₁**) (cm)	31	28.5	21	17	9	6	
Depth of Stagnation (**D₂**) (cm)	35	32	25	18	10.5	8	
Change in depth (**ΔD=D₂-D₁**) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Field Crew: ______________________ Site Code: ____________

Sampling Date: (DD/MM/YYYY) ______________________

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	[✓ 3]
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	24		26	7.1		51	3.4		76	6.5	
2	2 0		27	4.5		52	7.7		77	2.4	
3	1.3		28	4.1		53	3.8		78	4.3	
4	3.0		29	4,9		54	2 7		79	5.0	
5	4.2		30	5.0	0	55	1.0		80	3.8	1/2
6	2 2		31	3.0		56	2.0		81	4.4	
7	4 0		32	5.0		57	.7		82	3.5	
8	6.3		33	5.0		58	4.6		83	4.0	
9	.06		34	5.0		59	4.4		84	1.2	
10	5.6	1/4	35	2.0		60	1.4	0	85	2.5	
11	5.2		36	4.1		61	3,0		86	2.8	
12	4.0		37	1.5		62	.6		87	3.5	
13	3.3		38	,4		63	2.5		88	2.2	
14	3,9		39	3.8		64	.7		89	5,2	
15	5.0		40	5.8	1/4	65	2.4		90	3.0	0
16	6.2		41	4,3		66	5.0		91	4.2	
17	4 5		42	4.0		67	3.7		92	3.2	
18	2 7		43	2.0		68	2.8		93	2.2	
19	1,5		44	2.5		69	,9		94	.4	
20	6.0	1/4	45	2.0		70	5.3	1/4	95	3.4	
21	3.0		46	1.5		71	.2		96	2.2	
22	2.2		47	4.3		72	2 9		97	3,4	
23	4.1		48	4.0		73	5.7		98	6.0	
24	4.2		49	6.2		74	4.3		99	5.0	
25	6,0		50	5.0	0	75	6.2		100	3.9	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: ______________________________ Site Code: ____________

Sampling Date: (DD/MM/YYYY) ____________________

SITE INSPECTION

Site Inspected by: ______________________________

Communication Information

☐ Itinerary left with contact person (include contact numbers)

Contact Person: ________________________ Time checked-in: ________

Form of communication: ☐ radio ☐ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: ( ) ____________

Vehicle Safety

☐ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☐ Equipment and chemicals safely secured for transport

☐ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☐ Wading Task Hazard Analysis read by all field staff

☐ Wading Safe Work Procedures read by all field staff

☐ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☐ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: MS + J.

Site Code: CRB-DS-AQ01

Sampling Date: (DD/MM/YYYY) 30/07/2019 (1500 - 1600)

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: ______

Local Basin Name: Crabapple Creek.

River/Stream Name: Crabapple

Stream Order: (map scale 1:50,000) ______

Select one: ☑ Test Site ☐ Potential Reference Site

Geographical Description/Notes:

Larrmer Rd parking lot - follow small/short path to S - cut into forest ~ 10m in

Surrounding Land Use: (check those present)

Information Source: ______

☒ Forest ☐ Field/Pasture ☐ Agriculture ☑ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ______

Dominant Surrounding Land Use: (check one)

Information Source: ______

☐ Forest ☐ Field/Pasture ☐ Agriculture ☑ Residential/Urban

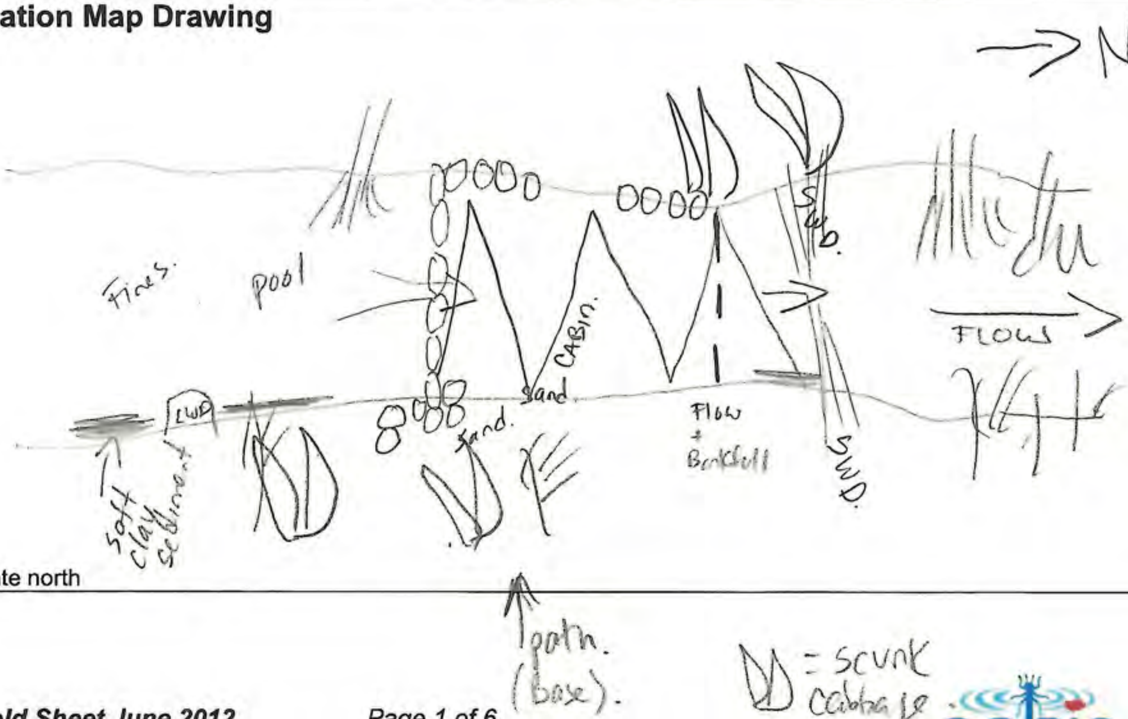
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ______

Location Data 10U 0502024 5552701

Latitude: ______ N Longitude: - ______ W (DMS or DD)

Elevation: 656 (fasl *or* masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: ______

Site Location Map Drawing



Note: Indicate north

Field Crew: MS + S Site Code: CRB-DS-AQ01

Sampling Date: (DD/MM/YYYY) 30/07/2019

Photos

☒ Field Sheet ☒ Upstream ☑ Downstream ☒ Across Site ☐ Aerial View

☐ Substrate (exposed) ☒ Substrate (aquatic) ☐ Other ________

+ 2 moss mats

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*

☑ Riffle ☐ Rapids ☐ Straight run ☒ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*

☐ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☑ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*

☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: *(check those present)*

☑ ferns/grasses ☑ shrubs ☑ deciduous trees ☐ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*

☐ ferns/grasses ☑ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

⊛⊛. Lot of moss mats on rocks

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)

☒ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)

☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)

☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)

☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	MS.
Sampling time (i.e. 3 min.)	3min
No. of sample jars	2
Typical depth in kick area (cm)	12cm.

Preservative used: Ethanol

Sampled sieved on site using "Bucket Swirling Method":

☐ YES ☒ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: M.S, J. Site Code: CRB-DS-AQ01

Sampling Date: (DD/MM/YYYY) 30/07/2019

WATER CHEMISTRY DATA **Time:** 1540 (24 hr clock) **Time zone:** ______

Air Temp: ~ 13 (°C) Water Temp: 13.9 (°C) pH: 7.6

Specific Conductance: 234.9 (µs/cm) DO: 10.0 (mg/L) Turbidity: – (NTU)

Conductivity 184.9 us/cm 96.7%

706.2 mmHg

152.75 TDS

Check if water samples were collected for the following analyses:

☐ TSS (Total Suspended Solids)

☐ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)

☐ Phosphorus (Total, Ortho, and/or Dissolved)

☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☐ Other ______

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

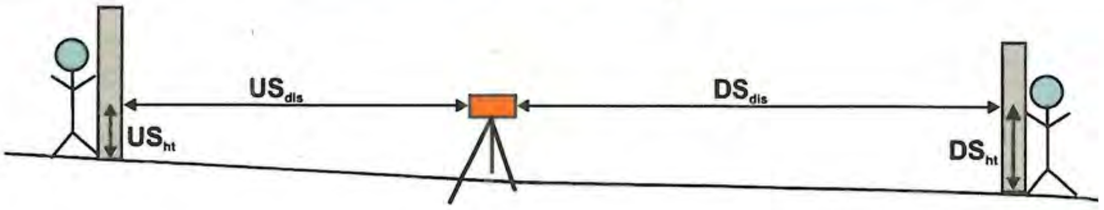
Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ______ (m),
distance between contour intervals (horizontal distance) ______ (m)
slope = vertical distance/horizontal distance = ______

OR

☐ **Measured in field** Clinometer 3% @ 5.2m.

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
^{a}Top Hairline (T)			
^{a}Mid Hairline (ht) OR ^{b}Height of rod			
^{a}Bottom Hairline (B)			
^{b}Distance (dis) OR ^{a}T-B x 100	$^{a}US_{dis}$=T-B	$^{a}DS_{dis}$=T-B	$US_{dis}+DS_{dis}=$
Change in height (Δht)			$DS_{ht}-US_{ht}=$
Slope (Δht/total dis)			



Field Crew: MS, J

Site Code: CBB-D5-AQ01

Sampling Date: (DD/MM/YYYY) 30/07/2019

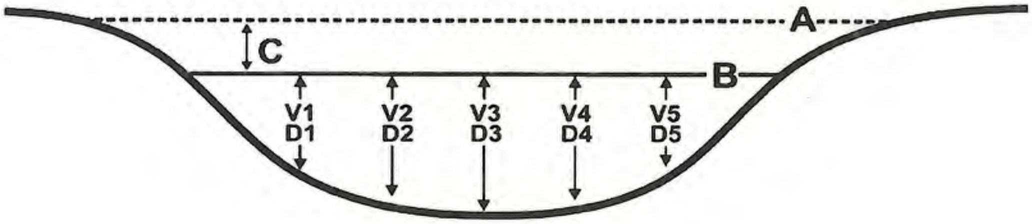
Widths and Depth

Location at site: middle of kick area (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 3.4 (m)

B - Wetted Stream Width: 2.3 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 35CM. (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☑ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other__________

Base ->

	1	2	3	4	5	6	AVG
Distance from Shore (m)	0.5	1.0	1.5	2.0			
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (**D₁**) (cm)	10.5	17	17.5	6.0			
Depth of Stagnation (**D₂**) (cm)	13	18.5	19.0	7.0			
Change in depth (**ΔD=D₂-D₁**) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Field Crew: MS, J

Site Code: CRB-DS-AQ01

Sampling Date: (DD/MM/YYYY) 30/07/2019

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	[✓ 2]
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	10.5		26	11.0		51	4.5		76	9.5	
2	7.2		27	25.0		52	5.0		77	10	
3	3.5		28	10.5		53	4.0		78	11	
4	8.0.		29	6.5		54	16.0		79	sand	
5	2.0		30	10.0	1/4	55	10.0		80	9.0	
6	3.8		31	3.0		56	11.0		81	13.0	
7	2.5		32	5.0		57	9.0		82	25	1/2
8	3.0		33	sand.		58	6.0		83	17	
9	5.0		34	3.5		59	11.0		84	21	
10	9.0		35	5.0		60	13.0		85	10	
11	6.9		36	13.0		61	13.5		86	7	
12	3.5		37	6.0		62	10		87	sand	
13	5.0	1/4	38	14.0		63	14.0	3/4	88	14	
14	sand.		39	4.0		64	8		89	fines	
15	3.0		40	25		65	16		90	19	
16	3.5		41	11		66	6.5		91	1.5	
17	7.5		42	6.0	1/2	67	5.0		92	16.0	1/4
18	7.0		43	13.0		68	7.0		93	1.0	
19	3.5		44	26.0		69	12.0		94	11	
20	3.0		45	13.0		70	16.5		95	sand	
21	7.0	1/4	46	5.0		71	sand		96	sand	
22	sand.		47	14.0		72	18	1/2	97	16	
23	6.8		48	3.0		73	16		98	1.8	
24	7.0		49	5.5	0	74	8		99	2.1	
25	8.0		50	11.5	0	75	5.5		100	6.0.	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: ________________________________ Site Code: ____________

Sampling Date: (DD/MM/YYYY) ______________________

SITE INSPECTION

Site Inspected by: ______________________________

Communication Information

☐ Itinerary left with contact person (include contact numbers)

Contact Person: _________________________ Time checked-in: _______

Form of communication: ☐ radio ☐ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (   ) ____________

Vehicle Safety

☐ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☐ Equipment and chemicals safely secured for transport

☐ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☐ Wading Task Hazard Analysis read by all field staff

☐ Wading Safe Work Procedures read by all field staff

☐ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☐ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: MS HW Site Code: JOR-DS-AQ31

Sampling Date: (DD/MM/YYYY) 31/07/2019

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: ______ Local Basin Name: Jordan Creek

River/Stream Name: Jordan Creek. Stream Order: (map scale 1:50,000) ______

Select one: ☐ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Alpha Lake Parking lot - take path Northward, just past treatment facility - go into bush @ lg conifer.

Surrounding Land Use: (check those present) Information Source: ______

☑ Forest	☐ Field/Pasture	☐ Agriculture	☑ Residential/Urban
☐ Logging	☐ Mining	☐ Commercial/Industrial	☐ Other ______

Dominant Surrounding Land Use: (check one) Information Source: ______

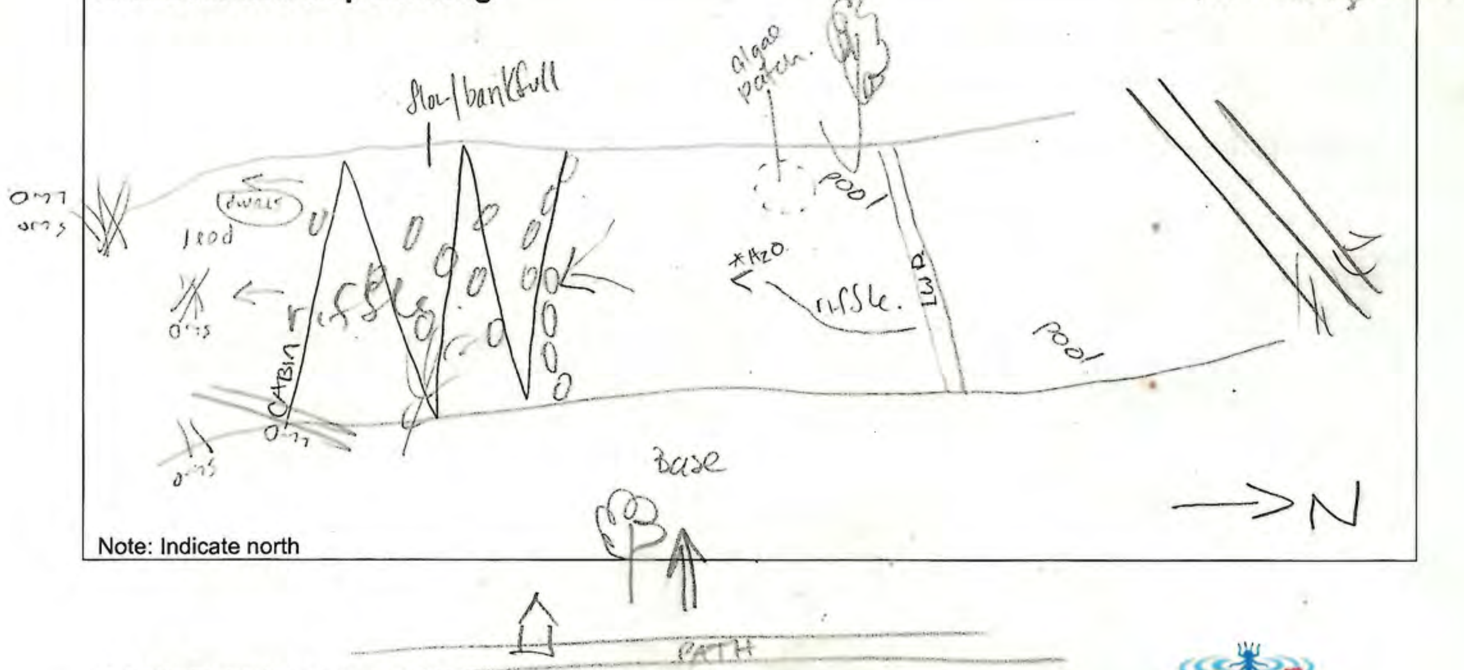
☐ Forest	☐ Field/Pasture	☐ Agriculture	☑ Residential/Urban
☐ Logging	☐ Mining	☐ Commercial/Industrial	☐ Other ______

Location Data 10U 0500194 5549249

Latitude: ______ N Longitude: - ______ W (DMS or DD)

Elevation: 624. (fasl *or* masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: ______

Site Location Map Drawing



Note: Indicate north

Field Crew: MS. Hill

Site Code: JOR - DS - AQ3

Sampling Date: (DD/MM/YYYY) 31/07/2019

Photos

☑ Field Sheet ☑ Upstream ☑ Downstream ☑ Across Site *3 ☐ Aerial View

☐ Substrate (exposed) ☑ Substrate (aquatic) ☐ Other ______

REACH DATA *(represents 6 times bankfull width)*

+1 Hillary doing paddle count

1. Habitat Types: *(check those present)*
   ☑ Riffle ☐ Rapids ☑ Straight run ☑ Pool/Back Eddy +1 d/s of kick area (LL30/SC10)

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   ☐ 0 % ☐ 1-25 % ☐ 26-50 % ☑ 51-75 % ☐ 76-100 %

+3 rock snot + algae.

3. Macrophyte Coverage: *(not algae or moss, check one)*
   ☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
   ☑ ferns/grasses ☑ shrubs ☑ deciduous trees ☑ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   ☐ ferns/grasses ☑ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

Clumps of algae @ u/s, slow flow area.

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
☒ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	MS.
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	24 cm

Preservative used: Ethanol

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☒ NO
If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: ______________________ Site Code: JOK - ______

Sampling Date: (DD/MM/YYYY) 31/07/2019

WATER CHEMISTRY DATA **Time:** 1230 (24 hr clock) **Time zone:** PST

Air Temp: 12. (°C) Water Temp: 17.4 (°C) pH: 7.66.

Specific Conductance: 78.4 (μs/cm) DO: 9.44. (mg/L) Turbidity: - (NTU)

Cond. 67.1 us/cm 98.6 %

707.3 mmHg

50.7 TDS

0.04 salinity (ppt)

Check if water samples were collected for the following analyses:

☐ TSS (Total Suspended Solids)

☐ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)

☐ Phosphorus (Total, Ortho, and/or Dissolved)

☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☐ Other ______

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: ______ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) ______ (m),

distance between contour intervals (horizontal distance) ______ (m)

slope = vertical distance/horizontal distance = ______

OR

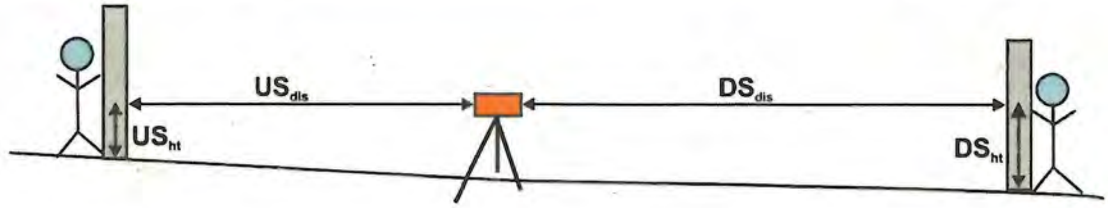
☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Clinometer 3% @ 15m.

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
ᵃTop Hairline (T)			
ᵃMid Hairline (ht) OR ᵇHeight of rod			
ᵃBottom Hairline (B)			
ᵇDistance (dis) OR ᵃT-B x 100	ᵃUS_{dis}=T-B	ᵃDS_{dis}=T-B	$US_{dis}+DS_{dis}$=
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			



Field Crew: ______________________ Site Code: ______________

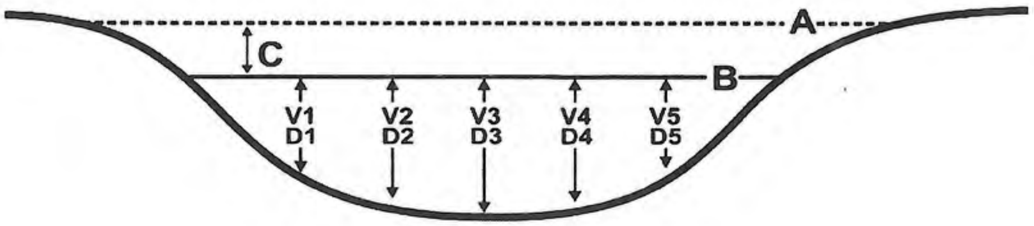
Sampling Date: (DD/MM/YYYY) ______________________

Widths and Depth

Location at site: middle of kick site (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 4.2 (m)   B - Wetted Stream Width: 4.4 (m) undercut

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 14cm. (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☑ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other______________

opposite base:

	1	2	3	4	5	6	AVG
Distance from Shore (m)	0.5	1.0	1.5	2.0	2.5	3.0.	~~3.5~~
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)	12.5	15	24	31.5	25.5	behind boulder.	
Depth of Stagnation (D_2) (cm)	15	19	27	34	26.0	^	
Change in depth (**ΔD=D₂-D₁**) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Field Crew: ______________________ Site Code: __________

Sampling Date: (DD/MM/YYYY) ______________

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	[✓ 4]
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	6.0		26	14.0		51	16		76	23	
2	7.0		27	23		52	8.5	1/2	77	19.	
3	13.0.		28	3.5		53	32		78	10	
4	19.0.		29	35.0		54	16		79	37	
5	1.0.		30	23		55	7.5		80	6.5	
6	12.0.		31	15		56	28		81	13	
7	8.0		32	7.5		57	17		82	28	1/2
8	9.5		33	34		58	19		83	9.0	
9	2.0.		34	29		59	18		84	14	
10	18.0		35	33		60	10	0	85	15	
11	6.0	0	36	15	0	61	18		86	8.0.	
12	15.0		37	15.5		62	30		87	20.	
13	5.5		38	7.0		63	21		88	10.	
14	1.5		39	30		64	17		89	22	
15	4.5		40	4.0		65	11		90	17	0
16	6.0		41	35.0		66	11		91	19	
17	15.5		42	23		67	18		92	8.5	
18	20		43	18		68	4.0		93	2.5	
19	8.5		44	8.		69	13		94	10	
20	8.0	1/4.	45	15	1/4	70	9.	1/4	95	11	
21	26.0.		46	22		71	27		96	3.5	
22	33		47	16		72	13		97	9.0	
23	11		48	27		73	13		98	14	
24	21.5		49	23		74	9.5		99	20.	
25	9.0		50	19		75	10.0.		100	9.	0

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: ______________________________ Site Code: ____________

Sampling Date: (DD/MM/YYYY) ____________________

SITE INSPECTION

Site Inspected by: ______________________________

Communication Information

☐ Itinerary left with contact person (include contact numbers)

Contact Person: ______________________ Time checked-in: ________

Form of communication: ☐ radio ☐ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (   ) ____________

Vehicle Safety

☐ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☐ Equipment and chemicals safely secured for transport

☐ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☐ Wading Task Hazard Analysis read by all field staff

☐ Wading Safe Work Procedures read by all field staff

☐ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☐ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: Ms. J Kozikowska Site Code: RGD-AQ11

Sampling Date: (DD/MM/YYYY) 30/07/2019 (1050am to 1240pm)

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: ____________ Local Basin Name: River of Golden Dreams

River/Stream Name: River of Golden Dreams (u/s site) Stream Order: (map scale 1:50,000) ____________

Select one: ☑ Test Site ☐ Potential Reference Site

Geographical Description/Notes: valley
Lorimer Parking Lot - trail to south ~20m - through treeline onto gravel bar

Surrounding Land Use: (check those present) Information Source: ____________

☑ Forest ☐ Field/Pasture ☐ Agriculture ☑ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☑ Other Outdoor Trails

Dominant Surrounding Land Use: (check one) Information Source: ____________

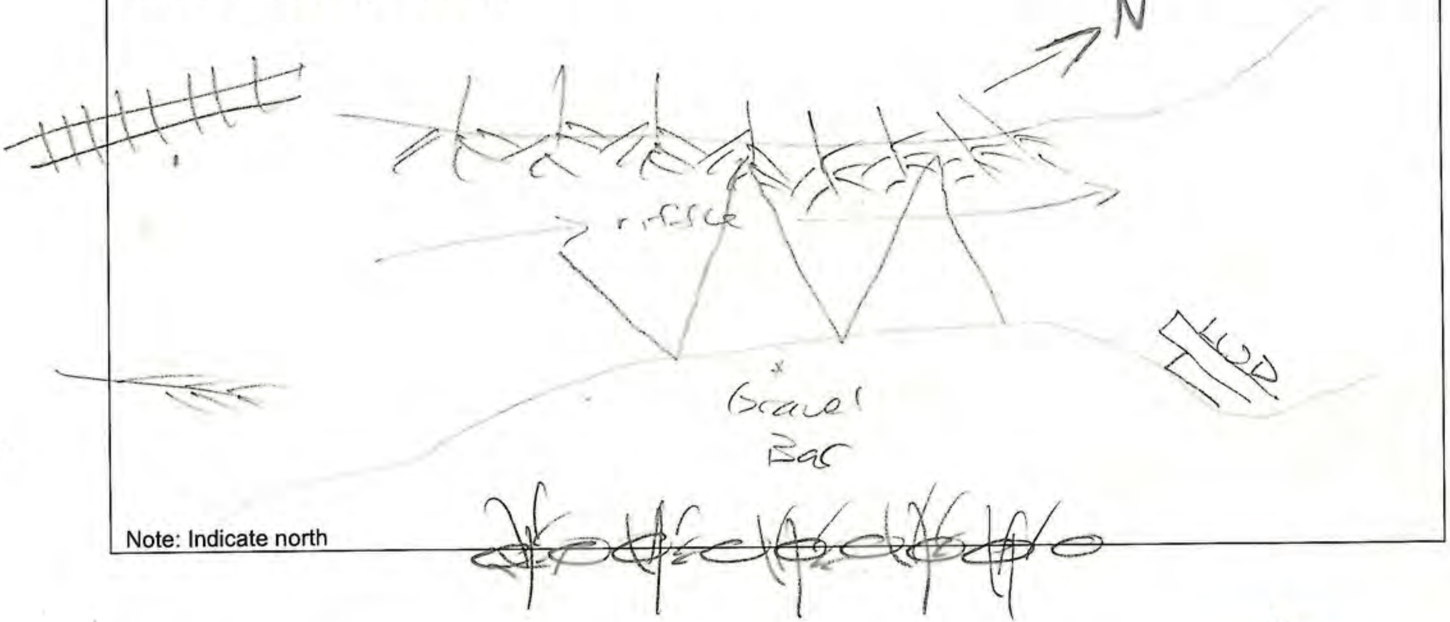
☐ Forest ☐ Field/Pasture ☐ Agriculture ☑ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other ____________

Location Data 10U 0502003 5552764

Latitude: ________N Longitude: - ________W (DMS or DD)

Elevation: 647 (fasl *or* masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: ________

Site Location Map Drawing



Note: Indicate north

Field Crew: ______________________ Site Code: RGD-AQ11

Sampling Date: (DD/MM/YYYY) 30/07/2019

Photos

☑ Field Sheet ☑ Upstream ☑ Downstream ☑ Across Site ☐ Aerial View

☐ Substrate (exposed) ☑ Substrate (aquatic) ☐ Other + 2 Looking d/s w/ kayakers

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*

   ☑ Riffle ☐ Rapids ☐ Straight run ☑ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*

   ☐ 0 % ☑ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*

   ☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*

   ☐ ferns/grasses ☑ shrubs ☑ deciduous trees ☑ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*

   ☐ ferns/grasses ☑ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

   ☑ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)

   ☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)

   ☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)

   ☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)

   ☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☐ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	M. S.
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1 + 2 QAQC.
Typical depth in kick area (cm)	15 CM.

Preservative used: Ethanol

Sampled sieved on site using "Bucket Swirling Method":

☑ YES ☐ NO

If YES, debris collected for QAQC ☑ 2 jars

+ 3 Sculpin in sample

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: ______________________ Site Code: ______________

Sampling Date: (DD/MM/YYYY) ______________________

WATER CHEMISTRY DATA **Time:** 12.15 (24 hr clock) **Time zone:** ______________

Air Temp: 12 (°C) Water Temp: 12.8 (°C) pH: 6.77

Specific Conductance: 44.3 (µs/cm) DO: 92.7% (mg/L) Turbidity: ________(NTU)

Conductivity 33.3 µs/cm 9.81

TDS - 29.25

MmHg - 705.7

Check if water samples were collected for the following analyses:

- ☐ TSS (Total Suspended Solids)
- ☐ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☐ Phosphorus (Total, Ortho, and/or Dissolved)
- ☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☐ Other______________

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

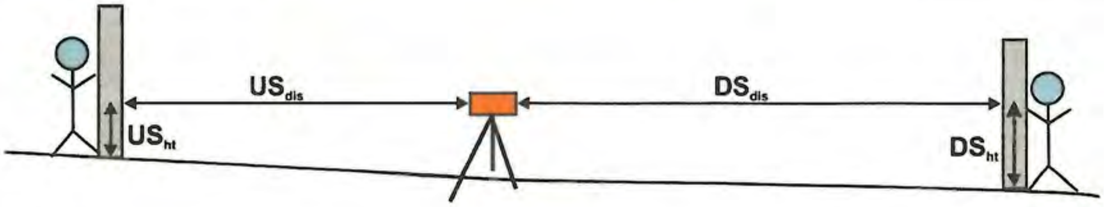
Scale: ______________ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) __________ (m),
distance between contour intervals (horizontal distance) __________ (m)
slope = vertical distance/horizontal distance =______________

OR

☐ **Measured in field** Clinometer: 1%. Other 19 m

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
aTop Hairline (T)			
aMid Hairline (ht) OR bHeight of rod			
aBottom Hairline (B)			
bDistance (dis) OR aT-B x 100	aUS_{dis}=T-B	aDS_{dis}=T-B	US_{dis}+DS_{dis}=
Change in height (Δht)			DS_{ht}-US_{ht}=
Slope (Δht/total dis)			



Field Crew: ______________________ Site Code: ____________

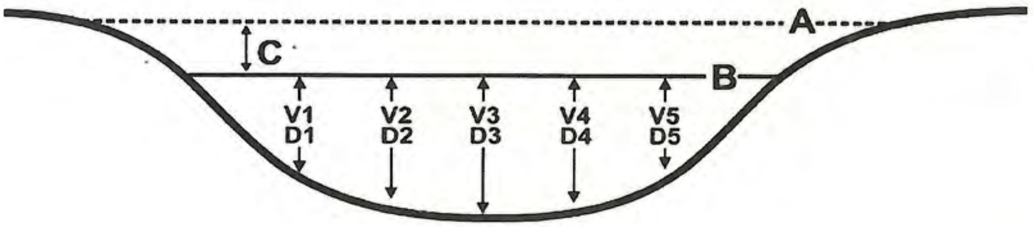
Sampling Date: (DD/MM/YYYY) ______________________

Widths and Depth

Location at site: middle of kick area (Indicate where in sample reach, ex. d/s of kick area)
* gravel bar

A - Bankfull Width: 17.30 (m) B - Wetted Stream Width: 6.60 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 33 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☑ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other ____________

Gravel Bar. —>

	1	2	3	4	5	6	AVG
Distance from Shore (m)	0.5	1.5	2.5	3.5	4.5	5.5	
Depth (D) (cm)	9.5	23	31	31	29	17	
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)	9.5	23	31	31	29	16	
Depth of Stagnation (D_2) (cm)	11.5	26	36.5	38	33	16.5	
Change in depth ($\Delta D = D_2 - D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (V) (m/s)							

Field Crew: ____________________ Site Code: RGD-AQ11

Sampling Date: (DD/MM/YYYY) 30/07/2019

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	[✓ 3]
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	2.2		26	4.4		51	3.6		76	3.5	
2	2.5		27	5.4		52	4.0		77	.5	
3	2.1		28	6.0		53	3.0		78	1.0	
4	1.5		29	6.0		54	3.0		79	1.1	
5	1.7		30	4.6	1/4	55	2.2		80	3.5	0
6	2.3		31	7.4		56	3.1		81	3.0	
7	5.8		32	5.2		57	4.4		82	2.8	
8	5.5		33	6.2		58	2.1		83	1.1	
9	3.6		34	2.3		59	2.9		84	.5	
10	1.6	0	35	6.9		60	4.2	0	85	5.8	
11	3.5		36	2.2		61	3.6		86	3.0	
12	4.5		37	2.3		62	4.5		87	1.4	
13	4.5		38	4.3		63	3.4		88	.6	
14	1.5		39	1.6		64	5.5		89	4.0	
15	8		40	2.8	0	65	.5		90	1.4	1.5
16	4.1		41	6.2		66	1.2		91	1.0	
17	3.4		42	3.3		67	6.1		92	2.0	
18	3.8		43	.9		68	2.5		93	.7	
19	3.0		44	1.1		69	4.2		94	2.3	
20	2.5	1/4	45	4.5		70	5.1	1/2	95	3.8	
21	3.2		46	5.4		71	1.8		96	.5	
22	2.0		47	4.0		72	3.0		97	3.0	
23	3.7		48	3.0		73	2.9		98	5.0	
24	1.3		49	.7		74	1.9		99	1.2	
25	3.2		50	2.0	0	75	3.2		100	2.3	

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: ______________________________ Site Code: __________

Sampling Date: (DD/MM/YYYY) ____________________

SITE INSPECTION

Site Inspected by: ______________________________

Communication Information

☐ Itinerary left with contact person (include contact numbers)

Contact Person: ________________________ Time checked-in: ________

Form of communication: ☐ radio ☐ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: ( ) ____________

Vehicle Safety

☐ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☐ Equipment and chemicals safely secured for transport

☐ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☐ Wading Task Hazard Analysis read by all field staff

☐ Wading Safe Work Procedures read by all field staff

☐ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☐ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Field Crew: MS, H.W.J Site Code: RGD-DS-AQ 12

Sampling Date: (DD/MM/YYYY) 31/07/2019

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: __________ Local Basin Name: River of Golden Dreams (D/S)

River/Stream Name: RoGD. Stream Order: (map scale 1:50,000) __________

Select one: ☑ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Park @ Nicholas Golf Course - trail / Boat Pull out location.

Surrounding Land Use: (check those present) Information Source: __________

☐ Forest ☐ Field/Pasture ☐ Agriculture ☑ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other Forest being developed Golf Course.

Dominant Surrounding Land Use: (check one) Information Source: __________

☐ Forest ☐ Field/Pasture ☐ Agriculture ☒ Residential/Urban

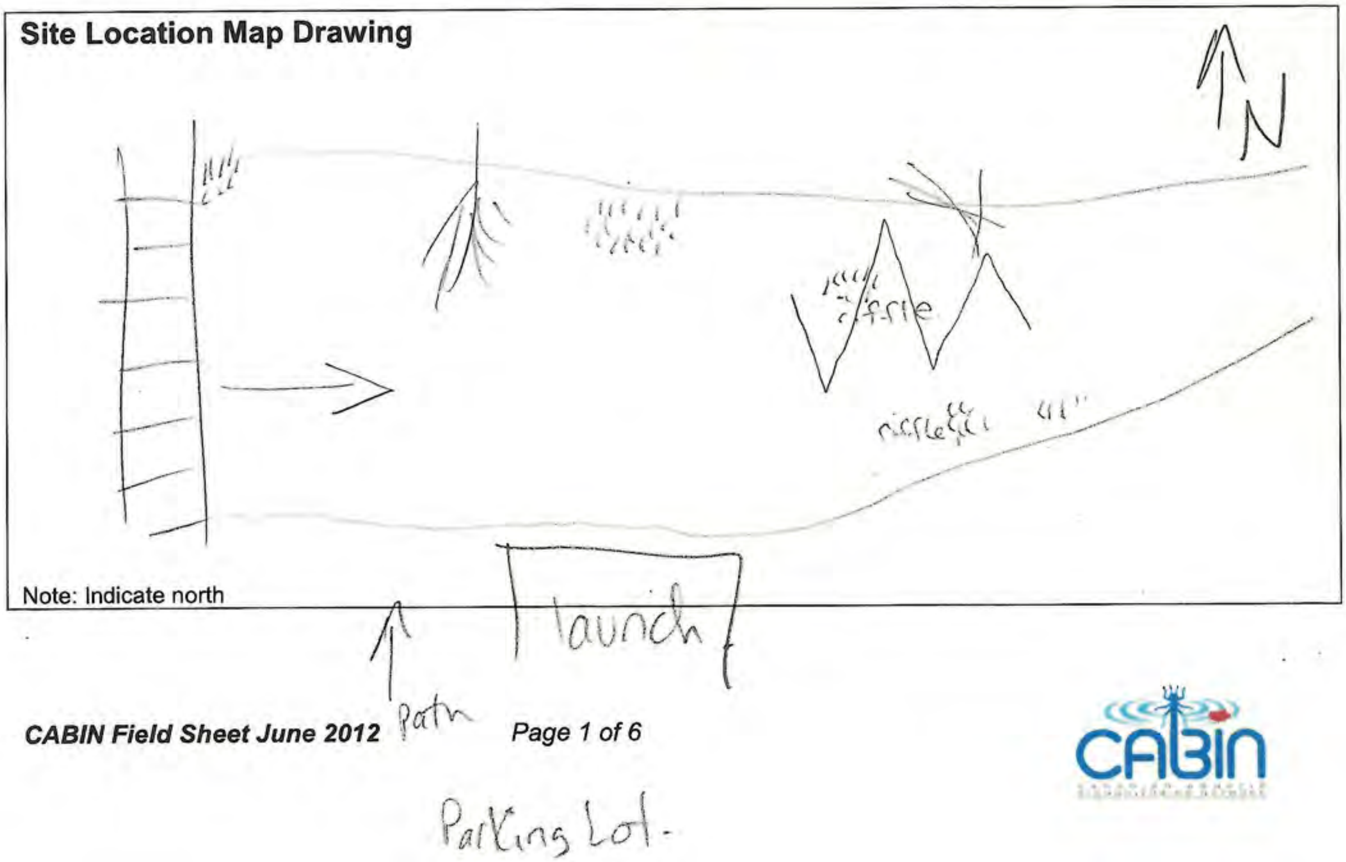
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other __________

Location Data 10 U 0503027 5554676

Latitude: __________ N Longitude: - __________ W (DMS or DD)

Elevation: 614 (fasl *or* masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: __________

Site Location Map Drawing



Note: Indicate north

Field Crew: MS + HW Site Code: RGD-DS-A012

Sampling Date: (DD/MM/YYYY) 31/07/2019

Photos +2, Hillary taking WQ

☑ Field Sheet ☑ Upstream ☑ Downstream ☑ Across Site ☐ Aerial View

☐ Substrate (exposed) ☑ Substrate (aquatic) ☐ Other ____________

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   ☑ Riffle ☐ Rapids ☐ Straight run ☑ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   ☐ 0 % ☑ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   ☐ 0 % ☑ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
   ☑ ferns/grasses ☑ shrubs ☑ deciduous trees ☐ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   ☐ ferns/grasses ☐ shrubs ☑ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one*)

   - random rocks w/ chunks of moss

   ☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   ☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   ☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   ☑ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   ☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	MS
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	

Preservative used: Ethanol

Sampled sieved on site using "Bucket Swirling Method":
☑ YES ☐ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: ____________________ Site Code: ____________

Sampling Date: (DD/MM/YYYY) 31/07/2019

WATER CHEMISTRY DATA **Time:** 1005 (24 hr clock) **Time zone:** ____________

Air Temp: ~17 (°C) Water Temp: 13.1 (°C) pH: 7.56 pH mV = -41.0?

Specific Conductance: 78.4 (µs/cm) DO: 9.93 (mg/L) Turbidity: — (NTU)

Conductivity 60.6 us/cm 94.3 %

707.4 mmHg

TDS 50.7

Salinity 0.04 ppt

Check if water samples were collected for the following analyses:

☐ TSS (Total Suspended Solids)

☐ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)

☐ Phosphorus (Total, Ortho, and/or Dissolved)

☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☐ Other ____________

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: ____________ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) ____________ (m),
distance between contour intervals (horizontal distance) ____________ (m)
slope = vertical distance/horizontal distance = ____________

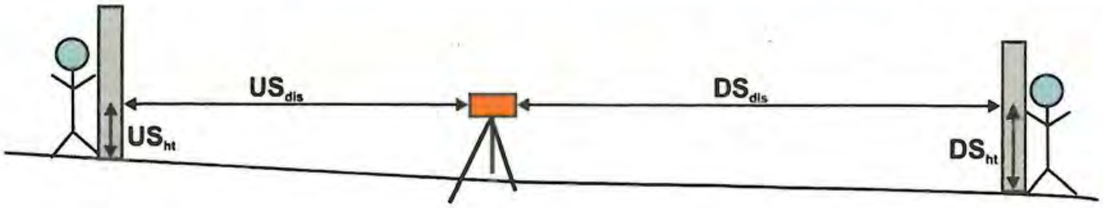
OR

☑ **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Clinometer 0% over 25m.

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
ᵃTop Hairline (T)			
ᵃMid Hairline (ht) OR ᵇHeight of rod			
ᵃBottom Hairline (B)			
ᵇDistance (dis) OR ᵃT-B x 100	ᵃUS_{dis}=T-B	ᵃDS_{dis}=T-B	US_{dis}+DS_{dis}=
Change in height (Δht)			DS_{ht}-US_{ht}=
Slope (Δht/total dis)			



Field Crew: ______________________ Site Code: ____________

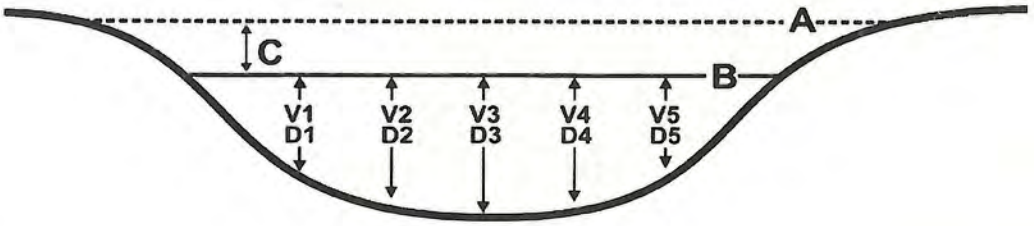
Sampling Date: (DD/MM/YYYY) ____________

Widths and Depth

Location at site: across kicknet site (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 15.6 (m) B - Wetted Stream Width: 15.5 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 7cm (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☑ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other ____________

Bare ->

Behind veg patch.

	1	2	3	4	5	6	AVG
Distance from Shore (m)	2m.	4	6	8	10	12m.	
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (**D_1**) (cm)	54.5	39.0	33.0	24.5	25.5	27.0	
Depth of Stagnation (**D_2**) (cm)	54.5	40.0	34.5	24.5	26.0	27.0	
Change in depth (**$\Delta D = D_2 - D_1$**) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Field Crew: ______________________ Site Code: ____________

Sampling Date: (DD/MM/YYYY) ______________

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	[✓ 2]
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	2.1		26	3.8		51	2.4		76	1.5	
2	4.2		27	S		52	2.6		77	2.8	
3	0.5		28	4.0		53	S		78	1.7	
4	3.5		29	2.2		54	S		79	4.0	
5	3.8		30	2.6	3/4	55	S		80	1.6	1/4
6	S		31	2.2		56	0.6		81	1.2	
7	2.1		32	2.3		57	1.4		82	3.0	
8	3.4		33	3.8		58	1.0		83	2.5	
9	4.1		34	0.9		59	S		84	1.6	
10	3.4	3/4	35	S		60	S		85	3.4	
11	1.5		36	S		61	3.1	3/4	86	1.9	
12	2.4		37	0.7		62	4.5		87	2.0	
13	1.1		38	S		63	1.1		88	2.6	
14	1.8		39	1.1		64	3.5		89	3.0	
15	2.0		40	1.6	3/4	65	3.0		90	3.4	3/4
16	0.9		41	0.8		66	3.8		91	2.2	
17	0.7		42	2.7		67	2.7		92	S	
18	2.3		43	3.6		68	0.9		93	1.4	
19	1.2		44	1.2		69	1.5		94	0.6	
20	2.7	1	45	0.6		70	1.2	1/4	95	1.3	
21	2.8		46	3.5		71	4.2		96	1.3	
22	0.6		47	2.6		72	0.2		97	0.5	
23	1.3		48	C		73	2.4		98	2.0	
24	2.2		49	4.5		74	1.9		99	2.1	
25	0.9		50	2.2	3/4	75	2.0		100	2.6	3/4

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: ______________________________ Site Code: ____________

Sampling Date: (DD/MM/YYYY) ____________________

SITE INSPECTION

Site Inspected by: ______________________________

Communication Information

☐ Itinerary left with contact person (include contact numbers)

Contact Person: ________________________ Time checked-in: ________

Form of communication: ☐ radio ☐ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: ( ) ____________

Vehicle Safety

☐ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☐ Equipment and chemicals safely secured for transport

☐ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☐ Wading Task Hazard Analysis read by all field staff

☐ Wading Safe Work Procedures read by all field staff

☐ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☐ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Appendix D

Fish Sampling Datasheets & Biological Characteristics

ID	Location	Site Name	Date	Species	Method	Legnth (mm)	weight (g)	Comments
CRB-01	Crabapple Creek	Crabapple Creek	Aug-1-2019	TR	EF	136	23.3	Photo #98-106
CRB-02	Crabapple Creek	Crabapple Creek	Aug-1-2019	TR	EF	116	13.1	Photo 107-108
CRB-03	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	65	2.4	13 anal fin rays
CRB-04	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	77	5.7	13 anal fin rays
CRB-05	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	64	2.4	
CRB-06	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	88	8.3	
CRB-07	Crabapple Creek	Crabapple Creek	Aug-1-2019	SB	EF	53	1.8	Photo 109-113
CRB-08	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	64	2.8	
CRB-09	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	62	2.6	
CRB-10	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	68	3.7	
CRB-11	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	77	4.6	
CRB-12	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	57	1.7	
CRB-13	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	56	2	
CRB-14	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	49	1	
CRB-15	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	43	0.7	
CRB-16	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	60	2.4	
CRB-17	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	72	4.1	
CRB-18	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	59	2	
CRB-19	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	42	0.6	
CRB-20	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	54	1.5	
CRB-21	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	58	2	
CRB-22	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	55	1.8	
CRB-23	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	50	1.4	
CRB-24	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	58	1.8	
CRB-25	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	50	1.3	
CRB-26	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	47	1	
CRB-27	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	55	1.8	
CRB-28	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	47	0.9	
CRB-29	Crabapple Creek	Crabapple Creek	Aug-1-2019	CC	EF	45	0.8	
CRB-30	Crabapple Creek	Crabapple Creek	Aug-1-2019	TR	EF	42	0.6	
CRB-31	Crabapple Creek	Crabapple Creek	Aug-1-2019	TR	EF	28	0.1	rounded up on scale
CRB-32	Crabapple Creek	Crabapple Creek	Aug-2-2019	TR	MT	107	16.1	Photo on phone

ID	Location	Site Name	Date	Species	Method	Legnth (mm)	weight (g)	Comments
CRB-33	Crabapple Creek	Crabapple Creek	Aug-2-2019	TR	MT	94	8.1	
CRB-34	Crabapple Creek	Crabapple Creek	Aug-2-2019	TR	MT	94	8.1	
CRB-35	Crabapple Creek	Crabapple Creek	Aug-2-2019	TR	MT	72	3.6	
CRB-36	Crabapple Creek	Crabapple Creek	Aug-2-2019	SB	MT	65	3.3	
CRB-37	Crabapple Creek	Crabapple Creek	Aug-2-2019	SB	MT	55	2	
CRB-38	Crabapple Creek	Crabapple Creek	Aug-2-2019	SB	MT	52	1.9	
CRB-39	Crabapple Creek	Crabapple Creek	Aug-2-2019	SB	MT	70	3.2	
RGD-DS-01	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.8	
RGD-DS-02	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	46	1.5	
RGD-DS-03	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	43	0.7	
RGD-DS-04	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	40	0.6	
RGD-DS-05	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.7	
RGD-DS-06	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	43	0.7	
RGD-DS-07	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	43	0.8	
RGD-DS-08	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.9	
RGD-DS-09	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	45	1	
RGD-DS-10	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	43	0.7	
RGD-DS-11	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	40	0.7	
RGD-DS-12	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	40	0.7	
RGD-DS-13	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	45	0.9	
RGD-DS-14	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	54	1.6	
RGD-DS-15	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	46	1	
RGD-DS-16	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	40	0.7	
RGD-DS-17	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	42	0.9	
RGD-DS-18	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	40	0.8	
RGD-DS-19	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	37	0.5	
RGD-DS-20	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	37	0.4	
RGD-DS-21	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	48	0.9	
RGD-DS-22	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	45	0.9	
RGD-DS-23	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	45	0.9	
RGD-DS-24	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	49	1	
RGD-DS-25	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	45	0.9	

ID	Location	Site Name	Date	Species	Method	Legnth (mm)	weight (g)	Comments
RGD-DS-26	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	55	1.7	
RGD-DS-27	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.8	
RGD-DS-28	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	42	0.7	
RGD-DS-29	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	51	1.4	
RGD-DS-30	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	45	1	
RGD-DS-31	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	45	1	
RGD-DS-32	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	50	1.2	
RGD-DS-33	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	39	0.6	
RGD-DS-34	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	45	0.9	
RGD-DS-35	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	1	
RGD-DS-36	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	33	0.3	
RGD-DS-37	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	37	0.5	
RGD-DS-38	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	42	0.7	
RGD-DS-39	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	35	0.5	
RGD-DS-40	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	39	0.6	
RGD-DS-41	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	42	0.8	
RGD-DS-42	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	42	0.6	
RGD-DS-43	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.9	
RGD-DS-44	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.8	
RGD-DS-45	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	39	0.5	
RGD-DS-46	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.9	
RGD-DS-47	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	36	0.4	
RGD-DS-48	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.8	
RGD-DS-49	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	42	0.7	
RGD-DS-50	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.7	
RGD-DS-51	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	44	0.7	
RGD-DS-52	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	42	0.7	
RGD-DS-53	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	41	0.6	
RGD-DS-54	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	37	0.5	
RGD-DS-55	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	SB	MT	43	0.7	
RGD-DS-56	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	CC	MT	60	2.1	
RGD-DS-57	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	CC	MT	55	1.7	

ID	Location	Site Name	Date	Species	Method	Legnth (mm)	weight (g)	Comments
RGD-DS-58	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	CC	MT	63	2.8	
RGD-DS-59	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	CC	MT	65	2.8	
RGD-DS-60	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	CC	MT	58	3.3	13 anal fin rays
RGD-DS-61	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	CC	MT	57	2	
RGD-DS-62	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	TR	MT	73	3.6	
RGD-DS-63	River of Golden Dreams	RGD-DS-AQ12	Aug-1-2019	TR	MT	84	5.8	
RGD-01	River of Golden Dreams	RGD-AQ11	Aug-2-2019	SB	MT	59	1.7	
RGD-02	River of Golden Dreams	RGD-AQ11	Aug-2-2019	SB	MT	50	1.1	
RGD-03	River of Golden Dreams	RGD-AQ11	Aug-2-2019	SB	MT	61	2.6	
RGD-04	River of Golden Dreams	RGD-AQ11	Aug-2-2019	SB	MT	48	1	
RGD-05	River of Golden Dreams	RGD-AQ11	Aug-2-2019	SB	MT	50	1.7	
RGD-06	River of Golden Dreams	RGD-AQ11	Aug-2-2019	CC	MT	80	6.2	
21M-01	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	81	7	Picture 77-78
21M-02	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	76	11.1	18-19 cadual rays, 15 anal rays, pic 79-86
21M-03	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	70	4.8	
21M-04	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	67	3.7	Picture 87
21M-05	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	49	1.8	
21M-06	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	61	3.1	
21M-07	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	48	2	
21M-08	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	67	4.1	
21M-09	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	55	2.2	
21M-10	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	45	0.8	
21M-11	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	61	2.6	
21M-12	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	50	1.5	
21M-13	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	60	2.3	Picture 88-89
21M-14	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	57	2.3	
21M-15	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	42	1.3	
21M-16	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	47	1.2	
21M-17	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	45	1.1	
21M-18	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	31	0.2	
21M-19	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	43	1	

ID	Location	Site Name	Date	Species	Method	Legnth (mm)	weight (g)	Comments
21M-20	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	45	1.1	
21M-21	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	49	2	
21M-22	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	56	2.8	
21M-23	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	51	1.2	
21M-24	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	29	0.2	
21M-25	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	27	0.1	rounded up on scale
21M-26	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	39	0.4	
21M-27	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	31	0.1	
21M-28	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	43	1	
21M-29	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	47	1.6	
21M-30	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	46	1.3	
21M-31	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	53	1.1	
21M-32	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	47	1.3	
21M-33	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	56	1.6	
21M-34	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	42	0.5	
21M-35	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	29	0.1	
21M-36	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	31	0.2	
21M-37	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	38	0.1	
21M-38	21 Mile Creek	21 Mile	Jul-31-2019	TR	EF	30	0.2	
21M-39	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	4.1	1.2	
21M-40	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	44	1.5	
21M-41	21 Mile Creek	21 Mile	Jul-31-2019	CC	EF	43	0.7	
21M-42	21 Mile Creek	21 Mile	Aug-2-2019	TR	MT	87	7	
21M-43	21 Mile Creek	21 Mile	Aug-2-2019	TR	MT	81	6.3	
21M-44	21 Mile Creek	21 Mile	Aug-2-2019	TR	MT	75	4.5	
21M-45	21 Mile Creek	21 Mile	Aug-2-2019	TR	MT	67	3.8	mortality
21M-46	21 Mile Creek	21 Mile	Aug-2-2019	SB	MT	51	1.8	
21M-47	21 Mile Creek	21 Mile	Aug-2-2019	SB	MT	52	1.7	
21M-48	21 Mile Creek	21 Mile	Aug-2-2019	SB	MT	52	1.7	
21M-49	21 Mile Creek	21 Mile	Aug-2-2019	SB	MT	46	0.6	
21M-50	21 Mile Creek	21 Mile	Aug-2-2019	SB	MT	46	0.7	

ID	Location	Site Name	Date	Species	Method	Legnth (mm)	weight (g)	Comments
21M-51	21 Mile Creek	21 Mile	Aug-2-2019	SB	MT	42	na	mortality (innards eaten)
JOR-01	Jordan Creek	Jordan Creek	Aug-1-2019	TR	MT	104	13.2	pic 116-117
JOR-02	Jordan Creek	Jordan Creek	Aug-1-2019	TR	MT	86	7.5	
JOR-03	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	49	1.5	
JOR-04	Jordan Creek	Jordan Creek	Aug-1-2019	CC	MT	94	11.2	13 anal fin rays
JOR-05	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	48	1.5	
JOR-06	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	57	2	
JOR-07	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	51	1.4	
JOR-08	Jordan Creek	Jordan Creek	Aug-1-2019	TR	MT	47	1.3	
JOR-09	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	46	1.6	
JOR-10	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	48	1.2	Mort
JOR-11	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	56	1.7	Mort
JOR-12	Jordan Creek	Jordan Creek	Aug-1-2019	TR	MT	79	7.2	Mort
JOR-13	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	53	1.8	Mort
JOR-14	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	51	1.5	Mort
JOR-15	Jordan Creek	Jordan Creek	Aug-1-2019	SB	MT	47	1.1	Mort
JOR-16	Jordan Creek	Jordan Creek	Aug-1-2019	TR	EF	128	21.6	pic 116-125
JOR-17	Jordan Creek	Jordan Creek	Aug-1-2019	CC	EF	83	7.4	
JOR-18	Jordan Creek	Jordan Creek	Aug-1-2019	CC	EF	74	4.8	
JOR-19	Jordan Creek	Jordan Creek	Aug-1-2019	CC	EF	58	2.2	
JOR-20	Jordan Creek	Jordan Creek	Aug-1-2019	SB	EF	59	2	pic 126
JOR-21	Jordan Creek	Jordan Creek	Aug-1-2019	CC	EF	62	2.3	

Appendix E

Site Data for Coastal Tailed Frog Surveys

Valley Side	Site	Date	Easting	Northing	Elev. (m)	Weather	Water Temp. (°C)	Air Temp. (°C)	Channel Width (m)	Wetted Width (m)	Disch-arge	Mean Depth (cm)	Stream Disturb-ance	Stream Morph.
East	Archibald Creek - 1	2019-09-04	502387	5550606	695	Sunny	11.4	18.0	4.0	2.4	Med	12	Med.	Step Pool
East	Archibald Creek - 2	2019-09-04	502854	5550298	835	Sunny	11.2	15.0	2.7	2.2	Med	18	Med.	Step Pool
East	Archibald Creek - 3	2019-09-04	503310	5549422	1026	Sunny	9.4	17.0	2.2	0.9	Med	8	Low	Step Pool (
East	Blackcomb Creek @ Yummy Numby	2019-09-06	505211	5552576	762	Sunny	8.0	11.0	8.4	5.0	Med	16	Low	Cascade (S
West	FJ Unnamed	2019-09-05	496157	5548481	699	Cloudy	11.0	18.0	8.0	2.0	Med	12	High	Step Pool
West	FJ West Creek - 1 (South Flank)	2019-09-05	496383	5548374	648	Cloudy	11.2	18.0	4.1	1.5	Med	12	High	Step Pool
West	FJ West Creek - 3 (Into the Mystic)	2019-09-03	496022	5549522	1119	Sunny	11.3	14.0	2.2	1.2	Med	10	Low	Cascade (S
West	Sproatt Creek - 1 (Danimal South)	2019-09-03	499063	5549434	692	Lt. Rain	12.9	16.0	6.6	2.2	Med	9	Low	Riffle (Step
West	Sproatt Creek - 2 (Don't Look Back)	2019-09-03	498996	5549662	790	Lt. Rain	12.3	17.0	7.8	1.5	Med	10	High	Riffle (Step
West	Sproatt Creek - 3 (Flank Trail)	2019-09-03	498483	5550455	996	Sunny	12.0	15.0	5.0	0.8	Med	12	High	Step Pool
West	Van West - 1 (Flank Trail)	2019-09-05	497563	5549038	706	Sunny	12.5	16.0	5.1	1.3	Low	12	High	Step Pool
West	Van West - 3 (Into the Mystic)	2019-09-03	497125	``	1036	Sunny	11.7	14.5	4.2	1.5	Low	12	Med.	Step Pool
East	Whistler Creek - 1	2019-09-06	501041	5549045	692	Sunny	11.0	11.0	6.2	6.0	Med	12	Med.	Step Pool
East	Whistler Creek - 2	2019-09-05	501417	5548276	879	Sunny	10.0	11.0	5.1	2.1	Med	18	Low	Riffle (Step
East	Whistler Creek - 3	2019-09-05	501649	5547961	972	Sunny	10.2	11.0	4.1	2.3	Med	15	Low	Step Pool

Valley Side	Site	Date	Easting	Northing	Rock Size	Rock Shape	Slope (%)	Crown Closure	Tree Comp.	Struct. Stage
East	Archibald Creek - 1	2019-09-04	502387	5550606	Bedrock (Boulder)	Subrounded	17	75	Decid.	Pole/Sapl.
East	Archibald Creek - 2	2019-09-04	502854	5550298	Cobble (Boulder)	Subangular	18	80	Mixed	YF
East	Archibald Creek - 3	2019-09-04	503310	5549422	Cobble (Boulder)	Subangular	12	95	Conif.	YF
East	Blackcomb Creek @ Yummy Numby	2019-09-06	505211	5552576	Boulder (Cobble)	Subrounded	15	60	Conif.	OF
West	FJ Unnamed	2019-09-05	496157	5548481	Boulder (Cobble)	Subangular	10	25	Mixed	YF/MF
West	FJ West Creek - 1 (South Flank)	2019-09-05	496383	5548374	Cobble (Bedrock)	Subangular	14	80	Mixed	YF
West	FJ West Creek - 3 (Into the Mystic)	2019-09-03	496022	5549522	Bedrock (Cobble)	Subrounded	14	30	Conif.	OF
West	Sproatt Creek - 1 (Danimal South)	2019-09-03	499063	5549434	Boulder (Cobble)	Subangular	25	30	Mixed	Shrub/MF
West	Sproatt Creek - 2 (Don't Look Back)	2019-09-03	498996	5549662	Boulder (Cobble)	Subrounded	32	50	Conif.	OF
West	Sproatt Creek - 3 (Flank Trail)	2019-09-03	498483	5550455	Boulder (Bedrock)	Subrounded	24	40	Conif.	MF
West	Van West - 1 (Flank Trail)	2019-09-05	497563	5549038	Boulder (Bedrock)	Subangular	18	95	Conif.	YF
West	Van West - 3 (Into the Mystic)	2019-09-03	497125	``	Cobble (Boulder)	Subangular	25	50	Conif.	OF
East	Whistler Creek - 1	2019-09-06	501041	5549045	Cobble (Boulder)	Subangular	14	5	Decid.	Shrub
East	Whistler Creek - 2	2019-09-05	501417	5548276	Cobble (Boulder)	Subangular	14	10	Conif.	OF
East	Whistler Creek - 3	2019-09-05	501649	5547961	Cobble (Bedrock)	Subangular	25	40	Conif.	OF

Appendix F

Capture Results Coastal Tailed Frogs

			Tadpoles detected							
Valley Side	**Site**	**Elev. (m)**	**T1**	**T2**	**T3**	**Total**	**per 100m2**	**Mets/ Adults**	**Water Temp. (°C)**	**Survey Area (m2)**
East	Archibald Creek - 1	695	0	4	1	5	15.4	0	11.4	32.5
East	Archibald Creek - 2	835	0	0	1	1	6.9	0	11.2	14.5
East	Archibald Creek - 3	1026	8	0	0	8	59.3	0	9.4	13.5
East	Blackcomb Creek @ Yummy Numby	762	0	0	0	0	0.0	0	8.0	23.5
West	FJ Unnamed	699	0	1	0	1	4.3	0	11.0	23.5
West	FJ West Creek - 1 (South Flank)	648	0	0	0	0	0.0	0	11.2	15.5
West	FJ West Creek - 3 (Into the Mystic)	1119	1	0	0	1	6.1	0	11.3	16.5
West	Sproatt Creek - 1 (Danimal South)	692	0	0	1	1	8.3	0	12.9	12.0
West	Sproatt Creek - 2 (Don't Look Back)	790	1	0	0	1	8.0	0	12.3	12.5
West	Sproatt Creek - 3 (Flank Trail)	996	4	0	5	9	38.3	0	12.0	23.5
West	Van West - 1 (Flank Trail)	706	0	0	0	0	0.0	0	12.5	12.0
West	Van West - 3 (Into the Mystic)	1036	2	1	3	6	46.2	0	11.7	13.0
East	Whistler Creek - 1	692	1	1	8	10	45.0	0	11.0	22.2
East	Whistler Creek - 2	879	9	5	1	15	90.9	0	10.0	16.5
East	Whistler Creek - 3	972	0	2	0	2	15.2	0	10.2	13.2

Length (mm) of tadpoles captured by site

Age Class / Cohort (Malt et al. 2014a, b)	**T1**		**T2**		**T3**		
Developmental Stage	No hind legs	Bulge only, hind legs not defined	Hind legs visible but covered	Hind feet protruding	Hind knees protruding	Total tadpoles	Total metamorphs & adults
Archibald Creek - 1			44	45	50	5	
				45			
				45			
Archibald Creek - 2					50	1	
Archibald Creek - 3	30					8	
	30						
	30						
	30						
	26						
	26						
	26						
	26						
Blackcomb Creek @ Yummy Numby						0	
FJ Unnamed			50			1	
FJ West Creek - 1 (South Flank)						0	
FJ West Creek - 3 (Into the Mystic)		35				1	
Sproatt Creek - 1 (Danimal South)					60	1	
Sproatt Creek - 2 (Don't Look Back)		40				1	
Sproatt Creek - 3 (Flank Trail)	35	36			48	17	
	35				51		
	35				49		
					51		

Age Class / Cohort (Malt et al. 2014a, b)	T1		T2		T3		
Developmental Stage	No hind legs	Bulge only, hind legs not defined	Hind legs visible but covered	Hind feet protruding	Hind knees protruding	Total tadpoles	Total metamorphs & adults
					50		
Van West - 1 (Flank Trail)						0	
Van West - 3 (Into the Mystic)	35	38		45	48	6	
					47		
					50		
Whistler Creek - 1		36	43		51	10	
					45		
					45		
					58		
					47		
					47		
					47		
					47		
Whistler Creek - 2	30	36		42	50	15	
	30	40		45			
	30	44		45			
	43			48			
	39			43			
	35						
Whistler Creek - 3				44		2	
				50			

Notes: Numbers in red indicate tadpoles that were seen but not captured - lengths are therefore estimates.
Surveyors included Bob Brett (all sites), Jagoda Kozikowska (13 sites), and Hillary Williamson (2 sites)

Appendix G

RMOW EMP 2019 Goose Hawks

Location	Date	Easting	Northing	Elev. (m)	Record	Observer(s)	Source	Notes
Blackcomb Alpine	2000-03-14	507070	5549311	1867	Visual	B Max Götz	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2001-03-03	501773	5552539	643	Visual	B Max Götz	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2007-06-02	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2008-02-02	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Blackcomb Alpine	2009-02-14	507070	5549311	1867	Visual	Peter Dunwiddie	eBird	Only info via eBird
Whistler Village and vicinity	2009-08-22	503156	5551541	683	Visual	Daniel Airola	eBird	Only info via eBird
Whistler Golf Club	2011-08-06	502208	5551354	684	Visual	Christopher Di Corrado	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2011-08-15	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Fitzsimmons Fan & Nicklaus North GC	2011-11-02	503656	5554556	636	Visual	Chris Dale	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2011-11-05	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2012-02-13	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2012-05-05	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2013-03-02	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2013-03-14	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2013-05-04	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2014-08-02	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2014-12-06	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Lost Lake and vicinity	2015-03-15	504636	5552716	687	Visual	Cole Gaerber	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2015-07-04	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Blackcomb Alpine	2016-03-12	507070	5549311	1867	Visual	Nina Rach	eBird	Only info via eBird
Valley Trail to Rainbow Beach	2016-05-07	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	Only info via eBird
Millar's Pond	2016-06-06	499601	5548228	727	Visual	Bob Brett	RMOW EMP	heard alarm calls (video)
Millar's Pond	2016-06-09	499601	5548228	727	Visual	Bob Brett	RMOW EMP	video of single goshawk defending nest
Callaghan Valley Road	2016-06-10	490798	5549818	679	Visual	BBS Team	eBird	watched NOGO on nest from 15:00 to 15:20 with George Clulow, Rob Lyske, David, and David Aldcrof
Millar's Pond	2016-06-12	499601	5548228	727	Visual	Bob Brett	RMOW EMP	photo of bird on nest
Valley Trail to Rainbow Beach	2016-07-02	501773	5552539	643	Visual	C. Dale, H. Baines et al.	eBird	
Musical Bumps Trail	2016-09-12	504873	5543244	1907	Visual	Bob Brett	WBP	photo of goshawk flying overhead
Millar's Pond	2016-09-20	499601	5548228	727	Visual	Bob Brett	RMOW EMP	Glimpsed and heard a goshawk flying near nest.
Millar's Pond	2016-09-20	499601	5548228	727	Visual	Bob Brett	RMOW EMP	Glimpsed (poor view of bird flying uphill), uphill of road (inside stand).
Whistler Village and vicinity	2016-11-30	503156	5551541	683	Visual	Daniel Tinoco	eBird	
5302 Alta Lake Rd.	2017-06-21	500162	5550088	690	Visual	C Palmer	eBird	
Decker Trail	2017-07-31	508618	5546519	1918	Visual	Dan Wilson	WBP	Est. date. Confirmed by George Clulow & Rob Lyske.

Location	Date	Easting	Northing	Elev. (m)	Record	Observer(s)	Source	Notes
Bayshores, ~500m e of active nest	2017-10-09	500005	5543876	671	Visual	Dave McPeake	WBP	vdieo of goshawk on house's deck
Westside Road (unspecified)	2018-04-14	499982	5550268	742	Visual	Christa Vandeberg	RMOW EMP	via H. Beresford; Conf. by George Clulow & Rob Lyske.
Alta Lake Road n. of Wildlife Refuge	2018-05-01	501524	5553719	685	Visual	Bob Brett	WBP	Backlit bird perched on power line. Large imm. or adult.
Lost Lake and vicinity	2018-06-09	504636	5552716	687	Visual	Mike Farnworth	eBird	
Callaghan Valley Road	2018-06-15	490798	5549818	679	Visual	BBS Team	WNS	
Kadenwood 2018 FireSmart site	2018-10-02	500291	5548095	756	Visual	Bob Brett	WBP	Moderate confidence, blurred view in forest
Kadenwood 2018 FireSmart site	2018-10-10	500386	5548095	870	Visual	Leo Coudrau	WBP	High confidence, good view flying through forest
Near Emerald Forest south gravel pit	2019-01-05	501730	5552795	644	Visual	C. Dale, H. Baines et al.	WNS	Single bird in area llikely hunting abundant Pine Siskins
Lost Lake (beach area)	2019-04-25	504629	5552704	694	Visual (?)	Jagoda Kozikowska	verbal	Jagoda saw a bird in the a.m. from the beach she thinks was a goshawk.
Chateau Golf Course, n. of hole #8	2019-05-25	504431	5553657	739	Visual (?)	Dan Nash	WBP	Dan is pretty sure he saw a goshawk flying.
Whistler Olympic Park	2019-06-22	491761	5554069	851	Visual	Paul Maury	eBird	2 sightings, same location, on eBird, May 22 & 25
Baxter Creek, Rainbow Housing	2019-07-01	503086	5556357	725	Visual (?)	Scott Aitken	verbal	Saw a goshawk drinking from Baxter Creek (date is approximate).
Kadenwood Drive	2019-07-01	500168	5548864	633	Visual (?)	Arthur De Jong	verbal	Twice saw a mid-sized, grey raptor flying low overhead of road.
Lost Lake disc golf, hole 21	2019-07-14	503973	5553968	693	Visual (?)	Bob Brett	personal	Saw a backlit bird shaped like a goshawk.
Sarajevo Drive, Creekside	2019-08-01	500615	5548650	741	Visual	Unknown (via Shawn Mason)	WNS	"She told me there is a trail off Sarajevo that she jogs on through the forest."
Kill Me Thrill Me vicinity	2019-08-06	506279	5557196	634	Visual (?)	Dan Raymond	email	"I think I saw a goshawk yesterday above kill me thrill me. It was soaring around making shrill screeches, then seemed to dive at a raven (then away)."
Powderwood condos, Whistler Road	2019-12-14	501356	5549526	732	Visual	Elizabeth Barrett	email	Liz saw the bird in her backyard

Location	Date	Easting	Northing	Elev. (m)	Record	Observer(s)	Source	Notes
Brew Creek	2015-07-24	490637	5545029	829	Audible	T. Tripp, C. Churchland	MFLNRO	"3 ot 4 very clear juvenile begging calls." UTM is on east side of Brandywine Creek, i.e., far from 2011 active nest.
Comfortably Numb w. of Wedge Creek	2019-07-20	506935	5555480	829	Auditory	Trystan Willmott, Bob Brett	Brett 2020	1, possible 2, juveniles responded to begging call near 2014 nest
Comfortably Numb w. of Wedge Creek	2014-06-30	506935	5555480	829	Nest	Pablo Jost, Naomi Sands	BC MOE	Active nest with 3 juveniles
Comfortably Numb @ Jeff's Trail	2015-07-24	506387	5555458	823	Nest	T. Tripp, C. Churchland	MFLNRO	Active nest found in existing territory.
Millar's Pond	2016-05-20	499601	5548228	727	Nest	Brent Matsuda	RMOW EMP	found active nest in 73cm Douglas-fir, ~14 above ground, SE (uphill) aspect, in branch crotch; found three feathers, one was sent for DNA test
Millar's Pond	2016-06-12	499601	5548228	727	Nest	B. Brett, G. Clulow & others	WNS	watched active nest from 15:00-15:20
Millar's Pond	2017-06-03	499601	5548228	727	Nest	B. Matsuda & Mike Toochin	WBP	One goshawk responded to playback. 3 fledglings (M. Wilson, pers. comm.)

Appendix H

Timing and Duration of Ice on Alta Lake, 1942-1976 and 2001-2019

Winter	**Ice-On**		**Ice-Off**		**Days Frozen**
	Date	**Day Count**	**Date**	**Day Count**	
1942/43	1942-12-04	338	1943-04-19	109	136
1943/44	1943-12-15	349	1944-04-13	104	120
1944/45	1944-12-15	350	1945-04-27	117	133
1945/46	**1945-11-08**	**312**	1946-04-20	110	**163**
1946/47	1946-11-20	324	1947-04-13	103	144
1947/48	1947-12-11	345	1948-05-07	128	148
1948/49	1948-12-18	353	1949-04-19	109	122
1949/50	1949-12-14	348	1950-04-24	114	131
1950/51	1950-12-02	336	1951-04-19	109	138
1951/52	1951-12-13	347	**1952-05-21**	**142**	160
1952/53	1952-12-22	357	1953-05-08	128	137
1953/54	1954-01-10	375	1954-05-05	125	115
1954/55	1954-12-26	360	1955-05-07	127	132
1955/56	1955-12-18	352	No Data	N/A	N/A
1956/57	1956-12-01	336	1957-04-23	113	143
1957/58	1957-12-26	360	1958-04-08	98	103
1958/59	1958-11-26	330	1959-04-23	113	148
1959/60	1959-12-05	339	1960-04-16	107	133
1960/61	1960-12-10	345	1961-04-10	100	121
1961/62	1961-12-01	335	1962-04-09	99	129
1962/63	No Data	N/A	**1963-03-23**	**82**	N/A
1963/64	1963-12-13	347	1964-04-24	115	133
1964/65	1964-12-11	346	1965-04-22	112	132
1965/66	1965-12-12	346	1966-04-21	111	130
1966/67	No Data	N/A	1967-04-30	120	N/A
1967/68	1967-12-12	346	1968-04-27	118	137
1968/69	1968-12-05	340	1969-05-07	127	153
1969/70	**1970-01-15**	**380**	1970-04-06	96	**81**
1970/71	1970-12-04	338	1971-05-06	126	153
1971/72	1971-12-14	348	1972-05-02	123	140
1972/73	1972-12-28	363	1973-04-11	101	104
1973/74	1973-11-24	328	1974-04-28	118	155
1974/75	No Data	N/A	No Data	N/A	N/A
1975/76	1975-12-12	346	No Data	N/A	N/A
Note: Data was not recorded between the fall 1975 freeze-up and the spring 2002 thaw.					
2001/02	No Data	N/A	2002-04-14	104	N/A
2002/03	No Data	N/A	2003-03-17	76	N/A
2003/04	No Data	N/A	2004-03-25	85	N/A
2004/05	No Data	N/A	No Data	N/A	N/A
2005/06	**2006-01-06**	**371**	2006-03-08	67	61
2006/07	**2006-11-30**	**334**	2007-04-10	100	131
2007/08	2007-12-10	344	**2008-04-29**	**120**	**141**
2008/09	2008-12-20	355	2009-04-28	118	129

Winter	**Ice-On**		**Ice-Off**		**Days Frozen**
	Date	**Day Count**	**Date**	**Day Count**	
2009/10	2009-12-08	342	2010-03-28	87	110
2010/11	2010-12-04	338	2011-04-23	113	140
2011/12	No Data	N/A	2012-04-23	114	N/A
2012/13	2012-12-16	351	2013-04-03	93	108
2013/14	2013-12-21	355	2014-04-14	104	114
2014/15	2014-12-26	360	**2015-02-20**	**51**	**56**
2015/16	2015-12-24	358	2016-03-16	76	83
2016/17	No Data	N/A	2017-04-24	114	N/A
2017/18	No Data	N/A	2018-04-10	100	N/A
2018/19	2019-01-01	366	2019-04-12	102	101