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Whistler Ecosystems and Species Monitoring Program

2020

Palmer Project #
1602506

Snowline Project #
RMOW20-02

Prepared For
Resort Municipality of Whistler

February 28, 2021

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February 28, 2021

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

Dear Ms. Beresford,

Re: Whistler Ecosystems and Species Monitoring Program
Project #: 1602506

Enclosed you will find the final Whistler Ecosystems and Species Monitoring Program 2020 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.

Yours truly,

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

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

Acknowledgements

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

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. 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 2020, the most important indicators in the Program included 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 2020 included Northern Goshawks (*Accipiter gentilis laingi*), and the timing and duration of ice on Alta Lake. The Covid-19 lockdown in spring 2020 precluded breeding season surveys of Western Toads (*Anaxyrus boreas*) and Northern Goshawks (*Accipiter gentilis laingi*). Additional efforts were therefore directed to beaver studies, including an inventory of dams on the River of Golden Dreams.

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 2020, 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 2020, 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 2020 results showed that the benthic invertebrate community was in reference condition for Crabapple Creek, the River of Golden Dreams Twenty-one Mile Creek, and mildly divergent from reference condition for Jordan 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 might be slightly impaired.

For the benthic invertebrate samples collected in 2020, 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 2020 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 at Jordan Creek and the River of Golden Dreams downstream site (RGD-DS-AQ12). Including the CABIN assessment, these results will be tested again in 2021 to find out if there have been any consistent changes over time that might be of concern.

2020 was the fifth year of benthic invertebrate sampling, and therefore (with 5 years of consecutive data) non-parametric Mann-Kendall statistical tests were completed on the benthic invertebrate community data to test for significant trends.. Over the period of record (2016 to 2020) Jordan Creek showed a significant increasing trend in Taxon Richness ($p=0.04$; $S=1.5$) and Jordan Creek ($p=0.04$; $S=1.0$) and the River of Golden Dreams upstream site ($p=0.04$; $S=1.8$) showed significantly increasing trends for EPT Taxon Richness ($p=0.04$; $S=1.0$). An increase in taxon richness, especially the EPT taxa, indicates improving conditions over the period of record at Jordan Creek and the upstream site of the River of Golden Dreams. Crabapple Creek ($p=0.03$; $S=4.00$) and the River of Golden Dreams upstream site ($p=0.03$; $S=5.3$) showed significantly decreasing trends for EPT relative abundance, or the number of EPT taxa relative to the total number of benthic invertebrate taxa.

Fish

A total of 342 fish were captured during the 2020 electrofishing and minnow trap efforts. As with previous years, three species of fish were captured in 2020: Threespine Stickleback (*Gasterosteus aculeatus*), undifferentiated trout 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. All three fish species were assessed at each site for abundance, relative abundance, distributions of fish lengths and fish body condition. These metrics were compared between years at each site and between sites for the 2020 sampling data. Similar to the benthic invertebrate analysis, a temporal trends analysis was also completed for the fish community endpoints used. Overall, the assessed metrics for the fish community remained relatively consistent over the period of record. For Twenty-one Mile Creek there was a decreasing trend in relative body condition for trout and sculpin, however, the sample size was small in some years and further sampling effort is required to confirm this trend. Crabapple Creek also showed a significantly decreasing trend in relative body condition for sculpin over the period of record, but again the sample size was low for some years. Three-spined Stickleback at the River of Golden Dreams downstream site showed significantly lower mean relative body condition to stickleback at the other sites over the period of record, however, sample sizes were variable between sites so additional sampling effort is required to further assess this difference. Overall, the fish communities were comparable between sites and persisted relatively unchanged through the period of record.

The results of the 2020 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 2020 results were consistent with earlier results collected in 2016, 2017, 2018 and 2019.

Coastal Tailed Frogs

The 2020 program continued to expand upon past years' surveys of Coastal Tailed Frogs (*Ascaphus truei*) in mountainside streams. Seventeen sites on six creeks were surveyed, the highest number of sites since the program began. No recent evidence of habitat impairment was noted on any creek and, with the exception of Archibald Creek, the number of tadpoles detected at each creek was not noticeably lower.

Detections at Archibald Creek continued a downward trend first noted in 2018. No visible impairments to stream habitat were noted in 2020 (nor in any year since 2016 when sedimentation of sands and other fines accumulated at the site). The trend towards lower detection of tailed frog tadpoles is consistent with a decreasing proportion of EPT relative abundance shown in five-year results from benthic invertebrate surveys downstream on Crabapple Creek (see above). However, since that second site is subject to more potential runoff (from the golf course, Highway 99 and adjacent housing), it is not currently clear the two deceasing trends are related.

As in past years, the density of tadpoles detected in east-side creeks was much higher than in west-side creeks. Most creeks with lowest detections were on the west side of Whistler Valley where logging debris and/or alterations caused by the fall 2017 flood were most evident. While it was not possible to conclude that these disturbances caused lower tadpole densities, each subsequent year of surveys in disturbed creeks on the west-side of the valley further documents lower populations than in east-side creeks.

A prime focus for 2020 was to resurvey Blackcomb Creek to determine if it supports a population of tailed frogs. A 2006 survey by the Whistler Biodiversity Project recorded colder water in Blackcomb Creek than any other creek it surveyed. That study suggested that such cold water may have prevented egg development and therefore precluded a population of tailed frogs within the creek. The 2019 program first discussed the hypothesis that the lack of tailed frogs in Blackcomb Creek was due to the cooling influence of its glacial source (Blackcomb Glacier), and therefore that glacial recession due to climate change could eventually reduce that influence enough to provide suitable habitat for tailed frogs. If that proved true, in-migration of tailed frogs over from adjacent creeks would be expected to establish a population within the creek.

In 2020, sampling at three sites on Blackcomb Creek again detected no tadpoles even though it recorded temperatures well within the temperature range of tailed frog creeks elsewhere in Whistler (9.0 to 10.0 deg. C). Since thermometer error was ruled out, it is possible (if surprising) that Blackcomb Creek warmed enough between 2006 and 2020 to support tailed frog habitation. For this surprising conclusion to be validated, future surveys would need to confirm those higher temperatures as well as the expected ingress of tailed frogs into the Blackcomb Creek system.

Beavers

Whistler's beaver survey first started in 2007. Since locating active lodges was much more feasible than counting individual beavers, that survey and all surveys since have used active lodges as a proxy for beaver colonies (that is, one colony per active lodge). The 2020 survey documented the highest number of active lodges since that 2007 survey. The number of active lodges found in 2020 (33) was six more than found in 2019 and brought the total estimated population to 192 beavers. Over half of this population was located in either the Millar Creek Wetlands (nine lodges) or in the River of Golden Dreams (10 lodges), with significant habitats also found in the associated Rainbow Wetlands and Wildlife Refuge. Only one active lodge was confirmed on the three golf courses in Whistler which is the lowest total in recent years. The absence of typically higher beaver activity was apparently not due to control efforts by course staff.

The total of just over 100 hectares of beaver-affected wetlands remained constant since 2019 which means no area was lost to development. This is an especially significant metric since approximately 72 percent of Whistler's wetlands have been lost since the railway was built in 1913. Based on the current density of beavers within the ca. 28% of remaining wetland habitat, over 700 beavers could have lived in Whistler before development.

Although past conflicts with beavers have been an inevitable consequence of urban development in Whistler's valleybottom, no serious conflicts were recorded in 2020. The greatest potential for conflict in 2020, adjacent to the new Valley Trail in the Millar Creek Wetlands, may have been averted (or at least mitigated) by the raised construction of the new Valley Trail linking Alta Lake Road with Function Junction.

In 2020, the RMOW requested an inventory of beaver dams on the River of Golden Dreams as a baseline for managing many competing interests including commercial and recreational boating, flood concerns, wildlife habitat, and fish spawning. Of the 11 dams surveyed on September 11, 2020, most were associated with the concentration of active lodges in the middle section of the River of Golden Dreams. Evidence of frequent breaching was noted at all dams. Some of the dams have been established for many years in the same place, including the largest one which has been active for at least 35 years.

Northern Goshawks

Information about annual Northern Goshawk activity in Whistler was updated with nine new records. Although no breeding pairs were confirmed, new activity suggesting breeding (or at least an active nest) uphill of Alta Lake Road near Alpha Lake. As in previous years, there were consistent sightings of at least one goshawk in the Nordic/Kadenwood area, as well as infrequent sightings on either side of Lost Lake. The Comfortably Numb area has been an important goshawk breeding site in past years but surveys during breeding season were precluded by Covid-19 restrictions. Future surveys in late spring are required to confirm whether any of these locations have active breeding pairs.

Alta Lake Ice

The timing and duration of ice on Alta Lake has been included as a climate indicator since the program began in 2013. Based on updated data, Alta Lake is frozen for almost one month less in recent years than in the mid-1900s. In addition, there is increasing evidence that the earlier onset of spring rather than later onset of winter is the main cause for this apparent change.

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1. Introduction

1.1 Overview

This report describes monitoring studies conducted in 2020 by Palmer and Snowline Ecological Research (Snowline) in aquatic and terrestrial environments in Whistler, British Columbia. The 2020 study was the eighth year of the Ecosystem and Species Monitoring Program[1] (the program) and the fifth study 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.

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. The report summarizing early results (Brett 2007) 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 proposed a framework for the establishment and application of ecological monitoring in Whistler (Askey *et al*. 2008).

The Ecosystem and Species 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[2]), and
- Local data held by Cascade Environmental Resource Group Inc (Cascade).

Cascade was contracted to conduct the first three years of the program, from 2013 through 2015 (Cascade 2014-2016). In 2016, Palmer and Snowline were contracted to conduct the program for the following five years. Several changes were made to the study design in 2016 to make it more scientifically robust (e.g., adopting data collection methods which allowed 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;
- 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;

[1] The name of the program changed in 2019 to recognize that specific species are useful indicators of ecosystem health. Previous reports refer to the "Ecosystems Monitoring Program."

[2] www.whistlerbiodiverisity.ca

- 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 Twenty-one Mile Creek;
- Use of the single-pass electrofishing method with no stop nets for fish sampling;
- An increase in the number of Coastal 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 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"[3]) is in the valley bottom, from Function Junction to Green Lake.

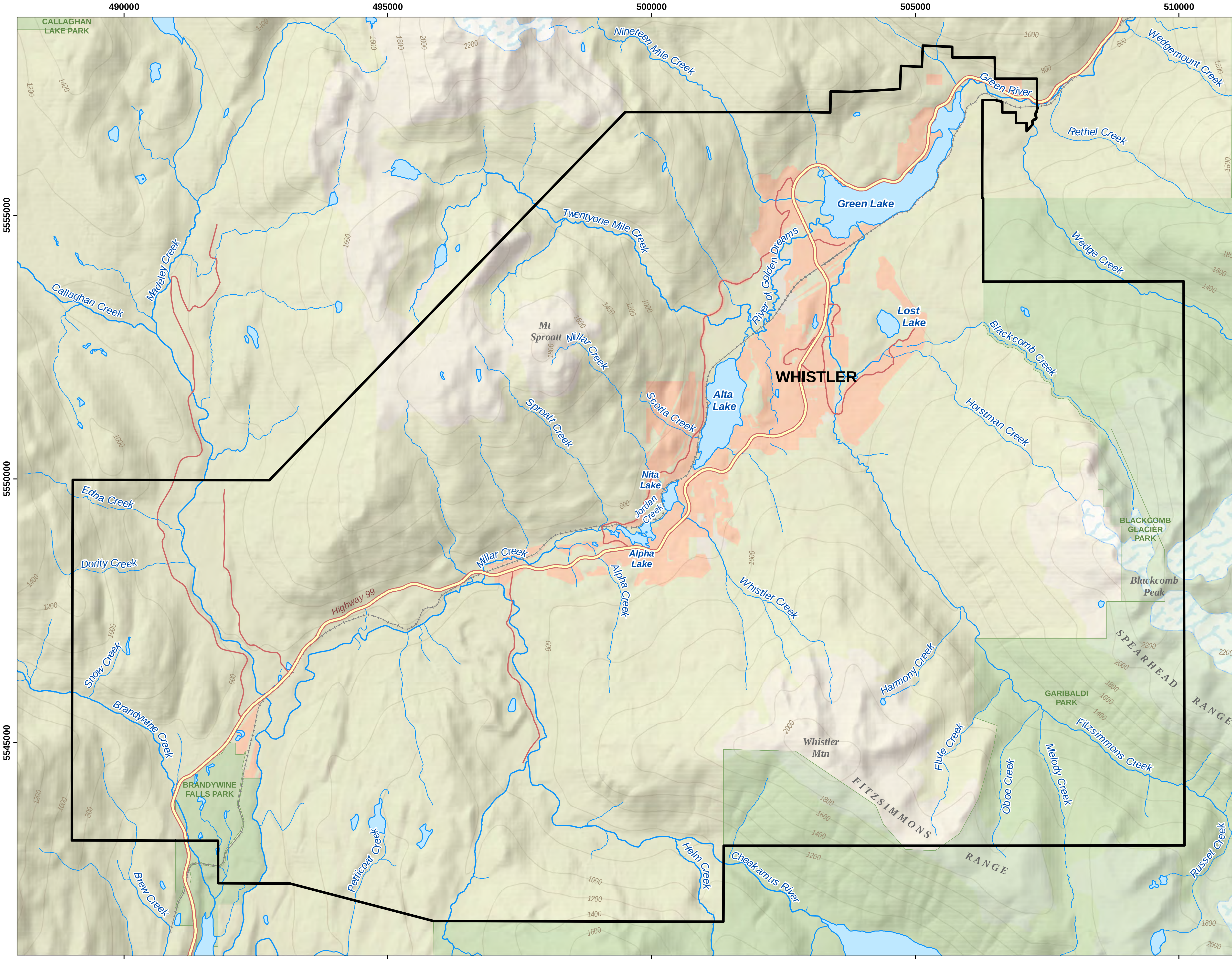
1.4 Study Design

The 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.

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

Table 1-1. 2020 Ecosystems Monitoring Program.

Study Component	Indicator(s)	Methodology/ Equipment	Metrics/Parameters
Aquatic Habitat	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 • Abundance • Size distribution • 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
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.

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CHECKED: I. Tuite
PROJECT: 1602506
DATE: Feb 11, 2020

Scale 1:70000
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CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2020

2020 Ecosystem Monitoring Program Study Area, Whistler, BC

FIGURE 1-1

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2. Surface Water

2.1 Introduction

The objectives of surface water monitoring within the program were to allow consideration for the influence of water chemistry and stream temperature on biological communities and to assess water quality by comparing parameter readings to provincial guidelines for the protection of aquatic life. Temperature loggers installed in the RMOW streams recorded hourly readings, which provided a continuous temperature record during the open water season.

2.2 Methods

The 2020 surface water monitoring program comprised five sites (Figure 2-1: Table 2-1). Field work was conducted by a two-person team on August 4th and 5th, 2020. Prior to field work, an on-site health and safety meeting was conducted to ensure crew members were aware of any potential site and stream hazards. High-visibility PPE was worn, and bear spray was available at all times.

Table 2-1. The 2020 Surface Water and Benthic Invertebrate Sampling Locations and Dates.

Site	UTM Location (Zone 10)		Aquatic Site ID	Access (Bridge Crossing)	Data Sampled
	Easting	Northing			
Jordan Creek	500242	5549278	JOR-DS-AQ31	Lake Placid Road	05-Aug-2020
Crabapple Creek	502030	5552670	CRB-DS-AQ01	Lorimer Road	04-Aug-2020
River of Golden Dreams (Upper)	502066	5552829	RGD-US-AQ11	Lorimer Road	05-Aug-2020
River of Golden Dreams (Lower)	503035	5554687	RGD-DS-AQ12	Off Nicklaus North Golf Course	05-Aug-2020
Twenty-one Mile Creek	501910	5552856	21M-DS-AQ21	Lorimer Road	04-Aug-2020

2.2.1 *In Situ* Surface Water Characterization

Consistent with previous years, *in situ* surface water temperature, dissolved oxygen (DO), pH, and conductivity were measured in 2020 using a hand-held YSI Pro plus meter at each of the five established stream sites (Figure 2-1). Measurements were taken concurrently with, but just prior to, benthic invertebrate sampling (Table 2-1).

2.2.2 Stream Temperature

Stream temperatures were downloaded from four sites within the RMOW in 2020. Crabapple Creek (at Sunridge Drive), Jordan Creek (JOR-DS-AQ31), Nita Creek, the River of Golden Dreams, and Twenty-One Mile Creek. Due to complications with missing or broken loggers and issues with downloading stream temperature data, the following sites and dates were available for review during the 2019-2020 seasons (Figure 2-2):

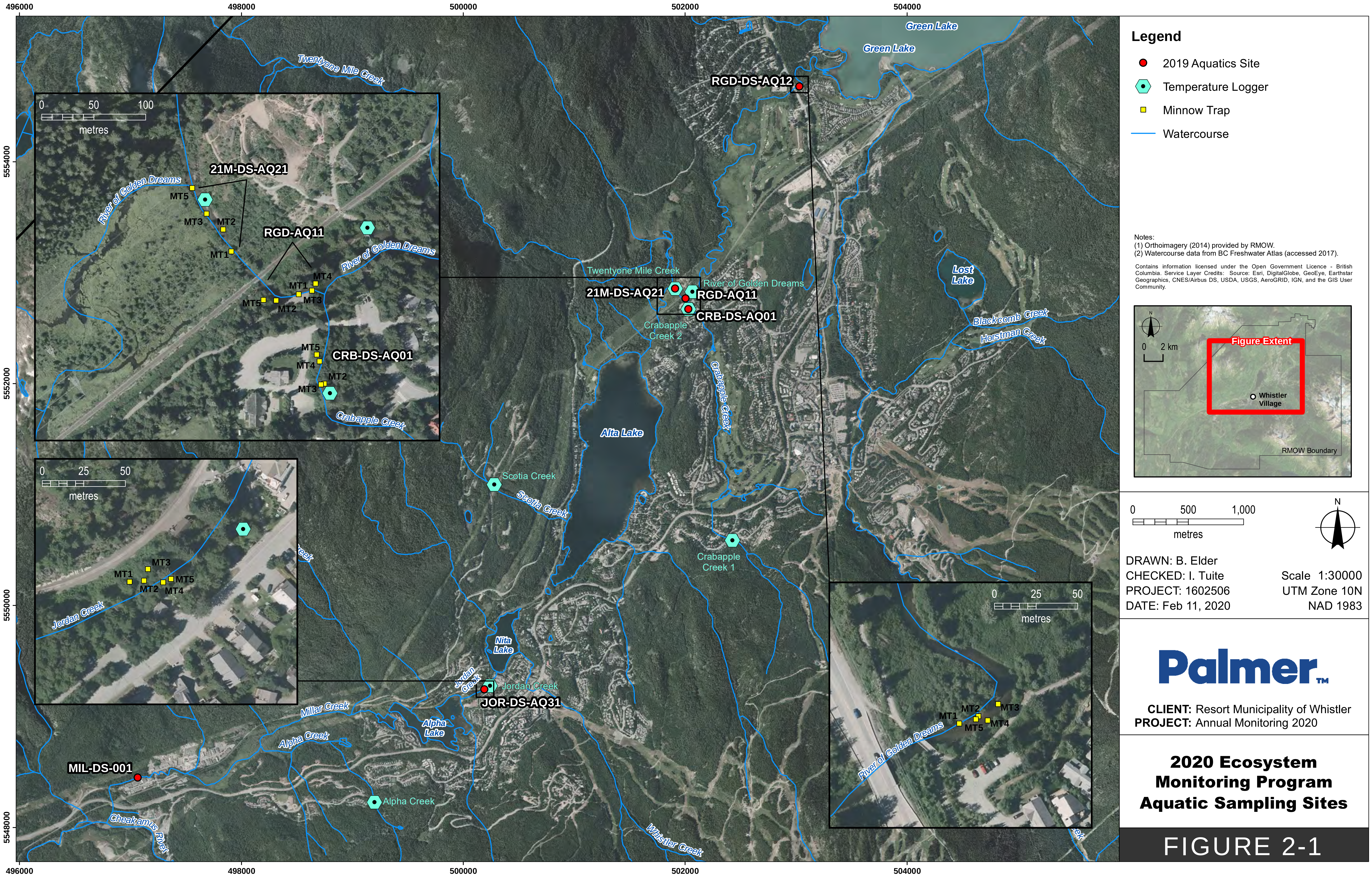
- Alpha Creek: January-July 2019
- Blackwater Creek: January – July 2019
- Crabapple Creek: January 2019 – December 2020
- Jordan Creek: January 2019 – April 2020
- Nita Creek: April 2020 – December 2020
- River of Golden Dreams: January 2019 – December 2020
- Scotia Creek: January 2019– July 2019, and
- Twenty-One Mile Creek: April 2020 – December 2020.

Monthly summary statistics (means, maxima, and minima) were calculated during the open water period for each creek between for 2019 and 2020 where data existed (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	Download Date
	Easting	Northing					
Alpha Creek	499199	5548227	At Tailed Frog Site #1	-	Spring Creek Drive	15-Dec-15	NA
Jordan Creek	500242	5549278	Near Aquatics Site	JOR-DS-AQ31	Lake Placid Road	24-Apr-20	24-Apr 2020
Scotia Creek	500280	5551092	At Tailed Frog Site #2	-	Stone Bridge Drive	15-Dec-15	NA
Crabapple Creek (1)	502426	5550589	At Tailed Frog Site #2	-	Sunridge Drive	24-Apr-20	NA*
Crabapple Creek (2)	502030	5552670	At Aquatics Site	CRB-DS-AQ01	Lorimer Road	24-Apr-20	09-Jan-21
River of Golden Dreams	502066	5552829	Near Aquatics Site	RGD-US-AQ11	Lorimer Road	24-Apr-20	24-Apr 2020 09-Jan-21
Twenty-oneTwenty-one Mile Creek	501910	5552856	At Aquatics Site	21M-DS-AQ21	Lorimer Road	24-Apr-20	09-Jan-21

** Crabapple Creek (1) temperature logger was not downloaded in 2020.*



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2.3 Results and Discussion

2.3.1 Surface Water Characterization

Dissolved oxygen varied from 7.5 mg/L to 14.6 mg/L across all sites and years and in 2020 varied from 8.0 mg/L to 9.1 mg/L. (Table 2-3). Based on temperature, these measured DO concentrations indicated that oxygen saturation was above 75% for all sites and years. Measured *in situ* dissolved oxygen at all sites in all years was above the BC WQG instantaneous minimum of 5 mg/L (BC MOE, 1997) for all fish life stages. However, a number of measurements were below the BC WQG instantaneous minimum guideline of 9 mg/L (BC MOE, 1997) for buried embryo/alevin life stages.

Table 2-3. In Situ Surface Water Results, 2016-2020.

Creek	Site ID	Date	Dissolved oxygen (mg/L)	Dissolved oxygen (%)	pH	Specific Conductance (µS/cm)	Water Temperature (°C)
Jordan Creek	JOR-DS-AQ31	03-Aug-16	9.3	94	7.1	64	15.8
		26-Jul-17	8.9*	88	7.1	105	14.9
		01-Aug-18	7.7*	83	7.1	65	18.8
		30-Jul-19	9.4	98	7.7	78	17.4
		05-Aug-20	**8.1***	**83**	**7.7**	**63**	**16.7**
Crabapple Creek	CRB-DS-AQ01	02-Aug-16	9.4	89	7.6	218	12.7
		25-Jul-17	11.6	108	7.4	336	12.0
		01-Aug-18	7.5*	76	7.5	194	16.0
		30-Jul-19	10.0	97	7.6	235	13.9
		04-Aug-20	**9.1**	**87**	**9.0**	**218**	**13.3**
Twenty-one Mile Creek	21M-DS-AQ21	03-Aug-16	9.4	87	6.3*	40	12.0
		25-Jul-17	11.3	104	7.1	40	11.6
		31-Jul-18	14.6	**160ᵻ**	6.2*	38	19.9
		30-Jul-19	9.8	94	7.0	52	13.3
		04-Aug-20	**8.0***	**77**	**9.4***	**47**	**13.9**
River of Golden Dreams (Upper)	RGD-US-AQ11	03-Aug-16	8.3*	76	7.3	64	11.7
		25-Jul-17	11.0	99	7.1	50	10.5
		31-Jul-18	7.5*	75	7.2	36	15.5
		30-Jul-19	9.8	92	6.8	33	12.8
		05-Aug-20	**8.2***	**79**	**7.7**	**42**	**13.6**
River of Golden Dreams (Lower)	RGD-DS-AQ12	05-Aug-16	9.9	99	7.8	69	15.2
		25-Jul-17	9.8	93	7.0	73	13.0
		01-Aug-18	8.2*	86	6.7	48	17.8
		31-Jul-19	9.9	94	7.6	61	13.1
		05-Aug-20	**9.1**	**93**	**7.5**	**71**	**16.3**

Notes: The 2020 results are ***bolded****; values that exceeded a guideline are identified with an asterisk (*).*

ᵻ Reading likely erroneous.

The pH varied from 6.2 to 9.4 across all sites and years and in 2020 varied from 7.5 to 9.4 (Table 2-3). The pH was below the BC pH guideline of 6.5 at Twenty-one Mile Creek in 2016 and 2018, and above the BC pH guideline of 9.0 at Twenty-one Mile Mile Creek in 2020: this variation in pH recorded for Twenty-one Mile Creek is unusual.

Specific conductance varied from 33 µS/cm to 105 µS/cm across four of the sites. In Crabapple Creek, however, specific conductance was measurably higher, varying from 194 µS/cm to 336 µS/cm through the period of record. The reasons for this difference have not been investigated, although it is noteworthy that Crabapple Creek flows right alongside the edge of a golf course.

2.3.2 Stream Temperature

Average monthly temperatures in the study streams ranged from approximately -2.1°C in February 2019 at Scotia Creek to 18.1 °C at Jordan Creek in August 2019. During 2020, average monthly stream temperatures ranged from approximately 0.9 °C in January at the River of Golden Dreams to 16.5 °C at Nita Creek in August (Figure 2-2). Consistent with previous years, the highest temperatures were measured during July, August and September and the lowest temperatures were measured in January and February. Despite not having a complete dataset for 2020, Jordan Creek has been the warmest creek through the period of record (Figure 2-2).

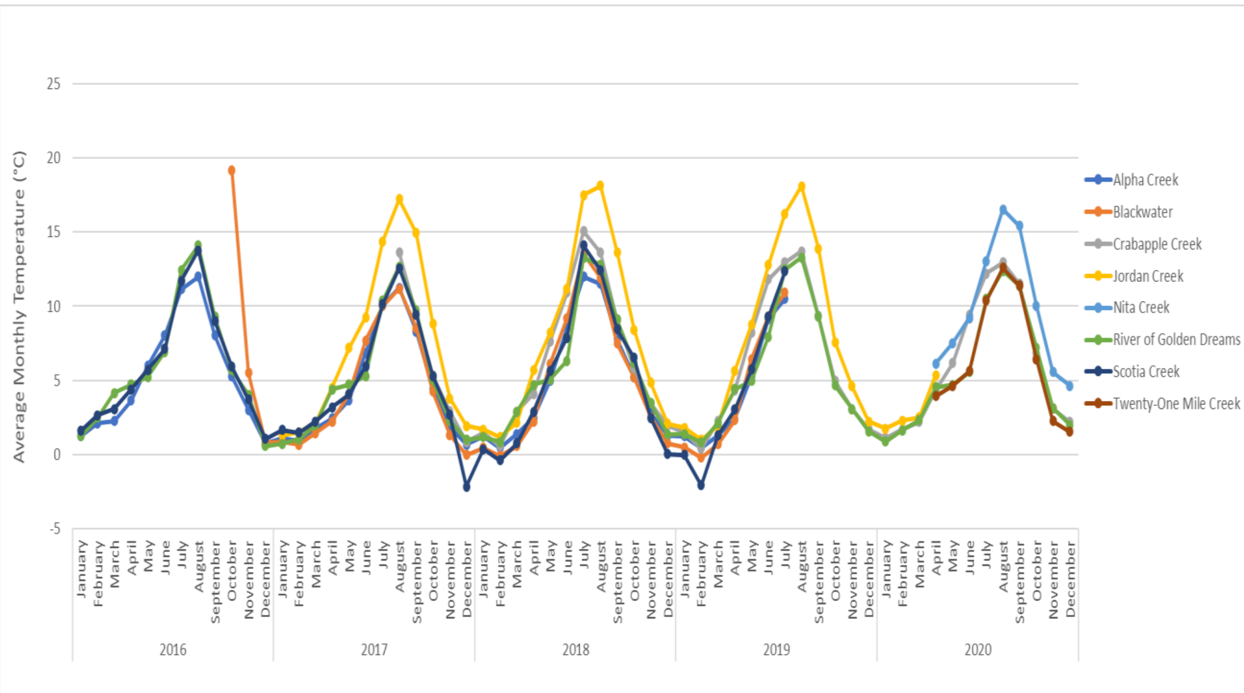


Figure 2-2. Monthly Mean Stream Temperature Record for 2016-2020.

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 in 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: these provide a comprehensive basis for interpreting community status and environmental effects.
- Sampling protocols are 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 (RGD-US-AQ11 and RGD-DS-AQ12), and Twenty-one 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 2020 (Table 2-1) to collect habitat information and benthic invertebrate samples. Field work was undertaken on August 4th, 2020 at Crabapple Creek and Twenty-one Mile Creek and on August 5th, 2020, at Jordan Creek and the upper and lower reaches of the River of Golden Dreams: these five sites were the same as those used in 2016, 2017, 2018 and 2019. Benthic invertebrate sampling was completed prior to fish sampling, to avoid disturbance of the substratum. 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 enumeration and taxonomic identification to the lowest possible level.

Samples from sites 21M-DS_AQ21 and CRB_DS_AQ01 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 these locations. 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. Velocity was determined using the Velocity Head Rod technique at six points along a transect of the stream, according to the 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 2020 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 included 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 2020 benthic invertebrate sampling results (habitat and taxonomy data) were entered into the online CABIN database. Data from 2016 to 2020 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, 2019). The data for all years were compared with the Fraser Basin Reference Model (2014); 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 and the type and proportion of taxa present (Sylvestre *et al*. 2005). The samples from the five sites over the five years were assigned to one 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 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%. 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, 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 = Standard Deviation/Mean)

**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, 2019 and 2020 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 - Classification

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

Source: Mandeville (2002)

3.2.3.5 Temporal Trends Analysis

Temporal trends analysis examines change over time. There are currently five years of benthic invertebrate data, which provides a sample size of ten temporal comparisons. These are considered an adequate number of comparisons and so trends analysis was undertaken for the first time in 2020 using the non-parametric Mann-Kendall (MK) temporal trends test.

Tests were performed using the 'Kendall' package version 2.2 in R (a programming language for statistical computing and graphics). A significance level of $\alpha = 0.05$ was used to determine whether a positive or negative trend existed in the data. Additionally, Sen's slope was calculated for each watershed and analyte. The Sen's slope characterized the magnitude of the trends, that is, how much the analyte changed from year-to-year.

The MK test assumes that temporal trends consistently increase or decrease over time, that is, the test assumes trends are monotonic through the period of record (2016-2020).

The sensitivity of the MK trends test increases with an increasing number of time steps and it is considered that somewhere between five and ten time steps are a minimum requirement. The analyses presented below used the minimum number of five yearly time intervals over the period of record to determine the direction and statistical significance of temporal trends in the benthic invertebrate community.

The following benthic invertebrate endpoints were used in the temporal trends analyses:

- Taxon richness
- EPT Richness
- Total Abundance
- EPT Relative Abundance
- Shannon-Wiener Diversity

Benthic invertebrate endpoints that had significant trends over time were graphed with Sen's slope trend lines to assist in determination of how the data were changing over time.

3.3 Results

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, eight to Group 4, and eight 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 five years of monitoring with the other four sites assigned to two different Groups each (Table 3-3).
- The probability of group membership was less than 50% for all but nine sites/years (Table 3-3), with the lowest probability estimated at only 27% (RGD-DS-AQ12, 2016).
- Group 3 and Group 5, which were assigned to 14 of the 25 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. Fraser Basin 2014 Reference Model Group Assignment (% Probability).

Site	Year	Group	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
# Reference Sites			64	57	19	103	13	46
Twenty-one Mile Creek (21M-DS-AQ21)	2016	3	6%	4%	***29%***	29%	21%	12%
Twenty-one Mile Creek (21M-DS-AQ21)	2017	3	10%	5%	***33%***	24%	17%	10%
Twenty-one Mile Creek (21M-DS-AQ21)	2018	5	10%	5%	22%	17%	***39%***	6%
Twenty-one Mile Creek (21M-DS-AQ21)	2019	3	10%	5%	***33%***	24%	17%	10%
Twenty-one Mile Creek (21M-DS-AQ21)	2020	4	0%	0%	*0%*	***56%***	33%	11%
Crabapple Creek (CRB-DS-AQ01)	2016	1	***44%***	27%	0%	19%	9%	2%
Crabapple Creek (CRB-DS-AQ01)	2017	1	***44%***	27%	0%	19%	8%	2%
Crabapple Creek (CRB-DS-AQ01)	2018	1	***44%***	27%	0%	19%	8%	2%
Crabapple Creek (CRB-DS-AQ01)	2019	5	0%	0%	0%	16%	***82%***	1%
Crabapple Creek (CRB-DS-AQ01)	2020	5	0%	0%	0%	10%	***90%***	0%
Jordan Creek (JOR-DS-AQ31)	2016	4	14%	8%	0%	***55%***	2%	20%
Jordan Creek (JOR-DS-AQ31)	2017	4	18%	10%	0%	***51%***	2%	18%
Jordan Creek (JOR-DS-AQ31)	2018	4	10%	7%	0%	***57%***	7%	18%
Jordan Creek (JOR-DS-AQ31)	2019	4	8%	6%	0%	***62%***	3%	21%
Jordan Creek (JOR-DS-AQ31)	2020	4	0%	0%	0%	***99%***	1%	0%
River of Golden Dreams (RGD-US-AQ11)	2016	3	9%	5%	***38%***	22%	17%	10%
River of Golden Dreams (RGD-US-AQ11)	2017	3	8%	4%	***41%***	21%	16%	10%
River of Golden Dreams (RGD-US-AQ11)	2018	5	9%	4%	27%	16%	***38%***	7%
River of Golden Dreams (RGD-US-AQ11)	2019	3	9%	5%	***39%***	22%	17%	10%
River of Golden Dreams (RGD-US-AQ11)	2020	4	0%	0%	0%	***61%***	33%	6%
River of Golden Dreams (RGD-DS-AQ12)	2016	4	17%	8%	16%	***27%***	23%	9%
River of Golden Dreams (RGD-DS-AQ12)	2017	5	16%	7%	10%	17%	***46%***	5%
River of Golden Dreams (RGD-DS-AQ12)	2018	5	12%	4%	5%	8%	***68%***	2%
River of Golden Dreams (RGD-DS-AQ12)	2019	5	18%	7%	10%	16%	***44%***	5%
River of Golden Dreams (RGD-DS-AQ12)	2020	5	18%	7%	10%	16%	***44%***	5%

3.3.2 Multivariate Site Assessment

The test site BCI values ranged from 0.36 to 0.94 with a first quartile of 0.57 and a median value of 0.71 (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 between 2016 and 2019 and similar to reference in 2020, with the difference between reference and test site BCI ranging between 0.14 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 ranging 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 ranging between 0.04 and 0.25. River of Golden Dreams upstream site (RGDUS-AQ11) was assessed as being mildly divergent to divergent from 2016 to 2019 and similar to reference in 2020, with the difference between reference and test site BCI ranging between 0.02 and 0.39. The River of Golden Dreams downstream site (RGD- DS-AQ12) was assessed as being in reference condition all five years, with the difference between reference and test site BCI's ranging between 0.02 and 0.17 (Table 3-4).

CABIN assessment results, when grouped by type, resulted in a difference in BCI between the test and reference sites of <0.18 for test sites in reference condition, between 0.14 and 0.34 for sites considered mildly divergent, and >0.25 for test sites considered divergent from reference condition (Table 3-4).

Table 3-4. Fraser Basin 2014 Reference Model Classification

Site	Year	Test Site Bray-Curtis Index	Reference Bray-Curtis Index (Mean ± SD)	RIVPACS O:E (p>0.7)	Group (Probability)	CABIN Classification
Twenty-one Mile Creek (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
	2020	0.36	0.53 ± 0.14	1.20	4 (56%)	Reference
Crabapple Creek (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
	2020	0.74	0.55 ± 0.22	1.11	5 (90%)	Mildly Divergent
Jordan Creek (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
	2020	0.74	0.53 ± 0.14	0.47	4 (99%)	Mildly Divergent
River of Golden Dreams (RGD-US-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
	2020	0.48	0.53 ± 0.14	1.19	4 (61%)	Reference
River of Golden Dreams (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
	2020	0.58	0.55 ± 0.22	1.21	5 (44%)	Reference

The RIVPACS O:E ratios ranged from 0.47 for Jordan Creek (JOR-DS-AQ31) to 1.21 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 for all years was Jordan Creek (JOR-DS-AQ31), where the ratio ranged from 0.47 to 0.95 (Table

3-4). The O:E ratio was less than 1.0 for Crabapple Creek (CRB-DS-AQ01) for three years (2016, 2017 and 2019), and for twenty-one Mile Creek (21M-DS-AQ21) in 2017. All other sites and years had O:E ratios greater than 1.0 (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 2200 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 per sample in 2019 to just over 2500 organisms per sample in 2017 (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 0.19 to 0.74 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 with 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 (Five-Year Average)

Parameter	**AQ21**	**AQ01**	**AQ31**	**AQ12**	**AQ11**	**Threshold**
Abundance	0.36	0.44	0.74	0.19	0.24	**0.06**
EPT Relative Abundance	1.08	1.21	0.48	0.91	1.05	**0.66**
Total Taxon Richness	1.19	0.95	0.78	1.17	1.18	**0.73**
EPT Taxon Richness	1.05	0.78	0.76	0.96	1.05	**0.69**
% Dominant	1.04	0.94	0.87	1.02	1.01	**0.90**
Shannon-Wiener Diversity	1.10	0.89	0.79	1.15	1.05	**0.78**
Average Metric Score	**0.97**	**0.87**	**0.74**	**0.90**	**0.93**	**0.75**

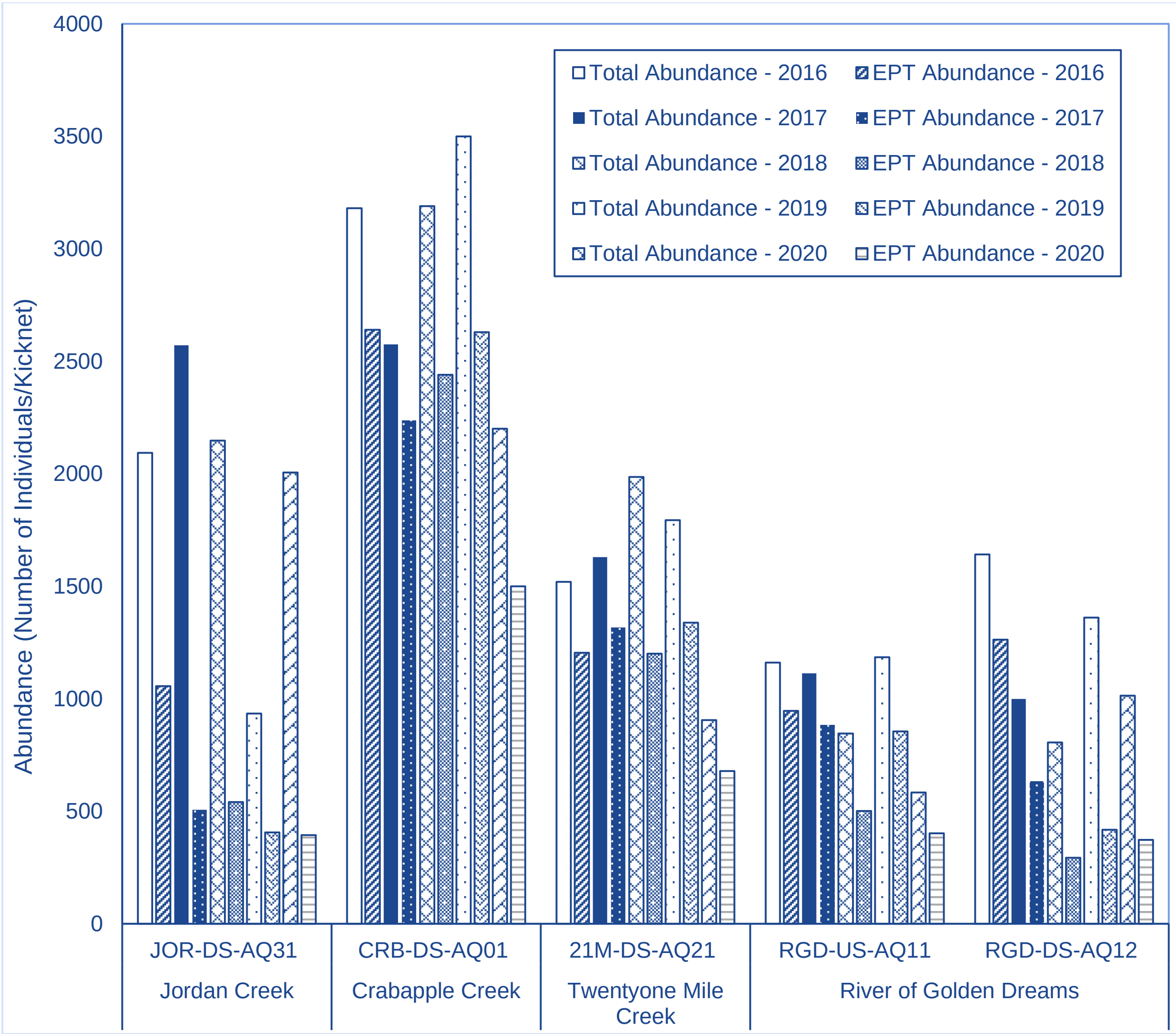


Figure 3-1. Benthic Invertebrate Total Abundance and Ephemeroptera, Plecoptera and Trichoptera (EPT) Abundance.

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 3-2). The relative abundance of EPT taxa was comparable and relatively stable among sites in Crabapple Creek (CRB-DS-AQ01), Twenty-one Mile Creek (21M-DS-AQ21), and the River of Golden Dreams upstream site (RDG-US-AQ11), only varying from 60% to 87% (Figure 3-2). In comparison, EPT abundance was relatively low and variable at Jordan Creek (JOR-DS-AQ31), ranging from 20% to 50% through the five years of sampling, and relatively variable at the River of Golden Dreams upstream site (RDG-DS-AQ12), ranging from approximately 30% to 80% (Figure 3-2).

Average metric scores ranged from 0.48 at the Jordan Creek site (JOR-DS-AQ31) to 1.21 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.

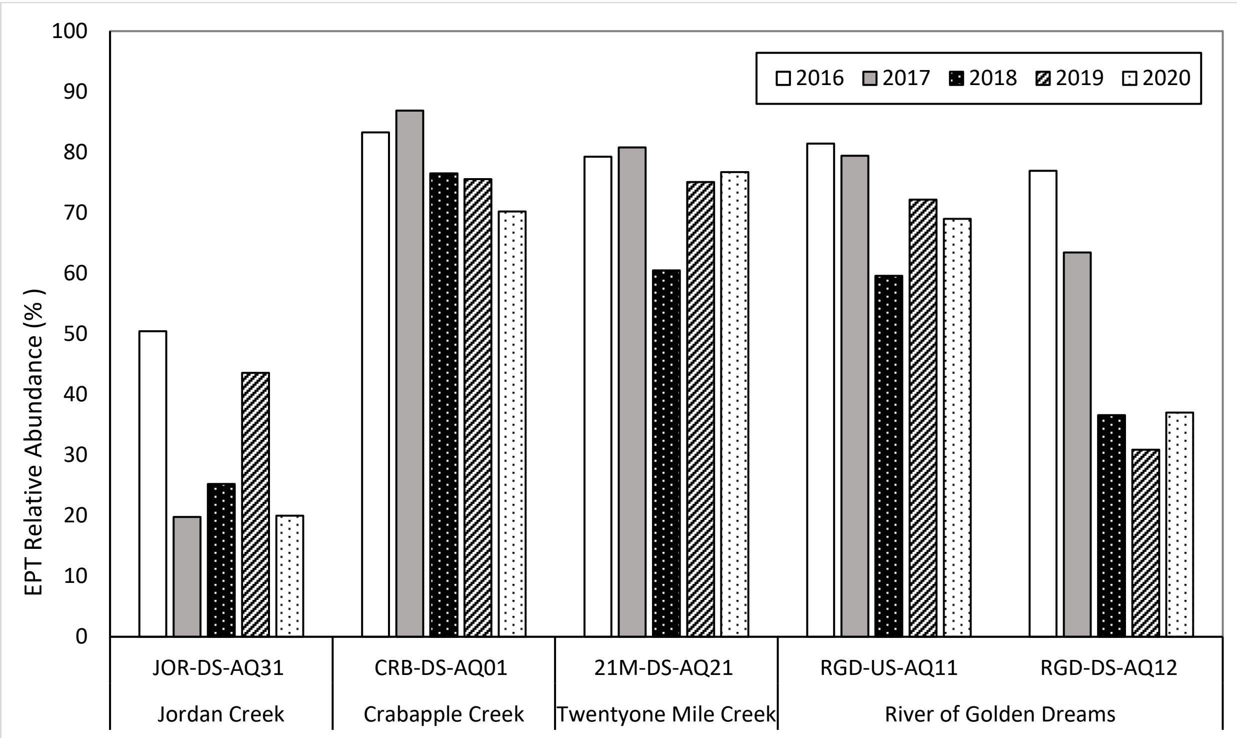


Figure 3-2. EPT Relative Abundance (%).

3.3.3.3 Taxonomic Richness

Taxonomic richness varied from a low of 10 at the Crabapple Creek site (CRB-DS-AQ01) in 2017, to a high of 25 at the River of Golden Dreams upstream site (RGD-US-AQ11) in 2018 and 2020 (Figure 3-3), but there were no consistent differences among sites (Figure 3-3).

Average taxonomic richness metric scores ranged from 0.78 at the Jordan Creek site (JOR-DS-AQ31) to 1.19 at the Twenty-one Mile Creek site (21M-DS-AQ21), with three of the sites greater than 1.0 (Table 3-5). 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.

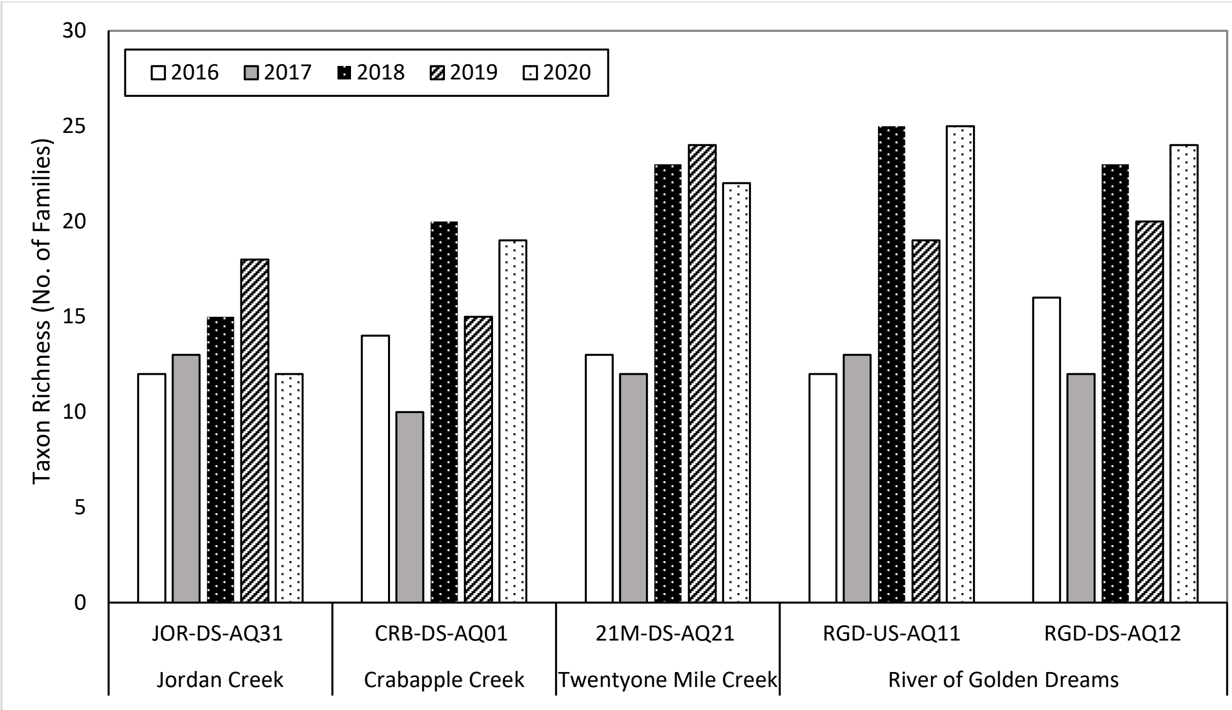


Figure 3-3. Benthic Invertebrate Taxon Richness.

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 2020, richness of EPT taxa ranged from six families at Jordan Creek (JOR-DS-AQ31) to 13 families at the Twenty-one Mile Creek (21M-DS-AQ21) and River of Golden Dreams upstream site (RGD-US-AQ11) (Figure 3-4).

Average metric scores ranged from 0.76 at the Jordan Creek site (JOR-DS-AQ31) to 1.05 at the Twenty-one Mile Creek site (21M-DS-AQ21) and the upstream site on the River of Golden Dreams (RGD-US-AQ11) (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.

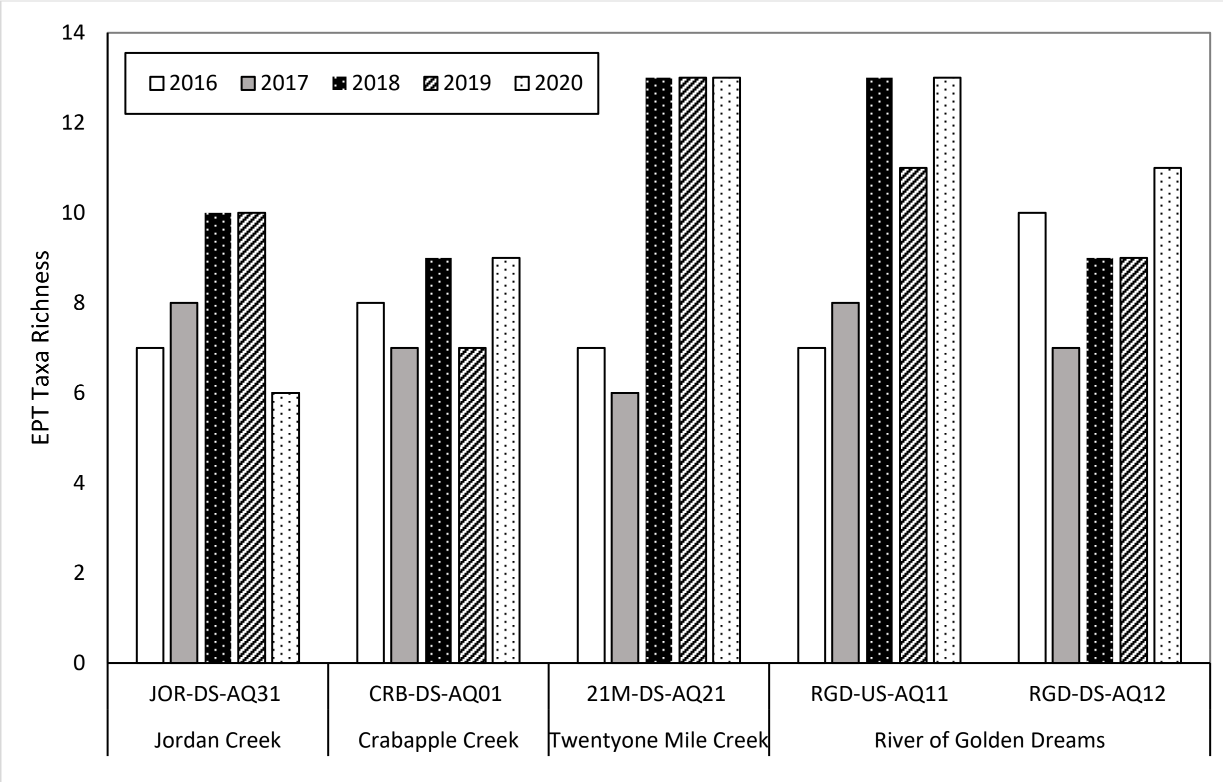


Figure 3-4. EPT Taxon Richness.

3.3.3.5 Community Composition

Sites in Crabapple Creek (CRB-DS-AQ01), Twenty-one Mile Creek (21M-DS-AQ21) and the River of Golden Dreams upstream site (RGD-US-AQ11), which are all clustered in the upper River of Golden Dreams system, had similar community structure, with 31% or less of Diptera+non-insects and greater than 65%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 (58%) relative to the upstream sites (Crabapple Creek, Twenty-one Mile Creek and River of Golden Dreams upstream site) and a lower proportion of Ephemeroptera (32%). The site also had the highest proportion of invertebrates in the 'other' category (5%).

Diptera+non-insects comprised 80% of the benthic community at the Jordan Creek site (Figure 3-5). This proportion was similar to that recorded in 2017 (80%) and 2018 (75%). Notably, in 2017, 2018, and 2020 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 1.04 at 21M-DS-AQ21 in Twenty-one Mile Creek (Table 3-5). Comparison with the reference threshold of 0.90 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 in Crabapple Creek (CRB-DS-AQ01), Twenty-one Mile Creek (21M-DS-AQ21), and the River of

Golden Dreams (RGD-US-AQ11 and RGD-DS-AQ12) was therefore in reference condition and considered unimpaired, while dominance at the Jordan Creek site (JOR-DS-AQ31) was considered mildly divergent.

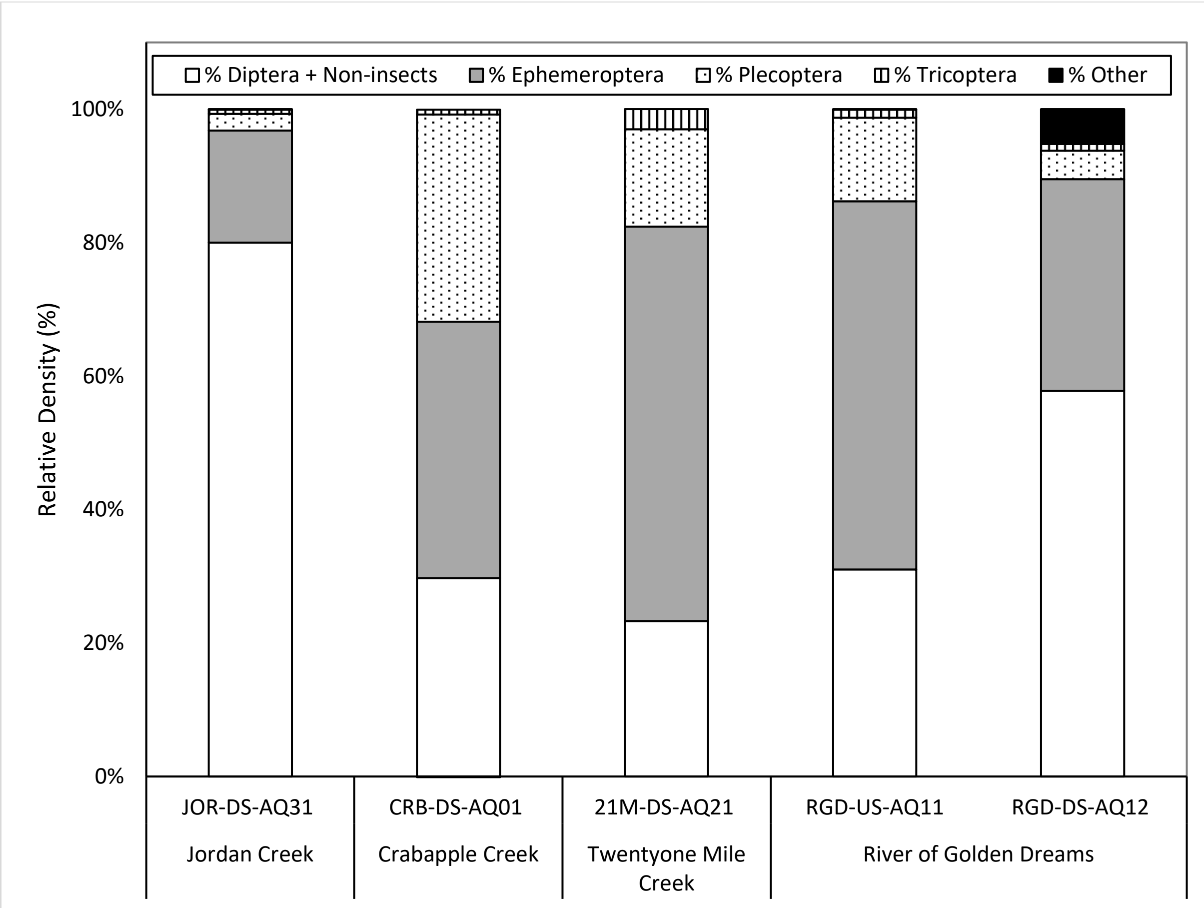


Figure 3-5. 2020 Relative Abundance of Major Taxonomic Groups (%).

3.3.3.6 Shannon-Wiener Diversity

Diversity ranged from 1.07 at the Crabapple Creek site (CRB-DS-AQ01) in 2017 to 2.40 at the downstream River of Golden Dreams site (RGD-DS-AQ12) in 2020 (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, 2019 and 2020 than earlier years (Figure 3-6).

Average metric scores for diversity ranged from 0.79 at the Jordan Creek site (JOR-DS-AQ31) to 1.15 at the downstream site on the River of Golden Dreams (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.

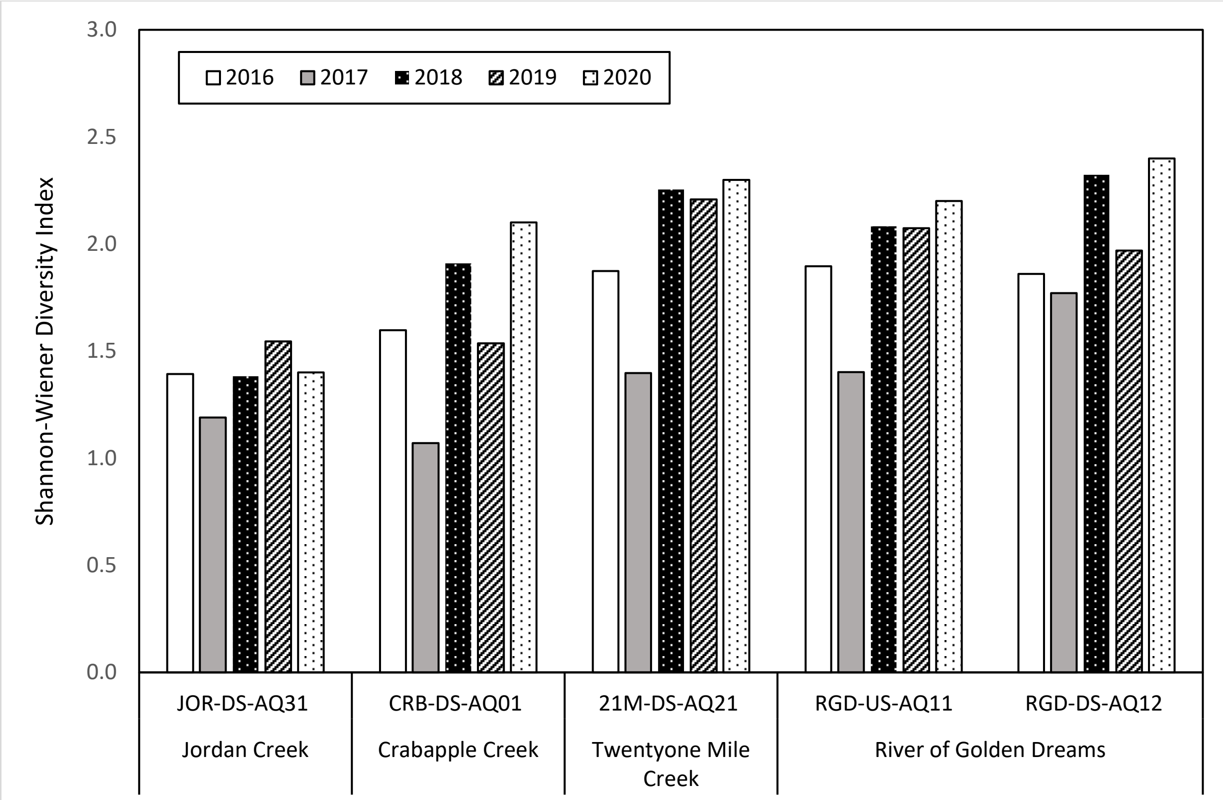


Figure 3-6. Shannon-Wiener Diversity Index.

3.3.4 Hilsenhoff Index of Biotic Integrity

Compilation of the HIBI scores was undertaken and indicated that the scores varied from 3.43 at the Twenty-one Mile Creek site (21M-DS-AQ21) in 2020 to 5.73 at the downstream River of Golden Dreams site RGD-DS-AQ12 in 2020 (Table 3-6). Based on these scores, classification ranged from fair to good at site RGD-DS-AQ12 in the River of Golden Dreams and site JOR-DS-AQ31 in Jordan Creek, and very good at the other three 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	2020	Classification*
AQ01 – Crabapple Creek	2	3.93	4.25	4.03	Very Good
AQ11 – River of Golden Dreams Upstream	3	3.93	3.98	3.93	Very Good
AQ12 – River of Golden Dreams Downstream	3	5.14	5.43	5.73	Good - Fair
AQ21 – Twenty-one Mile Creek	3	3.75	3.58	3.43	Very Good
AQ31 – Jordan Creek	2	5.21	4.66	5.51	Good - Fair

**See Table 3-2*

3.3.5 Temporal Trends Analysis

There was a total of five statistically significant trends (Table 3-7) from three different sampling sites: Crabapple Creek (CRB-US-AQ01), Jordan Creek (JOR-US-AQ31), and the upstream site at the River of Golden Dreams (RGD-US-AQ11).

Table 3-7. Benthic Invertebrates – Mann-Kendall Test for Trends (α = 0.05)

Statistic	Site				
	21M-AQ21	CRB-AQ01	JOR-AQ31	RGD-DS-AQ12	RGD-US-AQ11
Total Abundance					
p-value	0.09	0.09	1.0	0.81	0.46
Sen's Slope	227	318	-121	-38	62
EPT Relative Abundance					
p-value	0.22	**0.03***	0.09	0.22	**0.03***
Sen's Slope	2.2	4.0	7.7	-9.6	5.3
Total Taxon Richness					
p-value	0.46	1.0	**0.04***	0.81	0.13
Sen's Slope	0.75	-0.33	1.5	-0.67	3.1
EPT Taxon Richness					
p-value	0.58	0.79	**0.04***	1.0	**0.04***
Sen's Slope	0.50	0.25	1.00	0.25	1.83
Shannon Wiener Diversity					
p-value	0.81	0.46	1.0	0.81	0.22
Sen's Slope	-0.02	-0.10	0.02	-0.06	0.08

Note: Results that are bolded with an asterisk (*) are significant (p<0.05).

There were no significant trends for total abundance (Table 3-7). Jordan Creek showed significant trends (Figure 3-7) for Total Taxon Richness (p=0.04; S=1.5) and EPT Taxon Richness (p=0.04; S = 1.0; Figure 3-8). Crabapple Creek showed significant negative trends for EPT Relative Abundance (p=0.03; S=4.00; Figure 3-9) and the upstream River of Golden Dreams site (RGD-US-AQ11) demonstrated significant increasing trends for EPT Taxon Richness (p=0.04; S=1.8; Figure 3-10) and significant decreasing trends for EPT Relative Abundance (p=0.03, S=5.3; Figure 3-11).

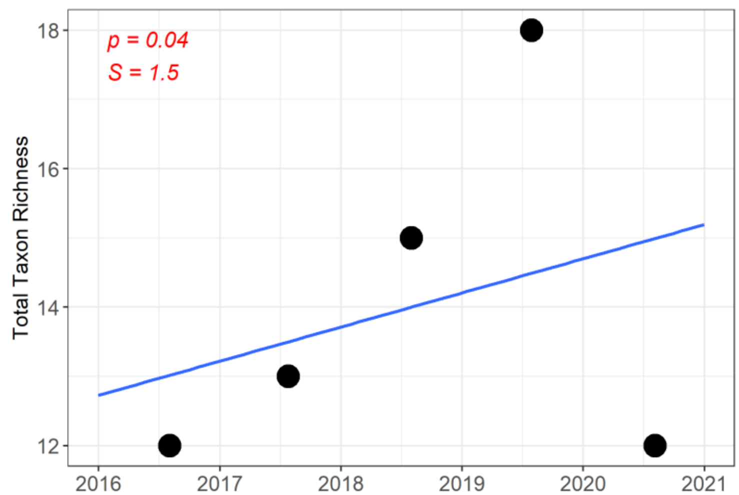


Figure 3-7. Total Taxon Richness at Jordan Creek (JOR-DS-AQ31).

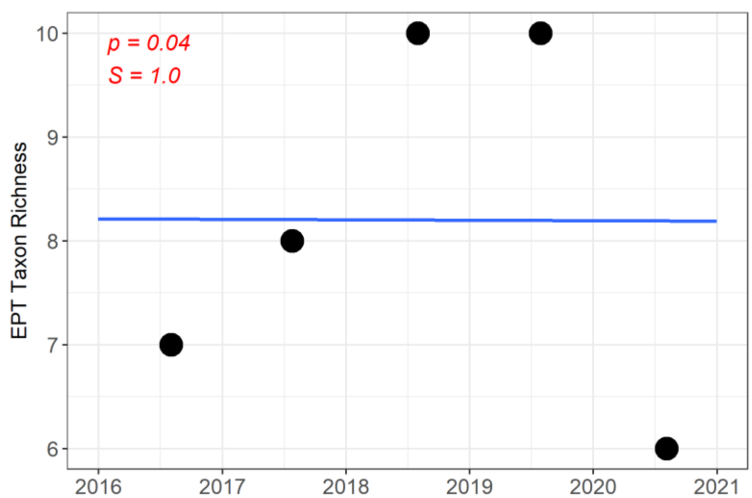


Figure 3-8. EPT Taxon Richness at Jordan Creek (JOR-DS-AQ31).

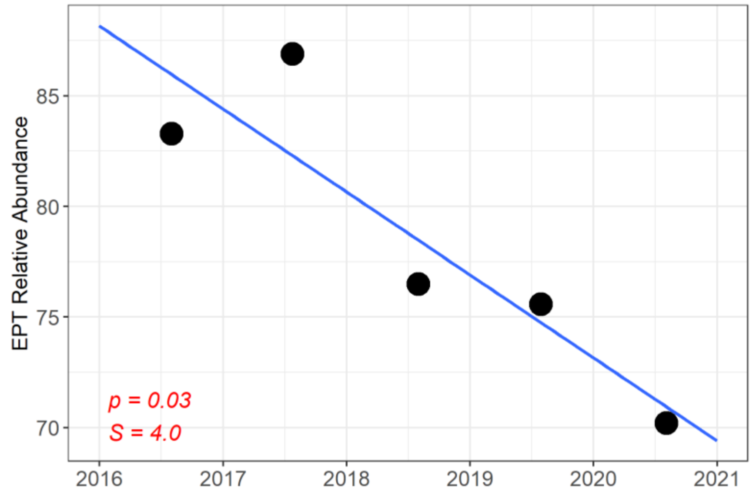


Figure 3-9. EPT Relative Abundance at Crabapple Creek (CRB-US-AQ01).

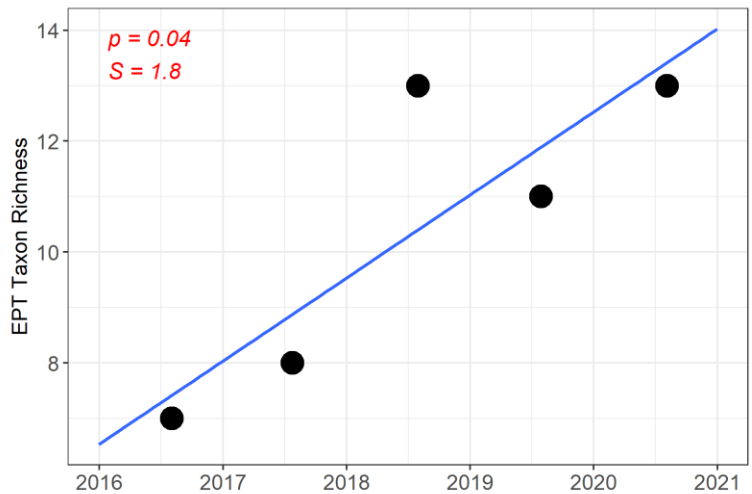


Figure 3-10. Taxon Richness at River of Golden Dreams (RGD-US-AQ11).

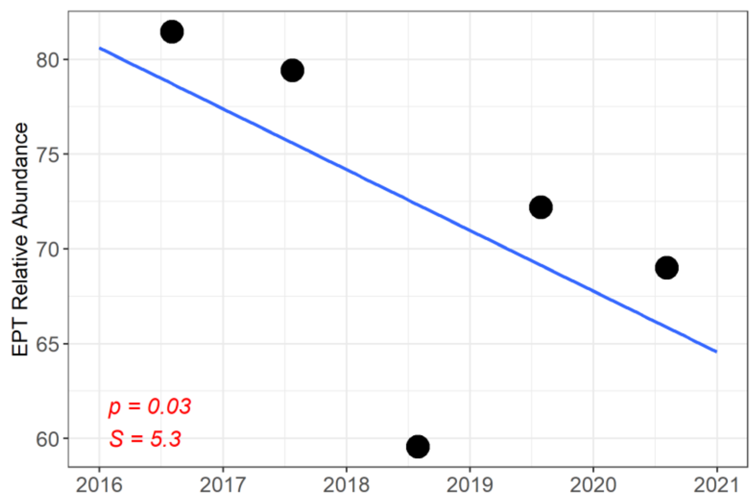


Figure 3-11. EPT Relative Abundance at River of Golden Dreams (RGD-US-AQ11).

3.4 Assessment Conclusions

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 0.87. The site was also assessed as in very good condition using the HIBI. These results suggest that Crabapple Creek 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 in reference condition in 2020 to mildly divergent in all other years using the CABIN assessment. The site was assessed as within reference condition for all six core metrics with an average metric score of 0.93 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 downstream site in the River of Golden Dreams was assessed as in reference condition for all five 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 0.90 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 Twenty-one Mile Creek Downstream Site 21M-DS-AQ21

The downstream site in Twenty-one Mile Creek was assessed as mildly divergent in 2016, 2018 and 2019, divergent for 2017, and in reference condition in 2020 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 0.97 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 Twenty-one 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 in 2019 to divergent in 2016 and mildly divergent for all other years 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 0.74, 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 freshwater fish monitoring program was to assess the fish communities of local watercourses in the Resort Municipality of Whistler (RMOW) using abundance, species composition, fish length distribution, and fish condition. The monitoring program also now has five years of monitoring data (2016-2020), which means that temporal trends analysis was possible. The objective of the trends analysis was to assess whether there have been any changes in the local fish populations over time at each site.

Common fish species found in the RMOW are Sculpin *(Cottus sp.),* Trout (*Oncorhynchus sp.*)*,* and Three-spined Stickleback *(Gasterosteus aculeatus*). Potential sculpin species within the study area are Prickly Sculpin (*Cottus asper*), the larger of the two cottid species expected to be in this region, and the Coastrange Sculpin (*Cottus aleuticus*), which is on average smaller than the Prickly Sculpin (McPhail and Carveth, 1993; Armour, 2010). These two sculpin species have not been separately identified in this report. Rainbow Trout were stocked in Rainbow Lake (the headwater lake of Twenty-one Mile Creek) in the late 1970s or early 1980s (Eric Crowe, pers. comm) and are now ubiquitous in the study streams. Within the Whistler area, however, Rainbow Trout are believed to have hybridized with Coastal Cutthroat Trout (*O. clarkii clarkii).* Because it is difficult to accurately identify hybrids in the field, captured trout are referred to in this report without separately identifying them as Rainbow Trout, Coastal Cutthroat Trout, or hybrid trout.

4.2 Methods

Five sites were monitored in 2020 (Table 4-1); one site in each of Jordan Creek (JOR-DS-AQ31), Crabapple Creek (CRB-DS-AQ01), and Twenty-one Mile Creek (21M-DS-AQ21), and two sites in the River of Golden Dreams (RGD-US-AQ11 and RGD-DS-AQ12). Streams were sampled for fish between August 4th and August 7th, 2020 (Table 4-1) under Scientific Fish Collection Permit SU20-608503 issued by the BC Ministry of Forests Lands and Natural Resource Operations (BC MoFLNRO). The fish community was sampled using a combination of minnow traps and backpack electrofishing.

Minnow traps were set on August 5th and removed the following day. 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.

Electrofishing was undertaken by a two-person crew after the removal of the minnow traps. The field crew used a Smith-Root LR-24 backpack electrofisher following methods outlined in Johnston et al. (2007). One electrofishing pass with no stop nets was made in Jordan Creek at site JOR-DS-AQ31 and Twenty-one Mile Creek at site 21M-DS-AQ21, and two electrofishing passes were completed in Crabapple Creek (CRB-DS-AQ01) where a second electrofishing pass was needed due to a dead battery. The River of Golden Dreams at both upstream (RGD-US-AQ11) and downstream (RGD-DS-AQ12) sites was not electrofished due to safety concerns.

Electrofisher voltage, duty cycle, and frequency settings were adjusted based on site conditions to maximize efficiency and minimize the risk of injury to fish and recorded for each site (Table 4-1).

All captured fish 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. There was an error with the scale that was used for some of the fish weight data from Jordan Creek and Crabapple Creek, which significantly underestimated weight. For the 2016 sampling period it seems for some individuals a similar issue occurred except that weight was significantly overestimated.

Any lesions, parasites, or other anomalies on fish were recorded before the fish were live-released at the site of capture. Biological data for fish collected as part of the 2020 study in the RMOW study area are presented in Appendix C.

4.2.1 Data Analysis

4.2.1.1 Fish Abundance and Catch-Per-Unit-Effort

Fish abundance was summarized by calculating catch-per-unit-effort (CPUE) for each individual fishing effort, gear type, and fish species that was captured. The CPUE is considered an index of 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.

The CPUE is defined as the number of fish captured per sampling device per unit time and was calculated as follows;

Electrofishing:
CPUE=number of fish caught per 100 s of electrofishing effort

Minnow Traps:
CPUE=number of fish caught per trap per day of set time

Following the calculation of CPUE for both minnow trapping and electrofishing, the mean CPUE values for each species at each site from 2016 to 2020 were calculated and use for further statistical comparisons between sites. First, a Shapiro-Wilks test for normality was completed to determine whether the data were normally distributed. If the data were normally distributed a single-factor ANOVA was completed to detect if there was a significant difference in CPUE between sites for a particular species, and if so, a Tukey's multiple comparison test was completed to determine specifically which sites had significantly different CPUE. If the data were not normally distributed, then non-parametric statistical analyses were used which comprised a Kruskal-Wallis ranked sums comparison followed by a Steel-Dwass multiple comparison test if a significant difference was found.

Table 4-1. 2020 Fish Field Program.

Creek	Site ID	*Gear Type	Date Sampled/Set	Minnow Trapping (MT)			Electrofishing (EF)			
				Date Retrieved	Number of Traps	Total Effort (hrs)	Voltage (V)	Frequency (Hz)	Duty Cycle (%)	Total Effort (sec)
Jordan Creek	JOR-DS-AQ31	EF	06-Aug-20	-	-	-	365	30	15	664
		MT	05-Aug-20	06-Aug-20	5	118.33	-	-	-	-
Crabapple Creek	CRB-DS-AQ01	EF 1	06-Aug-20	-	-	-	350	40	15	682
		EF 2	06-Aug-20	-	-	-	300	35	18	208
		MT	05-Aug-20	06-Aug-20	5	135.83	-	-	-	-
River of Golden Dreams (Upper)	RGD-US-AQ11	MT	05-Aug-20	06-Aug-20	5	132.5	-	-	-	-
River of Golden Dreams (Lower)	RGD-DS-AQ12	MT	05-Aug-20	06-Aug-20	5	128.75	-	-	-	-
Twenty-one Mile Creek	21M-DS-AQ21	EF	06-Aug-20	-	-	-	400	40	15	701
		MT	05-Aug-20	06-Aug-20	5	126.67	-	-	-	-

**EF = Electrofishing, MT= Minnow Trapping*

4.2.1.2 Species Composition and Relative Abundance

The percent abundance of each fish species relative to the total count of fish was determined each year at each site for electrofishing and minnow trapping. Relative abundance was calculated as

$$Relative\ Abundance\ (\%) = \frac{Species_i\ Count\ (site_i, year_i)}{Total\ Fish\ Count\ (site_i, year_i)} \quad (3)$$

Where: $Species_i$ Count=the count for one of the three species encountered, $Site_i$=the sampling location (e.g. Jordan Creek), and $year_i$=the year of the fish counts (e.g. 2016)

4.2.1.3 Length Distribution

Length frequency distributions were plotted for each species by site for each year and for all years combined. The length frequency distributions were compared using a two-level Kolmogorov-Smirnov Test to test whether the distribution was the same across the two groups being compared. A minimum of five individual length measurements was considered the minimum required for the KS test.

4.2.1.4 Fish Condition

Length-weight data were plotted to visually assess the entire data set and to identify outliers. Once outliers were visually identified, potential explanations for the outlier values were investigated and decisions were made to either repair the outlier, include the outlier in data analysis, or remove the outlier from further analysis.

Visual assessment indicated no consistent differences in fish condition between streams or years; the data were therefore combined and a normal range was calculated from the entire data set. For the overall regression equation used in the normal range calculations, weight values with the same length values were averaged to avoid adding additional weight to a particular length increment. For the normal range, a length-weight regression was calculated using the length increments and the associated average weight data from 2016-2020 using equation 5. The regression equation was then used to calculate the $\log_{10}$ of expected weight as:

$$log_{10}(W_E) = a + b \times log_{10}(L)$$

where W_E = expected weight (g), L = measured length (mm), a = the intercept of the regression and b = the slope of the regression. Residual $\log_{10}$(weight) values were then calculated as the difference between expected and measured weight as:

$$W_R = W - W_E$$

where W_R = residual weight, W = measured weight, and W_E = expected weight. The median, 25th percentile, 75th percentile, and the interquartile range (IQR) for both negative and positive residuals was then calculated. The upper and lower limits of the normal range of the residuals were then calculated as:

$$NR_{UL} = 75\%ile + 1.5 \times IQR$$

$$NR_{LL} = 25\%ile - 1.5 \times IQR$$

where NR_{UL} = the upper limit of the normal range of the residuals, NR_{LL} = the lower limit of the normal range of the residuals, IQR = the interquartile range, 25%ile = 25th percentile value for the negative residuals, and 75%ile = 75th percentile value for the positive residuals.

The upper limit of normal range for the length/weight linear regression was calculated using equation 9 and the lower limit of normal range for the length/weight linear regression was calculated using equation 10 as:

$$log_{10}(W_{UL}) = (a - NR_{UL}) + b \times log_{10}(L\quad)$$

$$log_{10}(W_{LL}) = (a + NR_{LL}) + b \times log_{10}(L\quad)$$

where W_{UL} = normal range upper limit for weight (g), W_{LL} = normal range lower limit weight (g), L = length (mm), a = the intercept of the regression and b = the slope of the regression. The lower limit and upper limit of normal range were used to assess the length/weight fit relative to the normal range, both among years and among sites.

The relative condition (K_n) was used as the metric for condition and was calculated by comparing the measured weight to the expected weight from the measured length using equation 5. Relative condition was calculated as:

$$K_n = \frac{W}{W_E}$$

where W = measured fish weight (g) and W_E =expected fish weight (g) calculated using Equation 5. Relative condition was statistically compared between sites and between years within sites. First, the distributions were tested for normality using an Anderson-Darling (AD) test and if normally distributed, a single factor ANOVA followed by a Tukey's multiple comparison test were computed to compare relative condition. If the data were not normally distributed, a Kruskal-Wallis (KW) test by ranks was used with a Steel-Dwass (SD) test for multiple comparisons. Significance was assumed when $p<0.05$. If a sample size of a particular year was less than N=2, these tests did not include that year.

4.2.1.5 Temporal Trends Analysis

Temporal trends analysis examines change over time and is a useful tool for assessment of change at the population, community, and ecosystem level, which is essentially the purpose of this monitoring program.

Trends analysis, however, requires a minimum number of time-steps: it is considered that somewhere between five and ten time-steps are a minimum requirement. With completion of the 2020 field campaign, this basic data requirement was finally met, with fish data available for the period 2016 – 2020 inclusive. The analyses presented below therefore used the minimum number of five yearly time intervals over the period of record to determine the direction and statistical significance of temporal trends in the fish community.

The non-parametric Mann-Kendall (MK) temporal trends test was used to assess the fish data. Tests were performed using JMP (v.15) to calculated Kendall's tau and the associated p-value (SAS, 2020). A significance level of $\alpha = 0.05$ was used to determine whether a positive or negative trend existed in the data. The MK test assumes that temporal trends consistently increase or decrease over time; that is, the test assumes trends are monotonic through the period of record (2016-2020).

Trends analysis of fish community data was undertaken for Crabapple Creek, Jordan Creek and Twenty-one Mile Creek. However, MK trends analyses could not be performed for catch data from the River of Golden Dreams and catches from minnow trapping as they did not yet have the minimum five time-steps required for such an analysis.

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. Care was taken to clean equipment between samples to prevent cross contamination. All scales were regularly tared to maintain accuracy while in use. However, during the visual assessment of the length-weight data, a substantial number of outliers were discovered for Jordan Creek and for the 2nd electrofishing effort at Crabapple Creek. It was determined that there was a calibration issue with the scale during those sampling periods. To address this QA/QC issue, all fish length and weight data from those sampling periods were excluded from analyses.

All data were 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 field data were transferred to electronic spreadsheets in the office. The spreadsheets were compared with the field notes to identify and correct transcription errors.

Field identification of juvenile trout can be confounded where Rainbow Trout occur in the same geographic area as 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 Trout and Rainbow Trout populations) can be quite high without genetic analyses to corroborate genotypes. Similar to 2019 (Palmer and Snowline 2020), 2020 field crews did not identify any suspected hybrid offspring of Coastal Cutthroat Trout 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 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 47 mm) captured in Crabapple Creek (CRB-DS-AQ01) during 2020 minnow trapping efforts. Date: August 6, 2020.

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

4.3 Results

4.3.1 Total Fish Abundance and Catch-Per-Unit-Effort

Total fish catch ranged from 31 in 2017 to 342 in 2020 (Table 4-2). For individual sites, fish catch ranged from 6 fish at RGD-AQ11 in 2019, to 192 fish at RGD-DS-AQ12 (Table 4-2). These data highlight the continued presence of fish through the period of record at all sites, but also the variability inherent in fish catch data, which makes it difficult to discern spatial or temporal trends until they are substantial.

Table 4-2. Total Fish Catch.

Site	2016	2017	2018	2019	2020
	Count	Count	Count	Count	Count
Twenty-one Mile Creek (21M-DS-AQ21)	79	6	24	50	34
Crabapple Creek (CRB-DS-AQ01)	54	15	46	39	64
Jordan Creek (JOR-DS-AQ31)	34	10	19	21	18
River of Golden Dreams (RGD-US-AQ11)	-	-	18	6	34
River of Golden Dreams (RGD-DS-AQ12)	-	-	45	63	192
Total	**167**	**31**	**152**	**179**	**342**

4.3.1.1 Electrofishing CPUE

Electrofishing over the past five years resulted in the capture of trout, sculpin, and Three-spined Stickleback at least once at all sites (Figure 4-1). These results indicate the consistent presence of these three species at all sites through the period of record.

The CPUE through the period of record ranged from 0 fish/100s to 4.6 fish/100s for sculpin, from 0 fish/100s to 2.2 fish/100s for trout, and from 0 fish/100s to 0.8 fish/100s for Three-spined Stickleback (Figure 4-1).

These CPUE data were variable over the period of record for species, sites, and years, but with no consistent or significant between-site differences for sculpin (p=0.41), trout (p=0.78) or Three-spined Stickleback (p=0.18). These results indicate that the fish community among the three sites has been generally comparable through the period of record.

The MK trends analysis indicated that there were no significant temporal trends in CPUE, except for sculpin in Crabapple Creek (Figure 4-1). However, visual assessment of the data also suggests a possible increase in sculpin and a decrease of Three-spined Stickleback in Twenty-one Mile Creek (Figure 4-1). These results again suggest that the fish community in the study area has been variable but generally comparable through the period of record.

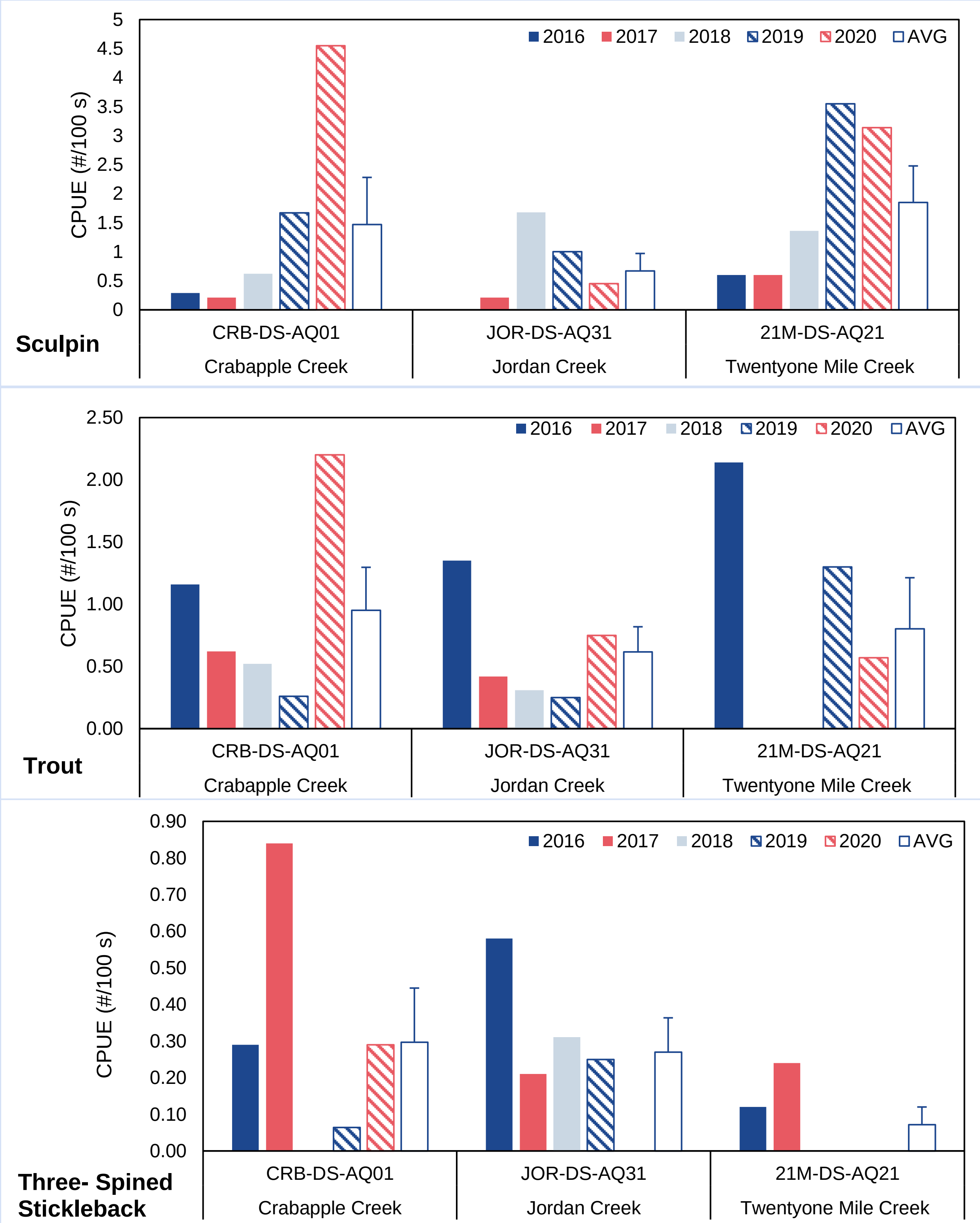


Figure 4-1. Electrofishing CPUE from 2016 to 2020.

4.3.1.2 Minnow Trapping CPUE

The CPUE ranged from 0 fish/day to 0.5 fish/day for sculpin, from 0 fish/day to 2.1 fish/day for trout, and from 0 fish/day to 6.7 fish/day for Three-spined Stickleback (Figure 4-4). These CPUE data were variable over the period of record for species, sites, and years, but with no consistent or significant between-site differences for sculpin ($p=0.34$), trout ($p=0.98$) or Three-spined Stickleback ($p=0.71$). These results are consistent with those developed through electrofishing, and indicate that the fish community among the three sites has been generally comparable through the period of record.

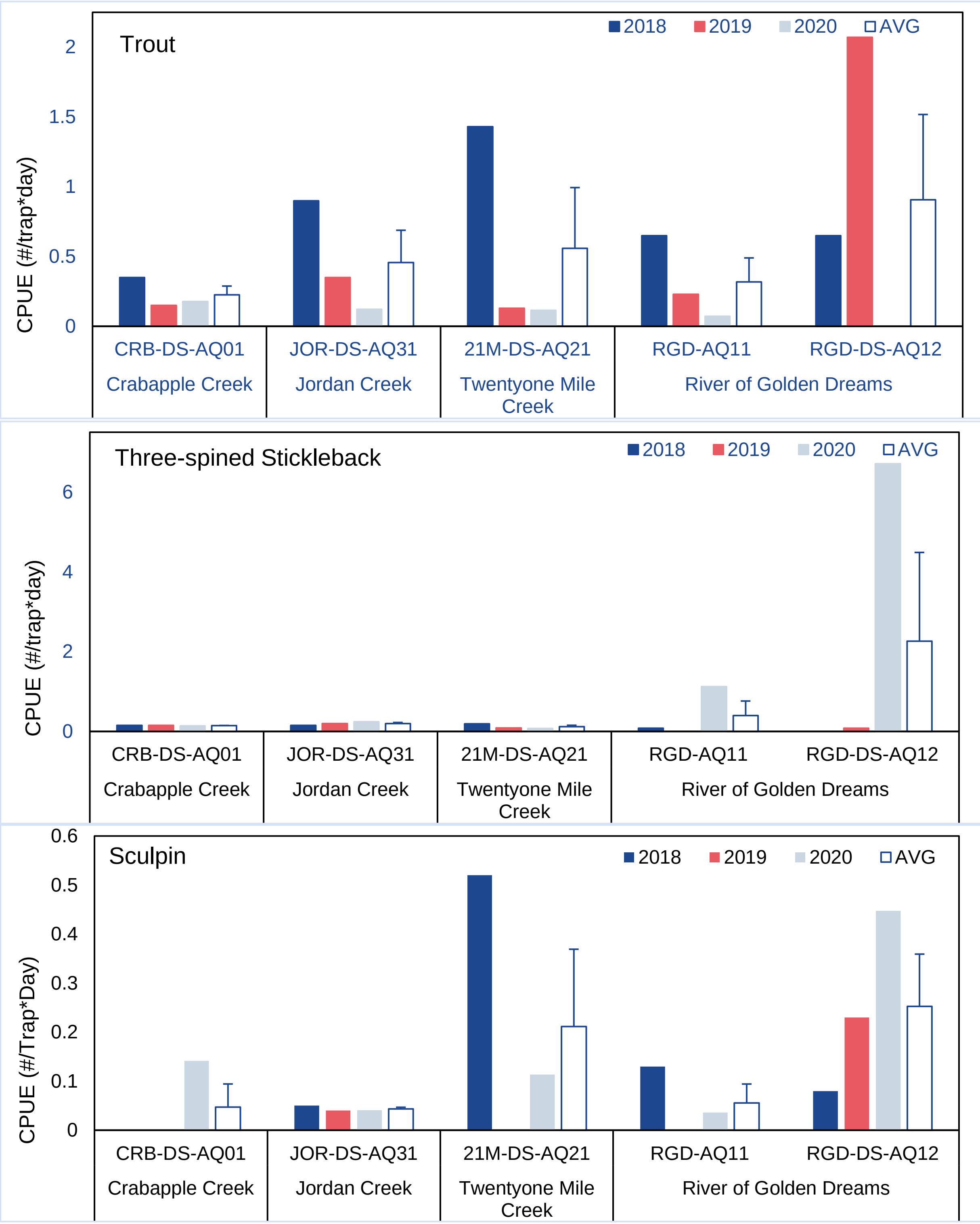


Figure 4-2. Minnow Trapping CPUE from 2018 to 2020.

4.3.2 Species Composition and Relative Abundance

4.3.2.1 Electrofishing

For the three sites that were monitored through the period of record, relative abundance as estimated through electrofishing was variable, with no consistent between-site or between-year differences visually apparent in the data (Figure 4-3). Overall, however, sculpin were the most abundant, with trout the second most abundant species, and with Three-spined Stickleback having the lowest relative abundance (Figure 4-3). The most abundant fish species captured during 2020 electrofishing efforts were sculpin at site 21M-DS-AQ21 in Twenty-one-Mile Creek (85%) and at site CRB-DS-AQ01 in Crabapple Creek (63%), and trout at site JOR-DS-AQ31 in Jordan Creek (62%).

There were no significant temporal trends through the five-year period of record for any site or fish species (Appendix C). These results indicate that over the past five years there has been no measurable and consistent trend in species composition or relative abundance in the fish communities in Crabapple Creek, Jordan Creek, or Twenty-one Mile Creek (Figure 4-3).

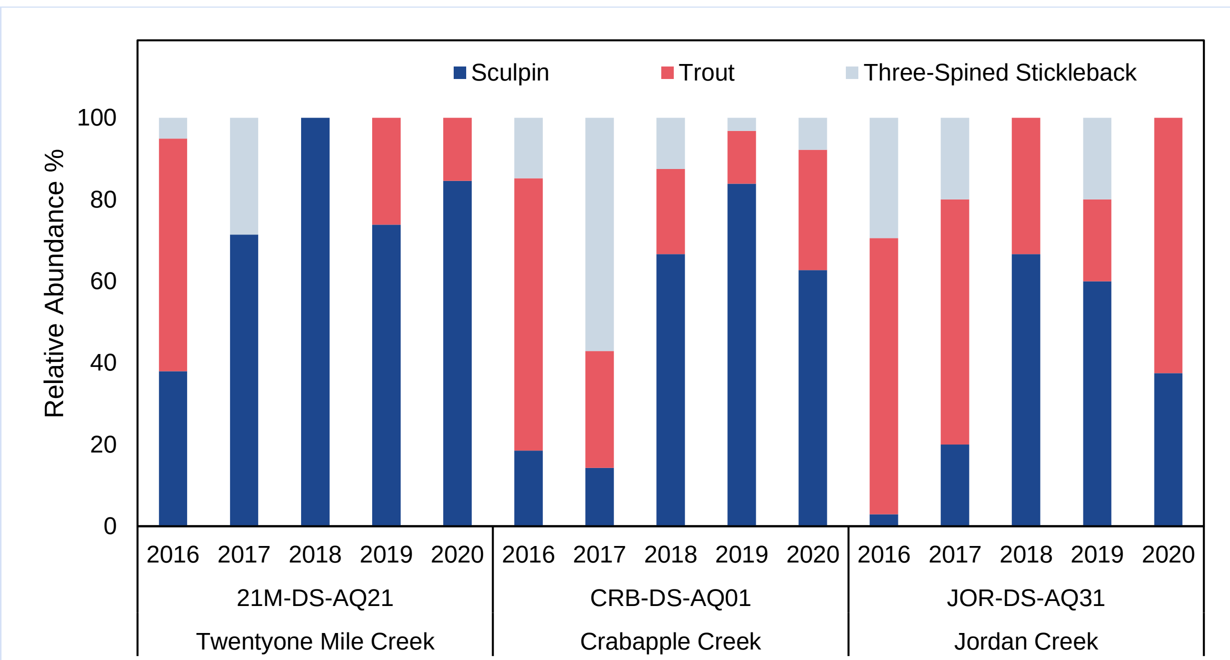


Figure 4-3. Relative Abundance of Sculpin, Trout, and Three-spined Stickleback based on Electrofishing.

Source Data: Appendix C, Table D.3

4.3.2.2 Minnow Trapping

The most abundant fish species captured during 2020 electrofishing efforts was Three-spined Stickleback at sites RDG-DS-AQ12 (94%) and RGD-US-AQ11 (91%) in the River of Golden Dreams (Figure 4-4).

For the five sites that were monitored through the period of record, relative abundance as estimated through minnow trapping was variable, with no consistent between-site or between-year differences visually apparent in the data (Figure 4-4). Overall, however, Three-spined Stickleback were the most abundant (25% to 94% relative abundance) with trout the second most abundant species (0% to 50% relative abundance, and with sculpin having the lowest relative abundance (6% to 38%) (Figure 4-4).

The relative abundance calculated using minnow trapping was different that the results calculated from electrofishing data, which indicates the specificity of sampling technique and the inherent difficulty in accurately describing community composition for fish.

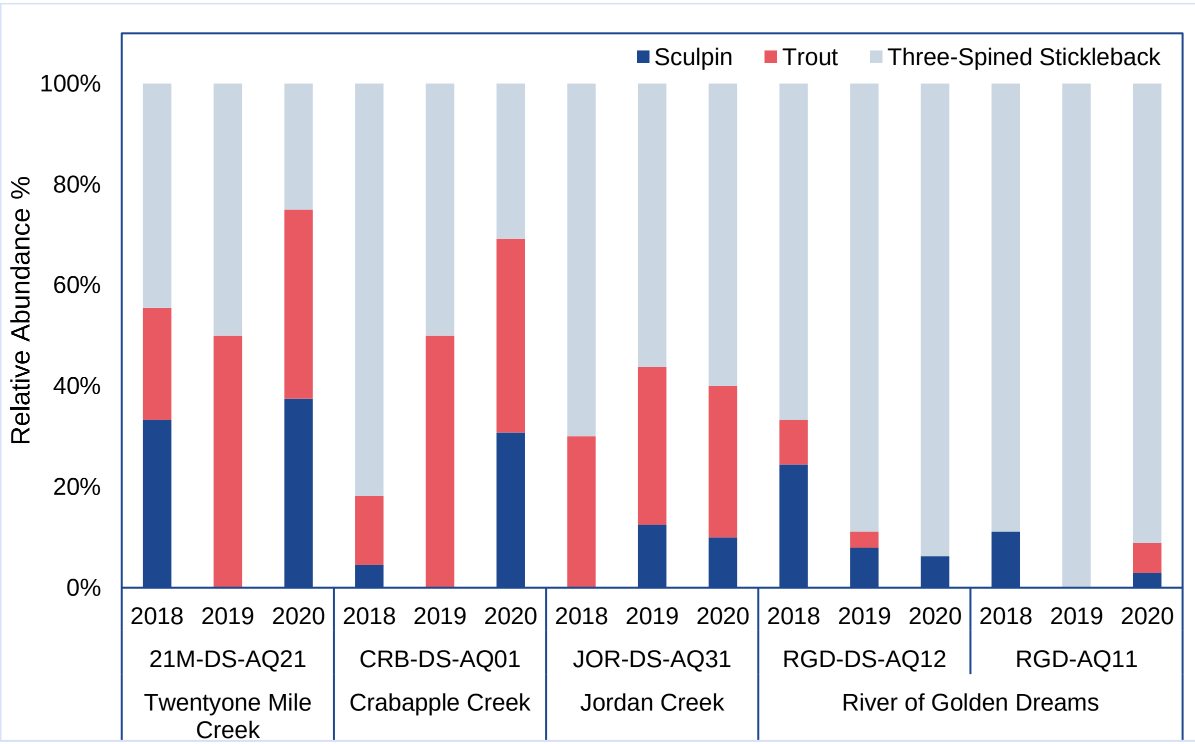


Figure 4-4. Relative Abundance of Sculpin, Trout, and Three-spined Stickleback based on Minnow Trapping.

Source Data: Appendix C, Table D.3

4.3.3 Length Distributions

4.3.3.1 Sculpin

At Crabapple Creek, a significant difference in length distribution shape was found between 2019 and 2020 for sculpin (KS Test D=0.57, p=0.022) (Figure 4-5**)**. In 2019, the length at the centre of the distribution was 61.13 mm ±2.5 mm (N=24) and in 2020 it was 48.8 mm ±2.0 mm (N=10). This is a difference of 12.33 mm and indicates that the age distribution over the one year at this site consisted of younger fish with far fewer larger fish (>70 mm) present in 2020 when compared to 2019. Given that a significant difference was only observed between two years and not all five years, and the smaller sample size for 2020 (N=10), it is uncertain whether there is an actual change in length distribution for Sculpin at Crabapple Creek. Further sampling years will be required to further assess this difference.

The cumulative length distributions for sculpin at each site were compared and the length distribution at Jordan Creek (2018-2020) was significantly different than Twenty-one Mile Creek (2016-2020; K-S Test D=0.5, p=0.01) and Crabapple Creek (2018-2020; K-S Test D=0.46, p=0.021). The length at the centre of the distribution for Jordan Creek was 77.53 mm ±4.1 mm (N=15), Twenty-one Mile Creek 59.47 mm ±2.3 mm (N=38); and 59.35 mm ±2.3 mm (N=37) for Crabapple Creek. The differences in length distributions indicate either that Jordan Creek has on average, larger and older individuals than Twenty-one Mile and Crabapple Creeks; or that Jordan Creek is predominantly prickly sculpin (*Cottus asper*), the larger of the two cottid species expected to be in this region (McPhail and Carveth, 1993; Armour, 2010). However, the cumulative sample size for Jordan Creek over 3 years was only N=15, a much lower sample size than Twenty-one Mile and Crabapple Creeks, so additional sampling efforts to establish a larger length frequency distribution sample size, as well as species identification, would be required to confirm the length distribution difference and cause.

There were very few significant changes in length distributions observed over time within one site or between sites for sculpin. This indicates over the sampling period that conditions within the streams sampled have not changed in such a way that would adversely impact sculpin species present.

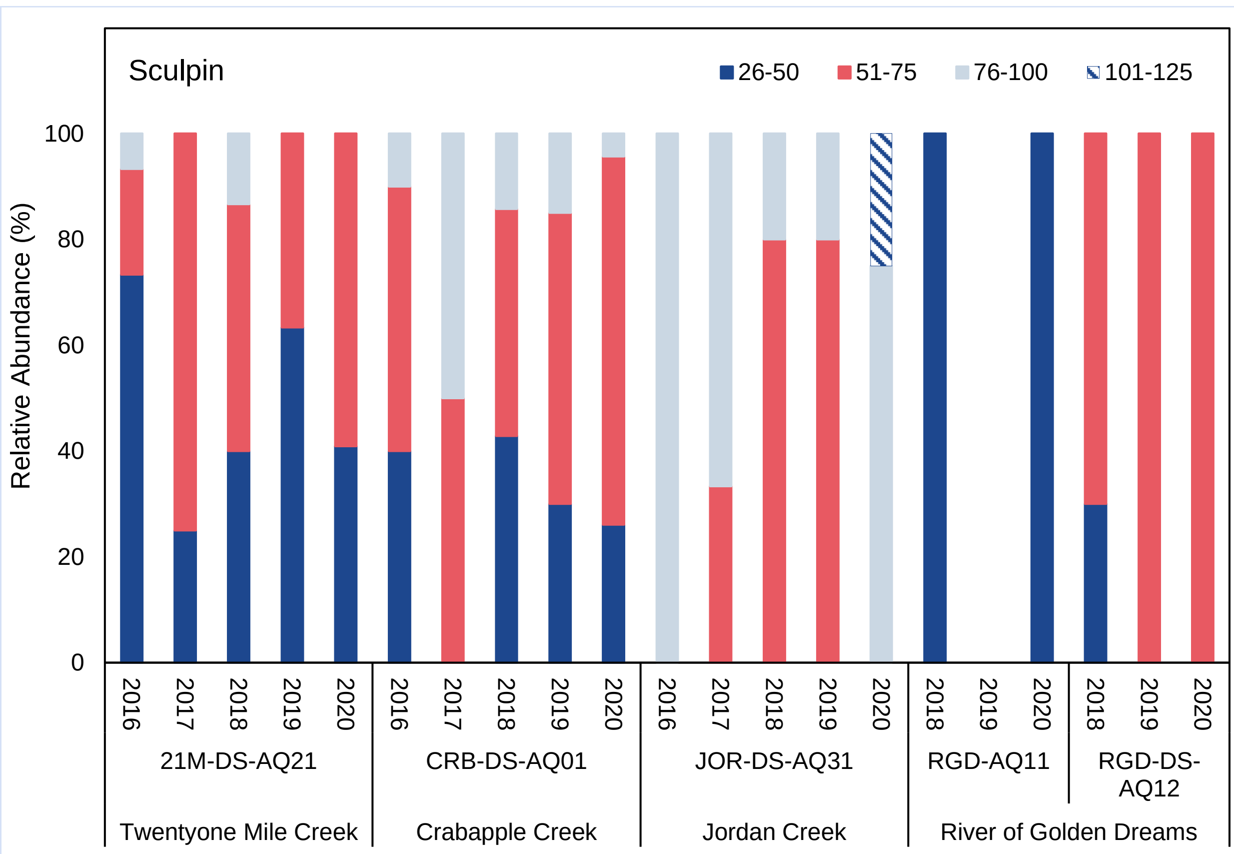


Figure 4-5. Length Frequency Distribution for Sculpin

4.3.3.2 Trout

The length frequency distributions for each site for trout species sampled can be seen in Figure 4-6 and the results of the KS tests in Appendix C**.** Each frequency count for each length range varied up or down, without evidence of a specific trend, between years. There were only three individuals for the River of Golden Dreams upstream site (RGD-AQ11), so this site was not included in the distribution or analyses for trout.

No evidence of an effect on length distribution for trout species was observed over time at each site, and cumulatively between sites; with the exception of a significant difference between 2016 and 2020 for Twenty-one Mile Creek (K-S Test D=0.67, p=0.019). The length distribution in 2016 was centred at 45.52 mm ±4.87 mm (N=21) and for 2020 70.86 mm ±8.76 mm (N=7). Given the sample size for 2020 (N=7) and no significant differences between other years, we cannot confidently determine if there was a change in length distribution for trout species at Twenty-one Mile Creek. Further sampling should be conducted within this system to investigate this as an increase in length distribution and a decrease in the abundance of smaller, younger fish in 2020 when compared to 2016.

There were no significant differences in cumulative length distribution over all sampling years found between sites with the exception of the length distributions of Twenty-one Mile Creek and the River of Golden Dreams downstream site (K-S Test D=0.65, p=0.028). However, similar to some of the other significant changes in length distribution detected, the sample size for one of the groups (RGD-DS-AQ-12) was very small (N=6), and therefore lacked the statistical power to confidently reach a conclusion on a change in length distribution.

There was no evidence of change in length frequency distribution over time for any of the sites and cumulatively between sites for trout species, indicating no change in conditions that adversely affected trout.

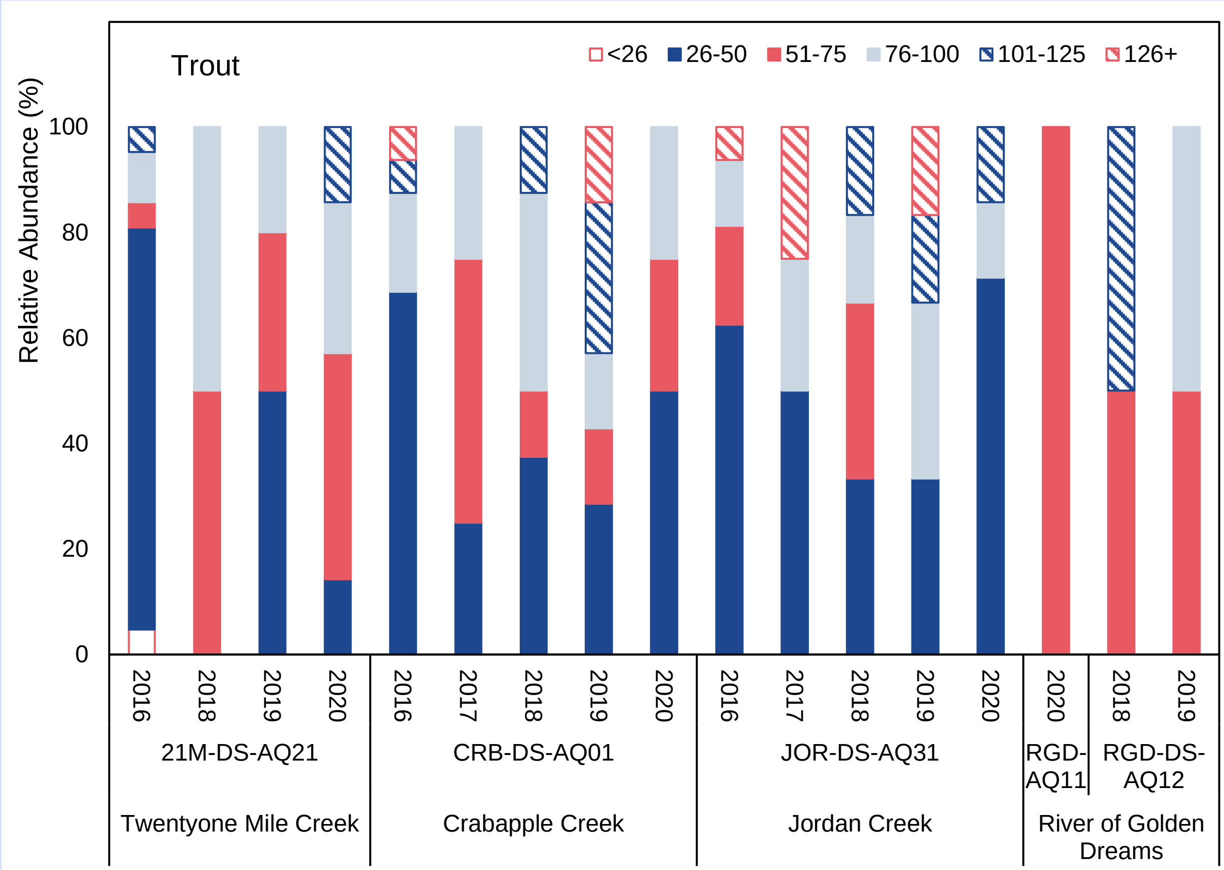


Figure 4-6. Length Frequency Distribution for Trout.

4.3.3.3 Three-spined Stickleback

The length frequency distributions for each site for Three-spined Stickleback can be seen in Figure 4-7 and the results of the KS test in Appendix C**.** No evidence of an effect on length distribution for Three-spined Stickleback was observed over time at any? site, or? cumulatively between sites; with the exception of a significant difference between 2016 and 2019 for Jordan Creek (K-S Test D=0.88, p=0.0044). In 2016, the centre of the distribution was 42.88 mm ±2.4 mm (N=8), and for 2019 was 52.50 mm ±1.58 mm (N=8). No significant difference was found between 2016 or 2019 compared to other years for Three-spined Stickleback in Jordan Creek so there is no evidence of a changing trend of length distribution from 2016 to 2020. The sample sizes for both years were both small (N=8) and further sampling effort would be required to confidently detect a change in length distribution between years.

It does not appear that at any site over the sampling period conditions changed in such a way that affected the length distribution of Three-spined stickleback within each site.

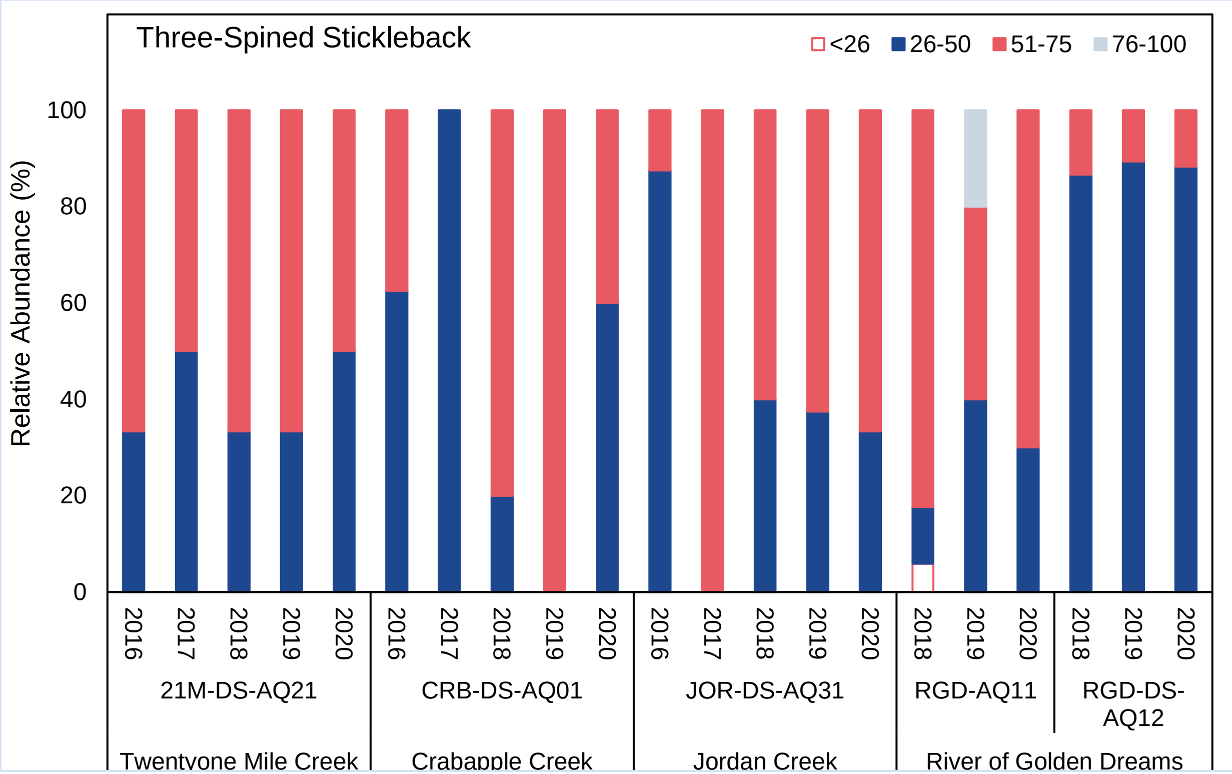


Figure 4-7. Length Frequency Distribution for Three-spined Stickleback

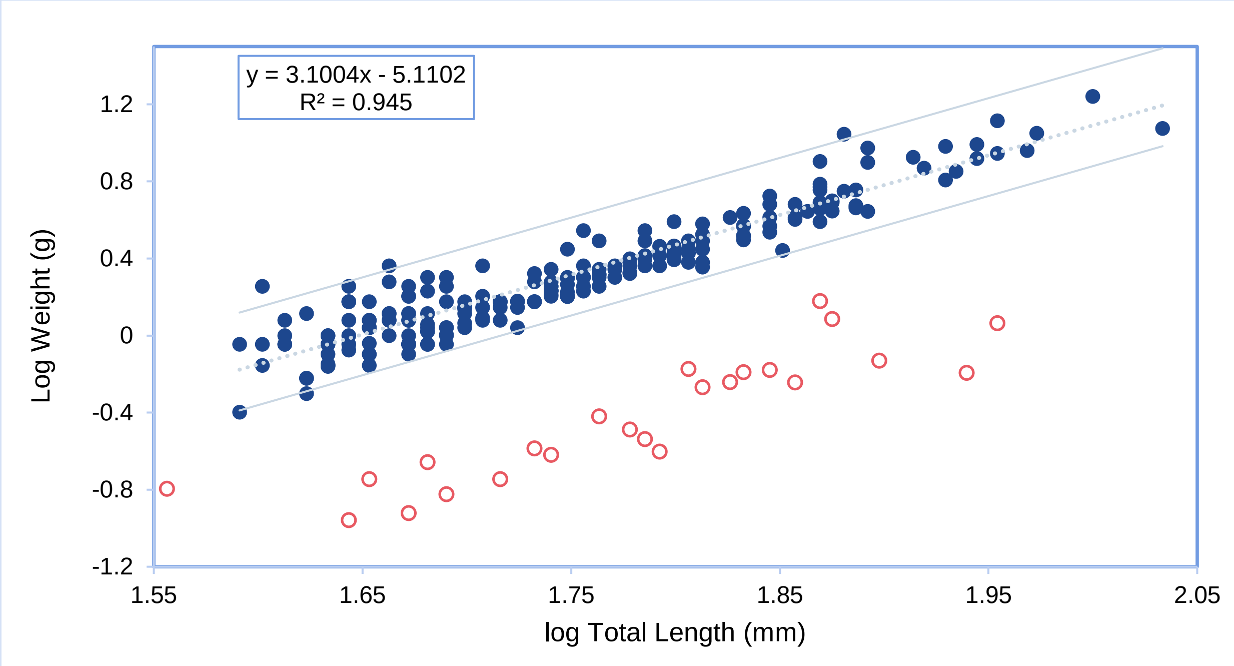
4.3.4 Fish Condition

4.3.4.1 Sculpin

Most sculpin length:weight data from all sites for all years were within the calculated normal range ( ). The mean relative condition values calculated from each sampling year for Twenty-one Mile Creek (Kn=1.03, SE±0.02) was significantly greater than the River of Golden Dreams downstream site (Kn=0.86, SE±0.04, p=0.001) and Crabapple Creek (Kn=0.95, SE±0.04, p=0.04). These data were not significantly different than 1.0 for any of the other sites (Figure 4-9). The mean relative condition values by year for Twenty-one Mile Creek demonstrated statistically significant differences with 2016, 2017 and 2019 being greater than 2020; and 2017 greater than 2018 (Figure 4-9). The mean relative condition by year for Crabapple Creek showed 2016 was significantly greater than 2018, 2019 and 2020.

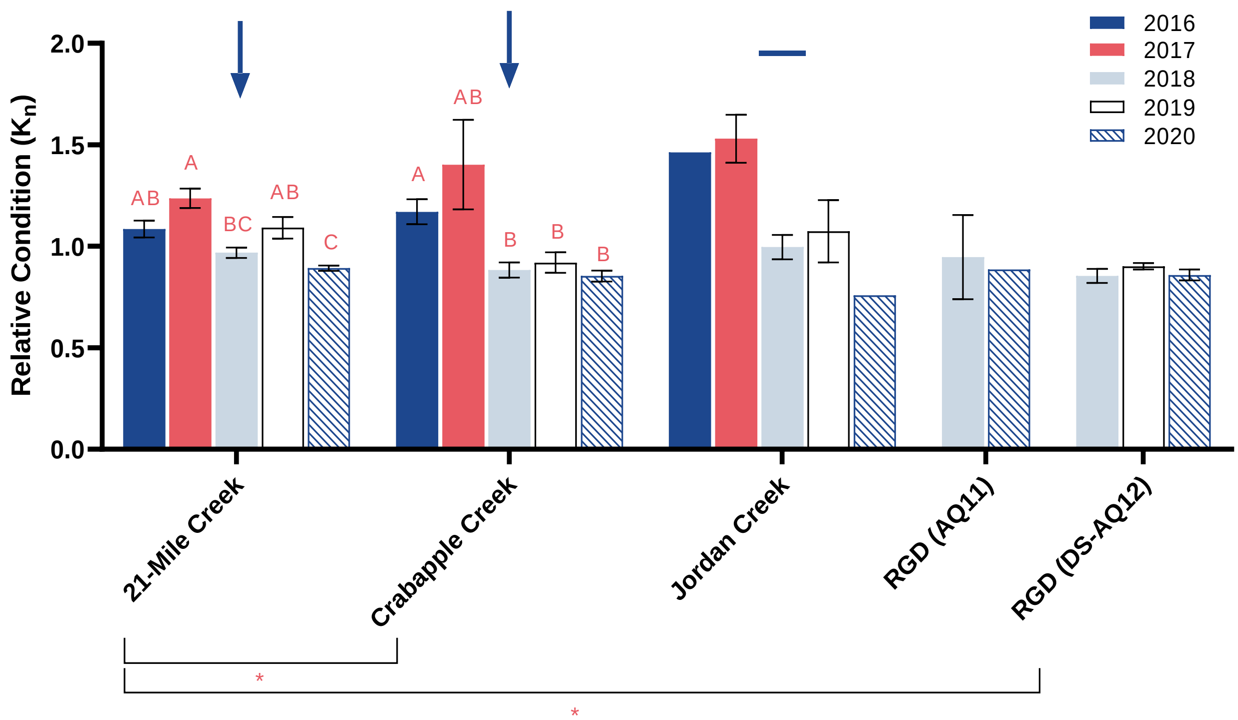
These data indicate that the sculpin within the study area were of normal length:weight throughout the period of record (Figure 4-8), with relative condition being lower at Crabapple Creek and the River of Golden Dreams downstream when compared to Twenty-one Mile Creek. Relative condition between years at each site was variable with some significant differences identified, however, Confidence in these results is low because of low sample size.

Through the period of record, there was a significant decreasing trend in sculpin condition at both Twenty-one Mile Creek (p=0.001) and Crabapple Creek (p=0.03) (Figure 4-9).



Notes: Period of record is from 2016 to 2020. The dotted line is the regression equation developed from the length: weight data for all sites and years. The upper and lower lines are the limits of normal range as calculated from the sculpin data. Open dots are outliers excluded from analysis due to a scale malfunction.

Figure 4-8. Sculpin Log Weight vs Log Total Length



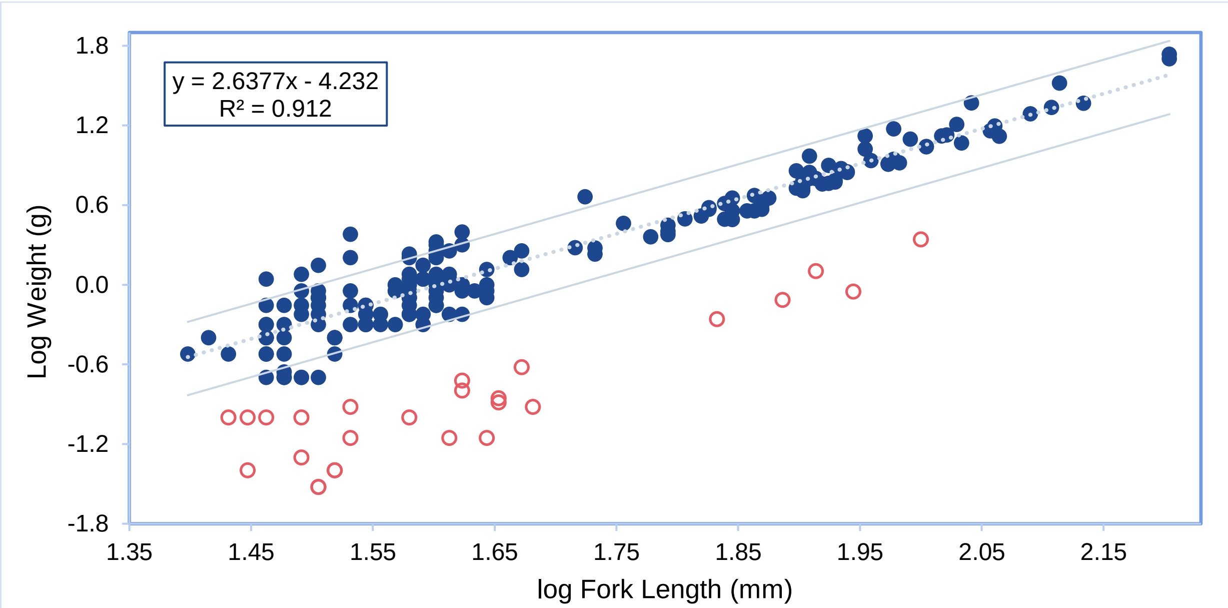
*Note: * Significantly different condition between sites; Connected letter differences (e.g. A, B, AB) significantly different mean condition between years within site;significant MK trend denoted by decreasing, increasing and no trend.*

Figure 4-9. Sciulpin Relative Condition.

4.3.4.2 Trout

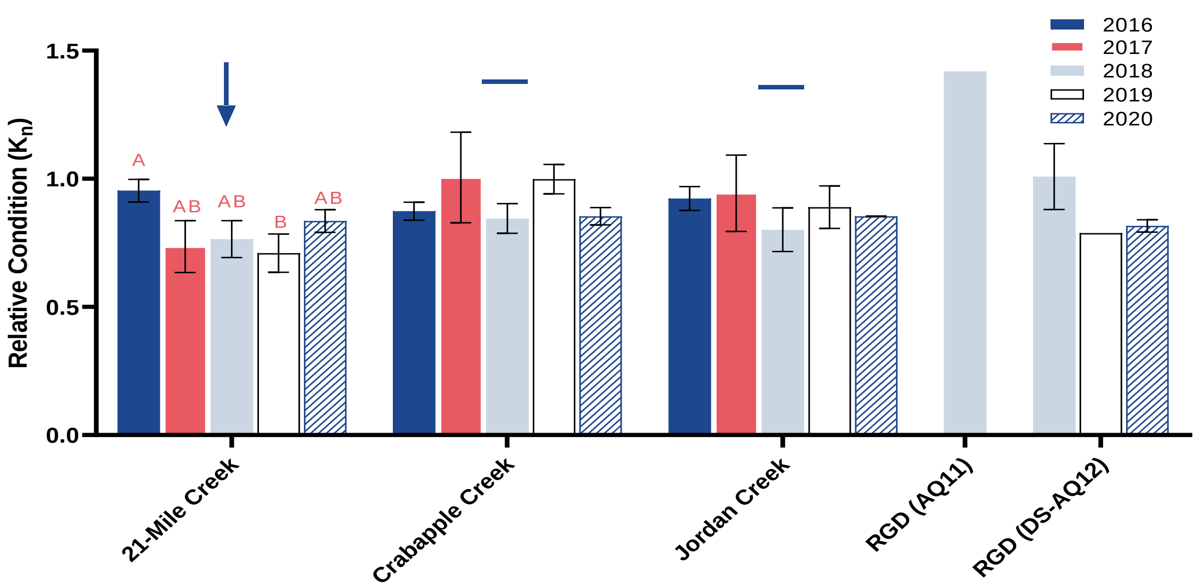
Most trout length:weight data from all sites for all years were within the calculated normal range (Figure 4-10) and except for Twenty-one Mile Creek, showed no significant difference in relative condition between sites, or years; and no trend over time (Figure 4-11). The mean relative condition values by year for Twenty-one Mile Creek demonstrated a single statistically significant difference with 2016 being greater than 2019 (Figure 4-11).

These data indicate that the trout within the study area were of normal length:weight throughout the period of record (Figure 4-10). Through the period of record, there was a significant decreasing trend in trout condition at Twenty-one Mile Creek (MK test, p=0.005; Figure 4-9). All statistical test results for relative condition can be found in Appendix C. Relative condition between years at each site was variable with some significant differences identified, however, confidence in these results is low because of low sample size and because of the aforementioned issue with the functioning of the weigh scale.



Notes: Period of record is from 2016 to 2020. The dotted line is the regression equation developed from the length:weight data for all sites and years. The upper and lower lines are the limits of normal range as calculated from the trout data. Open dots are outliers excluded from analysis.

Figure 4-10. Trout Log Weight vs Log Fork Length

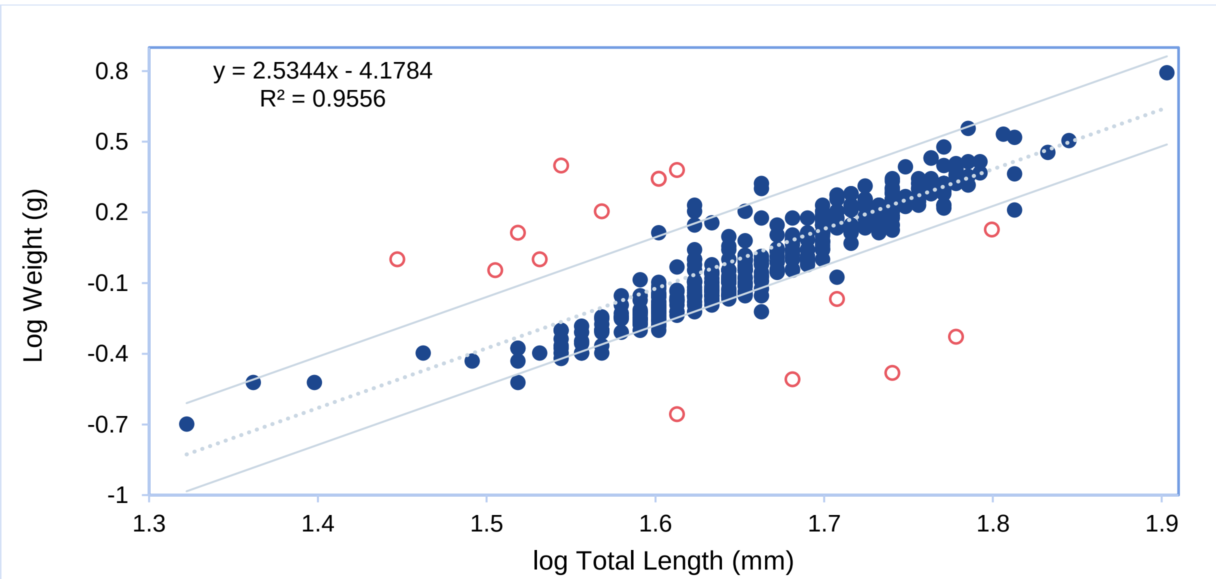


*Note: * Significantly different condition between sites; Connected letter differences (e.g. A, B, AB) significantly different mean condition between years within site; Significant MK trend denoted by decreasing (blue arrow pointing up), increasing (blue arrow pointing down), and no trend (flat blue line).*

Figure 4-11. Trout Relative Condition.

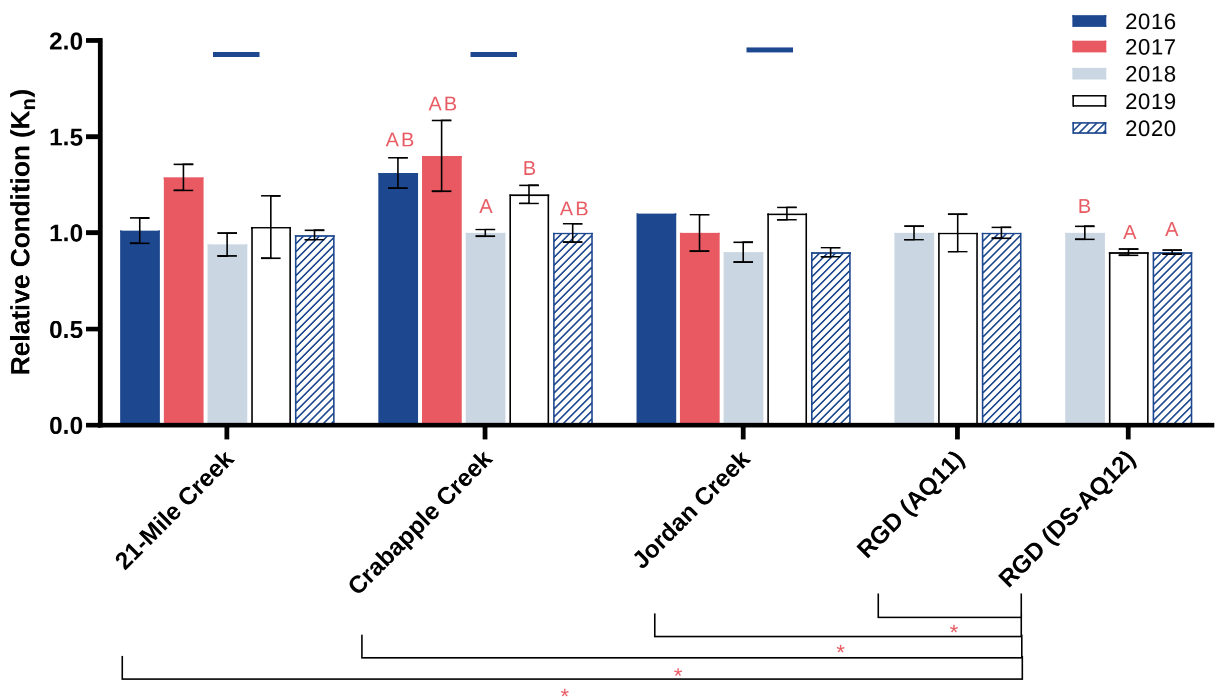
4.3.4.3 Three-spined Stickleback

Most Three-Spined Stickleback length:weight data from all sites for all years were within the calculated normal range (Figure 4-12). The mean relative condition calculated from each sampling year for the River of Golden Dreams downstream site (Kn=0.89, SE±0.01) was significantly less than all other sites (Kn=1.0-1.08, SE± 0.02-0.04; Figure 4-13). The mean relative condition values by year for Crabapple Creek demonstrated statistically significant differences with 2019 being greater than 2018, but not other significant differences between other (Figure 4-13). The mean relative condition by year for The River of Golden Dreams downstream site showed 2018 was significantly greater than, 2019 and 2020 (Figure 4-13). Through the period of record, there was no significant trend in Three-spined Stickleback condition found according to the MK test, despite some differences in condition found between years. Confidence in these results is low because of low sample size and because of the aforementioned issue with the functioning of the weigh scale. All statistical test results for relative condition can be found in Appendix C.



Notes: Period of record is from 2016 to 2020. The dotted line is the regression equation developed from the length:weight data for all sites and years. The upper and lower lines are the limits of normal range as calculated from the Three-spined Stickleback data. Open dots are outliers excluded from analysis.

Figure 4-12. Log weight vs log Total Length for Three-spined Stickleback.



*Note: * Significantly different condition between sites; Connected letter differences (e.g. A, B, AB) significantly different mean condition between years within site; Significant MK trend denoted by decreasing (blue arrow pointing up), increasing (blue arrow pointing down), and no trend (flat blue line).*

Figure 4-13. Three-spined Stickleback relative condition for each site and sampling year from 2016-2020 in the RMOW.

4.4 Assessment Conclusions

4.4.1 Twenty-one Mile Creek (21M-DS-AQ21)

Sculpin, trout, and Three-spined Stickleback were consistently present through the period of record. The catch data were variable, however, so it was not possible to develop conclusions regarding spatial differences or temporal trends for abundance, relative abundance, or length distribution. There was, however, a declining trend in relative condition for trout and sculpin. Because of low sample size, however, these results are not conclusive and further efforts should continue to monitor this trend. These results indicate that the fish community in Twenty-one-Mile Creek is comparable to other sites and has persisted relatively unchanged through the period of record.

4.4.2 Jordan Creek (JOR-DS-AQ31)

Sculpin, trout, and Three-spined Stickleback were consistently present throughout the period of record. The catch data were variable, however, so it was not possible to develop conclusions regarding consistent spatial or temporal trends for abundance, relative abundance, or length distribution. There was also no consistent spatial differences or temporal trends for fish condition. These results indicate that the fish community in Jordan Creek is comparable to other sites and has persisted relatively unchanged through the period of record.

4.4.3 Crabapple Creek (CRB-DS-AQ01)

Sculpin, trout, and Three-spined Stickleback were consistently present throughout the period of record. The catch data were variable, however, so it was not possible to develop firm conclusions regarding consistent spatial or temporal trends for abundance, relative abundance, or length distribution. There was, however, a declining trend in mean relative condition for sculpin, although the sample size was low and additional is required to assess the trend in relative condition. Overall, there were no changes in the assessed metrics that indicated reduced conditions over time or compared to other sampling locations. These results indicate that the fish community in Crabapple Creek is comparable to other sites and has persisted relatively unchanged through the period of record.

4.4.4 River of Golden Dreams Upstream Site (RGD-AQ11)

Sculpin, trout, and Three-spined Stickleback were consistently present throughout the period of record. The catch data were variable, however, so it was not possible to develop firm conclusions regarding consistent spatial or temporal trends for abundance, relative abundance, or length distribution. The River of Golden Dreams upstream site was only fished using minnow traps, due to safety concerns, and has only been sampled for three years, so quantitative trend analyses were not completed. Based on the available sampling data for this site, the River of Golden Dreams upstream site is comparable to other sites and has persisted relatively unchanged through the period of record.

4.4.5 River of Golden Dreams Downstream Site (RGD-DS-AQ12)

Sculpin, trout, and Three-spined Stickleback were consistently present throughout the period of record. The catch data were variable, however, so it was not possible to develop firm conclusions regarding consistent spatial or temporal trends for abundance, relative abundance, or length distribution, although there were no significant differences for any of these metrics assessed between years or sites for any species. The River of Golden Dreams upstream site was only fished using minnow traps, due to safety concerns, and has only been sampled for three years, so quantitative trends analyses were not completed.

The mean relative condition of Three-spined Stickleback, however, was significantly lower at this site compared with all other sites: further sampling effort is required to assess this potential effect on relative condition. Based on the available sampling data for this site, River of Golden Dreams downstream is comparable to other sites and has persisted relatively unchanged through the period of record.

5. Coastal Tailed Frogs

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 includes aquatic and terrestrial habitats. These characteristics make them susceptible to perturbations in both habitat types and suitable as indicator species of ecosystem health.

Stream-dwelling amphibians such as 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,[4] 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 (usually >10% grade), 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 and, as a result, tadpoles have been detected in most Whistler streams surveyed to date (Wind 2005-2009; Cascade 2014-2016; Palmer and Snowline 2017-2020).

Prior to 2004, the only 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 built on that creek. In late 2004, the Whistler Biodiversity Project began the first valley-wide survey Since then, tadpoles have been found in over 40 local creeks (Wind 2005-2009; Brett 2007; Cascade 2013-2015; Palmer and Snowline 2017-2020).

In 2017, Coastal Tailed Frogs were down-listed in BC from Blue (Special Concern) to Yellow ("least risk of being lost"; CDC 2021). It remains a species of Special Concern under the Species at Risk Act (Government of Canada 2021).

5.2 Methods

5.2.1 Site Selection

Most creeks that have been surveyed in the program since 2013 have been surveyed in two or more successive years (Table 5-1). Selection criteria were modified in 2016 to achieve multiple goals, including:

1. To allow comparisons between years and detect possible changes;
2. To provide baseline data in streams that could be affected by adjacent developments; and,
3. To include proportionate representation of creeks on the east and west sides of Whistler Valley.

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

The inclusion of similar number of east- and west-side creeks increases the geographic range of sampling. At least as importantly, the inclusion of sites on both sides of the valley means creeks with different hydrological regimes are represented – most east-side creeks are glacier-fed while most west-side creeks are not. Creeks with a glacial source typically have higher and more sustained flows than those relying solely on snowmelt and rainwater. They are also more sensitive to climate change since glacier melt reduces the volume and timing of water flows.

Since it began in 2013, the program has surveyed for tailed frogs in 11 creeks, five on the east side of Whistler Valley and six 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 (56) than west (44) side of the valley.

Table 5-1. Coastal Tailed Frog sampling sites, 2013 to 2015 (Cascade) and 2016 to 2020 (Palmer and Snowline)

Creek	Valley Side	2013	2014	2015	2016	2017	2018	2019	2020	Total
Agnew Creek	West					3	3			6
Alpha Creek	East	3	3	3	3					12
Archibald Creek	East		3	3	3	3	3	3	3	21
Blackcomb Creek	East							1	3	4
FJ West Creek	West						2	3	2	7
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	3	7
Van West Creek	West						2	2	3	7
Whistler Creek	East				4	3	3	3	3	16
	Total	**6**	**11**	**11**	**13**	**12**	**15**	**15**	**17**	**100**
Total East		*3*	*6*	*6*	*10*	*9*	*6*	*7*	*9*	*56*
Total West		*3*	*5*	*5*	*3*	*3*	*9*	*8*	*8*	*44*

An increased elevational range of sampling sites on each creek was added in 2016 to include:

1. the toe slope just above the valley bottom;
2. ca. 800 m; and
3. ca. 1000 m.

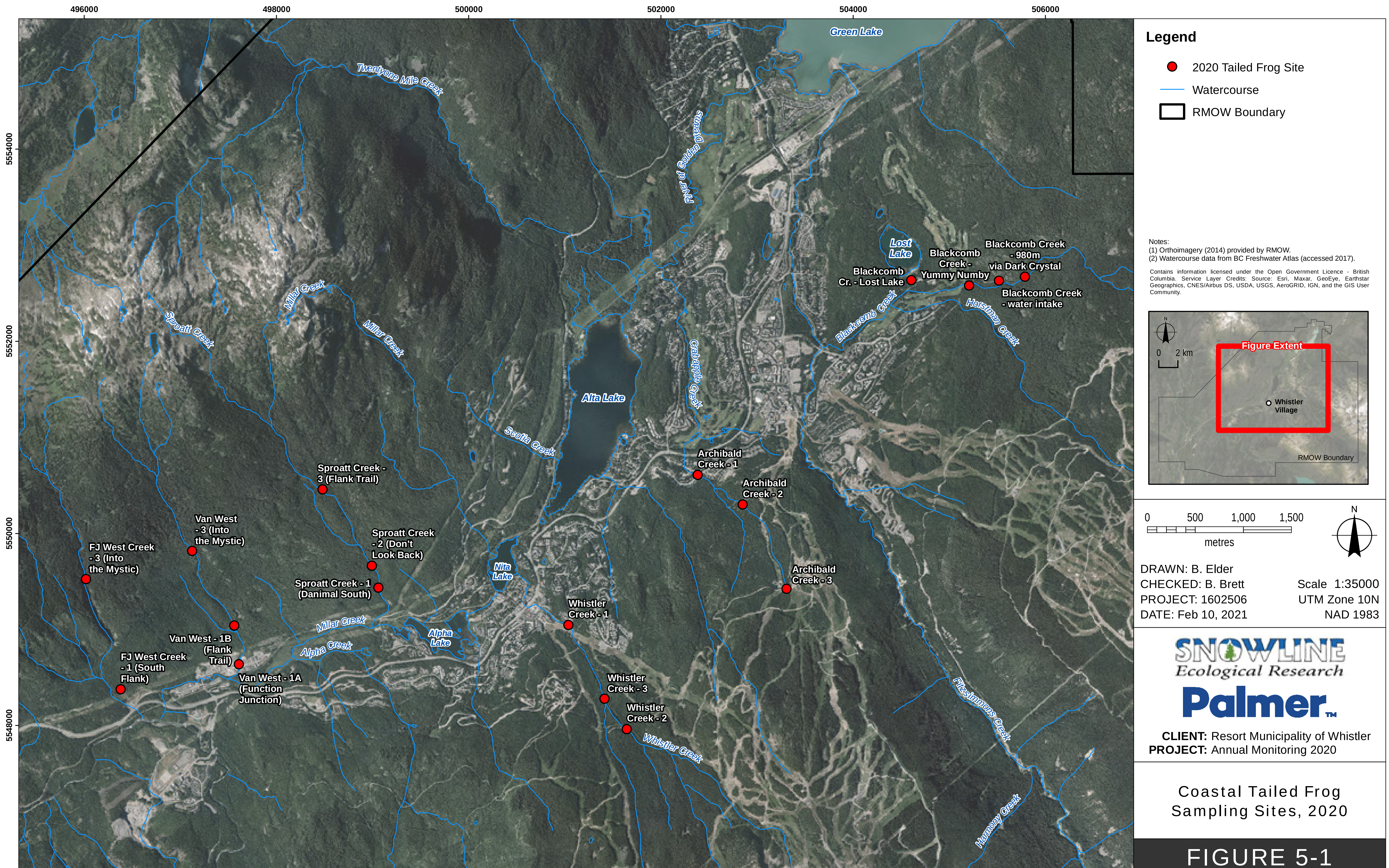
This elevational range was meant to include one site within the development footprint, one at its upper end, and a third above the development footprint (as a control site), respectively.

Four creeks were sampled in the first three years of the program (Cascade 2014 to 2016; Table 5-1). Five years of sampling from 2016 to 2019 included 10 creeks, seven of which were new to the program (Palmer and Snowline 2017 to 2020). The decision to replace some creeks was based on the site selection criteria above, in particular, the goal of expanding geographic representation.

Only one creek, Archibald, has been included in all years of the program to date (Table 5-1). Whistler Creek, added in 2016, is the next most frequently sampled creek. These two watersheds are both within the Whistler-Blackcomb ski area and contain the Whistler Bike Park. Sampling in consecutive years has been intended to increase the likelihood of detecting effects from both winter and summer activities.

No tadpoles have yet been detected in three of 11 creeks surveyed in this program: Agnew and Nineteen Mile Creeks (on the west side of the valley), and Blackcomb Creek (on the east side). Topography has limited the ability to survey at higher elevations on the first two creeks. As a result, they may support a tailed frog population that has not yet been detected. While also challenging to survey due to steep chasms, the absence of detections on Blackcomb Creek may be related more to low temperatures resulting from its reliance on meltwater from the Blackcomb Glacier (though this hypothesis is challenged by 2020 results; Section 5.3.2).

Surveys in 2020 mostly resurveyed sites from 2019, other than the addition of three sites and removal of one (Table 5-1; Figure 5-1). The additions included two sites on Blackcomb Creek and one site on Van West Creek.



Coastal Tailed Frog Sampling Sites, 2020

FIGURE 5-1

5.2.2 Sampling Design

All previous surveys for tailed frog tadpoles in the RMOW study area by the WBP (Wind 2005-2009) and this program (Cascade 2014-2016; Palmer and Snowline 2017-2020) have used the same methods, with one exception. Surveys from 2013 to 2015 were the only ones to use area-constrained rather than time-constrained surveys.

The BC Resource Inventory Committee (BC MELP 2000) recommended the area-constrained approach for measuring relative abundance. Based on this guidance, surveys from 2013 to 2015 sampled in fixed 5 m stream lengths for a total of 30 minutes (Cascade 2014-2016). Far fewer tadpoles were detected using this method compared to previous WBP surveys (Wind 2005-2009).[5] Surveys since 2016 therefore returned to the time-constrained approach of 30 minutes total sampling time, regardless of area, which greatly increased detections (Palmer and Snowline 2017-2020) and therefore statistical power (Malt et al. 2014a, 2014b).

In spite of the change back from area- to time-constrained surveys, it has still been possible to make comparisons between these years since both methods sampled for the same amount of time (30 minutes per site). It is also noteworthy that the total area surveyed at each site since 2016 using the time-constrained approach remained remarkably similar to that surveyed using the area-constrained approach (Palmer and Snowline 2017 to 2020).

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 rocks and other unembedded cover objects 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 tadpoles 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 including location, weather, overhead cover and stand type;
- Stream characteristics including 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 (measured at the sampling site); and
- Total survey area (measured with a cloth tape to the nearest 0.1 m).

[5] 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.

Photo 5-1. Hillary Williamson dipnetting for tadpoles in Whistler Creek (2019 photo).

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

Data collected for tadpole captures also followed standard methods, including a measurement of total length for tadpoles and 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 accurately these classes acted as reliable proxies for age cohorts, especially across different streams. The relationship between length and cohorts (as defined above) was weaker than expected, for example, many longer tadpoles were placed into early cohorts based on morphology, and vice-versa, Pre-survey tests in 2017 again showed overlaps between length and developmental stages within and between streams. These observations intensified questions about whether “cohorts” 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)
DS0 – Hatchling <15 mm	T0
DS1 - No visible hind legs	T1
DS2 - Bulge only, hind legs not defined	
DS3 - Hind legs visible but covered	T2
DS4 - Hind feet protruding	
DS5 -Hind knees protruding outside body	T3

Note: No hatchlings (DS0, T0) have been observed in September surveys in Whistler.

Photo 5-3. Tadpole cohort 2 (T2). This individual's developmental stage is transitional between developmental stages DS1 and DS2 2 and 3 (hind legs covered but just starting to be defined).

Photo 5-4. This tadpole's hind knees protrude outside its body and its legs are clearly free from previously enclosing skin. It is in cohort T3 and its equivalent developmental stage DS5.

For consistency with past reports, the classes above were grouped according to Malt et al.'s (2014a, b) cohorts during data analysis. That is, Developmental Stages 1 and 2 (DS1 and DS2) were grouped into Malt's T1 cohort, and Developmental Stages 3 and 4 (DS3 and DS4) 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 et al.'s cohorts.

To prevent recaptures, all tadpoles were placed in buckets and released after measurements were complete (Photo 5-2); 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). Surveys were scheduled for early September when low streamflows would increase the detectability of tadpoles.

5.2.3 Data Analysis

The total number of tadpoles per site (reach) detected in 2020 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 five 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, surveys since 2017 have included at least two surveyors from the previous year. A trial survey was conducted beforehand to ensure consistency 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

5.3.1.1 Study Sites

Seventeen sites were surveyed from September 1 to 8, 2020 (Figure 5-1, Table 5-3; Appendix D), two more than in 2019 and the highest total to date in this program. An 18th site, at the water intake on Blackcomb Creek, was excluded due to difficulties sampling the altered streambed (Section 5.3.2.3). Surveys included three creeks with 9 sites on the east side of Whistler Valley, and three creeks with eight sites on the west side of the valley. Chasm topography precluded sampling a third, mid -elevation site on FJ Creek.

Table 5-3. Coastal Tailed Frog sampling sites, 2020.

Site	Valley Side	Date	Easting	Northing	Elev. (m)	Weather	Water Temp. (°C)	Air Temp. (°C)
Archibald Creek - 1	East	2020-09-02	502387	5550606	695	Sun	10.5	17.0
Archibald Creek - 2	East	2020-09-01	502854	5550298	835	Cloud	9.0	15.5
Archibald Creek - 3	East	2020-09-01	503310	5549422	1026	Cloud	8.0	11.5
Blackcomb Cr. - Lost Lake	East	2020-09-02	504608	5552632	690	Sun	9.5	17.2
Blackcomb Creek - Yummy Numby	East	2020-09-02	505211	5552576	762	Sun	9.0	13.0
Blackcomb Creek - 980m via Dark Crystal	East	2020-09-05	505792	5552668	942	Sun	10.0	17.0
FJ West Creek - 1 (South Flank)	West	2020-09-08	496383	5548374	648	Sun	10.0	15.0
FJ West Creek - 3 (Into the Mystic)	West	2020-09-03	496022	5549522	1119	Sun	11.0	17.0
Sproatt Creek - 1 (Danimal South)	West	2020-09-03	499063	5549434	692	Sun	11.0	17.0
Sproatt Creek - 2 (Don't Look Back)	West	2020-09-03	498996	5549662	790	Sun	11.0	17.0
Sproatt Creek - 3 (Flank Trail)	West	2020-09-03	498483	5550455	996	Sun	10.2	14.0
Van West - 1A (Function Junction)	West	2020-09-04	497611	5548635	604	Sun	13.5	23.0
Van West - 1B (Flank Trail)	West	2020-09-08	497563	5549038	706	Sun	10.5	15.0
Van West - 3 (Into the Mystic)	West	2020-09-03	497125	5549816	1036	Sun	10.0	17.0
Whistler Creek - 1	East	2020-09-02	501041	5549045	692	Cloud	11.0	17.0
Whistler Creek - 2	East	2020-09-01	501649	5547961	972	Cloud	8.3	13.0
Whistler Creek - 3	East	2020-09-01	501417	5548276	879	Cloud	8.2	13.2
					East-side Average		9.3	14.9
					West-side Average		11.0	17.1
					Average (All Sites)		**10.0**	**15.8**

Water and air temperatures were lower at east-side sites than at west-side sites (Table 5-3) which was expected since they typically had less direct sun and a greater influence of glacial water. Highest temperatures were recorded at Van West-1 which was at the lowest elevation and had the least canopy cover of any site (Appendix D).

5.3.1.2 Tadpole Detections

A total of 51 tadpoles were detected in 2020 (Table 5-4, Appendix E). Only one later-stage animal was detected -- a small frog that escaped capture at the lower extent of Sproatt Creek-3 and that, based on size, was likely an adult male.

The average of 3.0 tadpoles per site is the lowest since the survey was changed to a time-constrained approach in 2016 (Figure 5-2). The strongest impact lowering that average has been three years of ever-lower detections in Archibald Creek (Table 5-4; Section 5.3.2.1). The non-detection of any tadpoles in Blackcomb Creek, in spite of sampling two additional sites, also lowered the average.

The average survey area has decreased slightly each year since 2016 (Figure 5-2), which reflects more emphasis on an intensive rather than extensive search effort since, for example, tadpoles in the substrate can otherwise be missed. This decrease in average survey area somewhat offsets the general trend towards fewer detections – although the number of tadpoles detected per site was the same in 2016 and 2020, more tadpoles were detected per unit area in 2020.

Previous results showed a weak, positive relationship between warmer water and higher detection rates of tadpoles (Palmer and Snowline 2019). At lower temperatures, tadpoles are typically more difficult to find since they are less likely to be active on surveyable rocks.[9] At 10.1 deg. C., however, the average water temperature in 2020 was not unusual when compared to previous years (Figure 5-2) so was presumably not a factor in lower detections.

[9] *That is, they are more likely to be in the substrate where detection is difficult.*

Table 5-4. Tadpole surveys by creek, 2015-2020.

Year	Valley Side	Site	No. of Sites	Total Survey Area (m²)	Avg. Survey Area (m²)	No. Tadpoles Detected	Tadpoles /100m²	Avg. 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	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
	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**	**23.2**	**39**	**12.9**	**8.1**
2017	West	Agnew Creek	3	56.2	18.7	0	0	8.8
	East	Archibald Creek	3	88.2	29.4	33	37.4	12
	East	Horstman Creek	3	56.2	18.7	6	10.7	9.3
	East	Whistler Creek	3	36.2	12.1	48	132.6	13
		All 2017 Sites	**12**	**236.8**	**19.7**	**87**	**36.7**	**10.8**
2018	West	Agnew Creek	3	82.3	18.7	0	0	8.1
	East	Archibald Creek	3	55.5	18.7	30	54.1	8.1
	West	FJ West Creek	2	18	18.7	1	5.6	9
	West	Scotia Creek	1	9.5	18.7	2	21.1	9
	West	Sproatt Creek	1	19.5	18.7	11	56.4	9.1
	West	Van West Creek	2	30	18.7	17	56.7	10
	East	Whistler Creek	3	89	18.7	21	23.6	8.1
		All 2018 Sites	**15**	**303.8**	**18.7**	**82**	**27**	**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	8
	West	FJ Unnamed	1	23.5	23.5	1	4.3	11
	West	FJ West Creek	2	32	16	1	3.1	11.3
	West	Sproatt Creek	3	48	16	11	22.9	12.4
	West	Van West Creek	2	25	12.5	6	24	12.1
	East	Whistler Creek	3	51.9	17.3	27	52	10.4
		All 2019 Sites	**15**	**264.4**	**17.6**	**60**	**22.7**	**10.8**
2020	East	Archibald Creek	3	57.0	19.0	5	8.8	9.2
	East	Blackcomb Creek	3	38.0	12.7	0	0.0	9.5
	West	FJ West Creek	2	36.0	18.0	4	11.1	10.5
	West	Sproatt Creek	3	51.0	17.0	14	27.5	10.7
	West	Van West Creek	3	45.0	15.0	8	17.8	11.3
	East	Whistler Creek	3	50.0	16.7	20	40.0	9.2
		All 2020 Sites	**17**	**277.0**	**16.3**	**51**	**18.4**	**10.1**

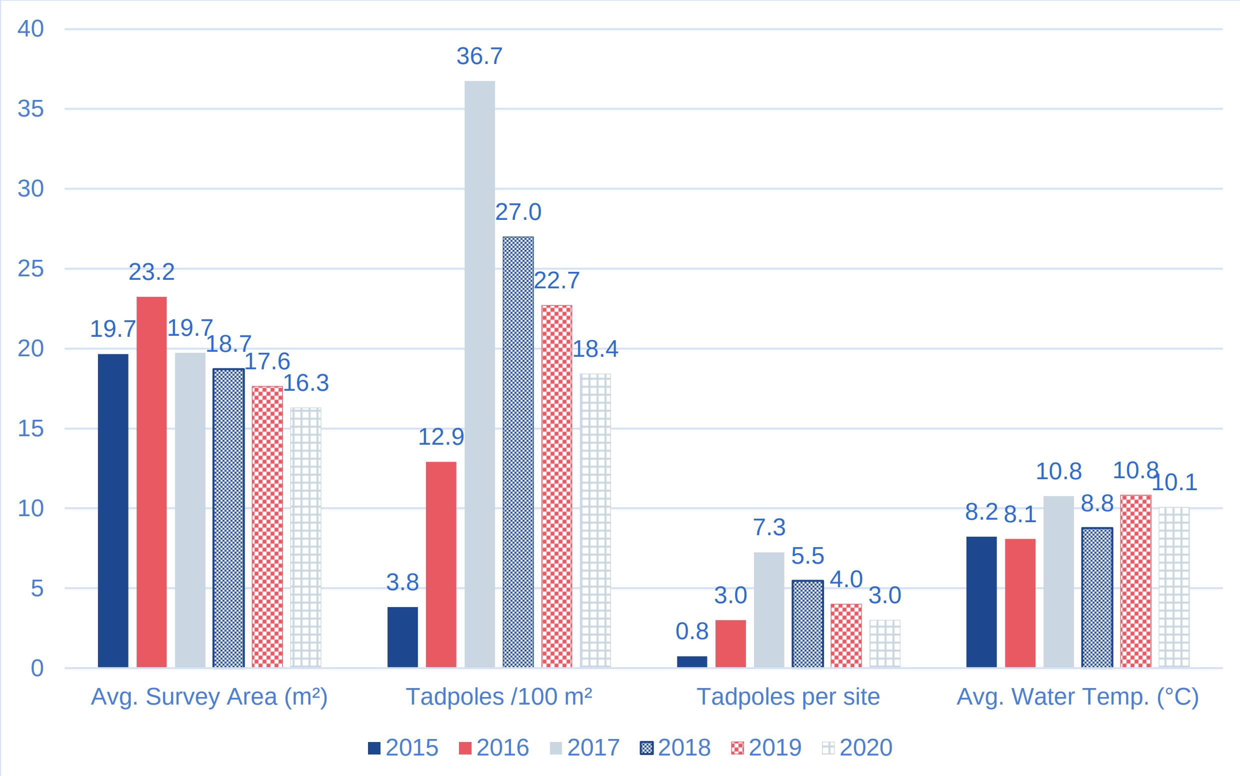


Figure 5-2. Average area, tadpoles per 100 m2, tadpoles per site, and average water temperature of Coastal Tailed Frog Surveys, 2015 to 2020.

5.3.1.3 Detections by Cohort

There was a striking change in the life stage of tadpoles captured from 2016 to 2018 compared to those captured in the past two years (Table 5-5; Figure 5-3). Far more young tadpoles (T1 cohort)[10] were found in those first three years, while the majority of tadpoles captured since have been older (T2 and T3 cohorts). Most of the T1 tadpoles captured from 2016 to 2018 were from Archibald and Whistler Creeks which suggests that those survey sites were adjacent to recent hatches that have not been so productive and/or close in 2019 and 2020.

While the number of tadpoles in the youngest cohort declined markedly in the past two years, the combined total of T2 and T3 tadpoles increased to its highest yet (Table 5-5; Figure 5-3). It is premature to conclude that this switch to older tadpoles represents a lack of ingress into the population and/or higher survivorship. It is more likely that the timing and/or location of hatches has not coincided as closely with the 2016 to 2018 surveys. While more tadpoles have been found in east-side than west-side creeks (Section 5.3.3), there has ben no discernible difference between them in the life stage (cohort) of the captured tadpoles (Table 5-8).

[10] In spite of overlaps between length and developmental stage (Section 5.3.4), it is reasonable to assume tadpoles that are in a later life/developmental stage are likely to be older, especially in the same creek, and even more so at the same site.

Table 5-5. Tadpole detections by year, site, elevation and cohort, 2016-2020.

	Tadpoles by Cohort			%Tadpoles by Cohort			
Year	**T1**	**T2**	**T3**	**T1**	**T2**	**T3**	
2016	25	5	9	64%	13%	23%	36%
2017	63	11	13	72%	13%	15%	28%
2018	64	2	16	78%	2%	20%	22%
2019	26	14	20	43%	23%	33%	57%
2020	22	20	9	43%	39%	18%	57%
Total	200	52	67	66%	12%	22%	26%

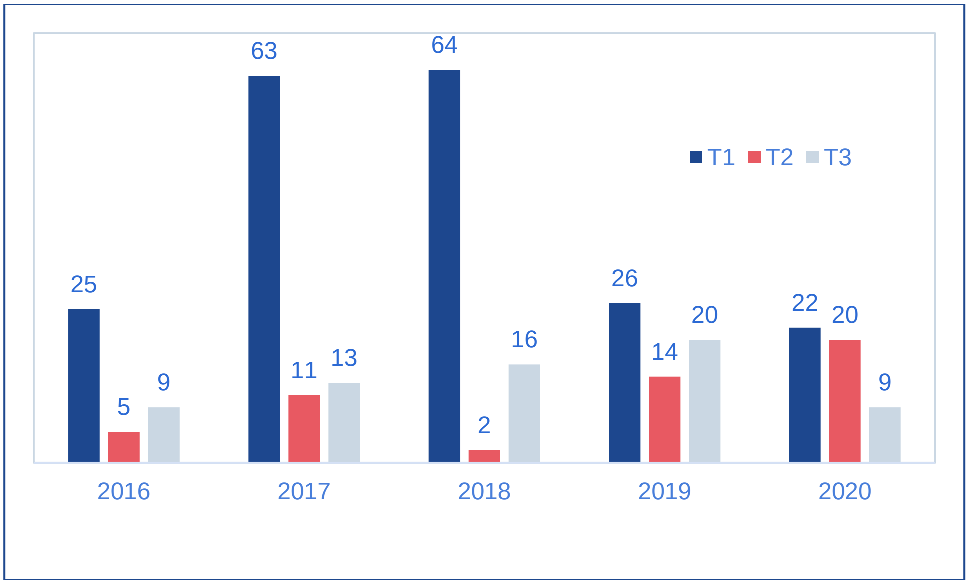


Figure 5-3. Tadpole detections by cohort and year.

Table 5-6. Tadpoles detected in east-side versus west-side creeks since 2016, by cohort.

Valley Side	T1/Site	T2/Site	T1/Site	Total/Site
East	4.0	1.3	1.3	6.5
West	1.6	0.5	0.5	2.5
East to West Ratio	2.5	2.8	2.5	2.6

5.3.2 Notes on Streams Surveyed in 2020

5.3.2.1 Archibald Creek

The five tadpoles detected in Archibald Creek in 2020 were the fewest recorded since 2015 (Table 5-4). The majority of tadpoles detected in previous years have been at the lowest site (Archibald Creek-1), just upstream of Panorama Drive. Tadpoles are often visible at this site on sections of exposed bedrock in the streamflow, especially in warmer weather, and past surveys have sometimes occurred when tadpoles are less visible (e.g., 2019). In 2020, there was no visible reason for fewer detections at this lowest site, for example, the sedimentation in 2016 that apparently flushed from the Bike Park after a heavy, late summer rainstorm (Photo 5-5).

Photo 5-5. Sedimentation in 2016 at Archibald Creek-1 adjacent to Panorama Drive.

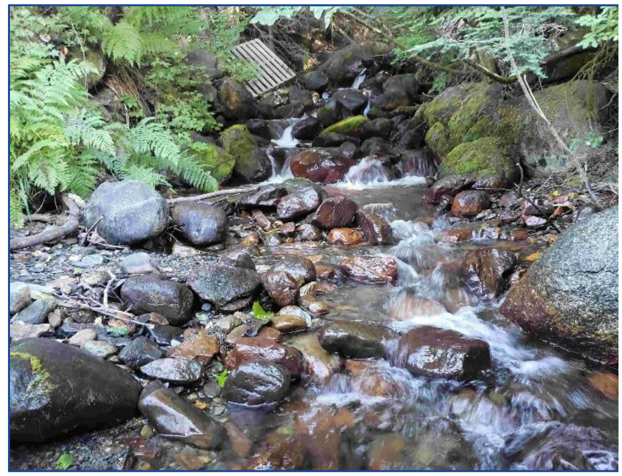


Photo 5-6. The streambed at Archibald Creek-3, uphill of the culvert at Olympic mid-station, changed significantly between 2019 and 2020 surveys (2020 photo).

Although the highest site on Archibald Creek (Archibald Creek-3; Photo 5-6) has also been a productive area for detecting tadpoles in the past, none were found in 2020. One likely reason for this change was that the small cobble/riffle habitat normally found uphill of the culvert was replaced by a narrow channel, probably due to rock movement during high water. Since this part of the site is uphill of the majority of Whistler Bike Park trails, the change to the habitat was likely a consequence of typical stream behaviour rather than caused by mountain operations. Future surveys will be help confirm if lower detections in 2020 reflected a longer-term decline in this creek's population.

5.3.2.2 Blackcomb Creek

The first tailed frog survey on Blackcomb Creek in 2006 yielded no detections at sites at four elevations, from valleybottom (near Lost Lake) to 1377 m. Very cold water at these sites provided the most obvious explanation for the lack of detections. The surveys took place on August 25, 2006 when the water was 6.3°C at 859 m (at the RMOW water intake) and only 4.0°C at 1377 m (Wind 2006). This creek is therefore the coldest yet recorded during Whistler tailed frog surveys. Since water colder than 5.0°C is inhospitable for egg development (Section 5.1), it was reasonable at that time to assume Blackcomb Creek might be too cold to support tailed frogs, at least until run-off from the melting Blackcomb Glacier (due to climate change) diminished enough to reduce its cooling effect.

In 2019, one Blackcomb Creek site next to the Chateau Golf Course and Yummy Numby bike trail was surveyed as the first test of this hypothesis (Palmer and Snowline 2020). While it was not surprising that no tadpoles were detected, it was surprising to measure the water at 8.0 deg. C, a temperate well within the range of other tailed frog creeks in Whistler.

In 2020, that site and two additional ones (Figure 5-1) were surveyed to further investigate whether tailed frogs inhabited, or could inhabit, Blackcomb Creek. Water temperatures in 2020 were again warmer than would be expected from 2006 measurements (Table 5-3). The temperature at the lowest site, next to the main beach at Lost Lake, was 9.5 deg. C and only slightly colder, 9.0 deg. C, at the Yummy Nummy site (Photo 5-7). Most surprisingly, water at the highest site surveyed, at 942 m in a small chasm accessed via Dark Crystal bike trail, was 10.0 deg. C (Photo 5-8).


Photo 5-7. Blackcomb Creek at the Yummy Numby bridge at 762 m. Water here measured 9.0 deg. C on September 2, 2020.

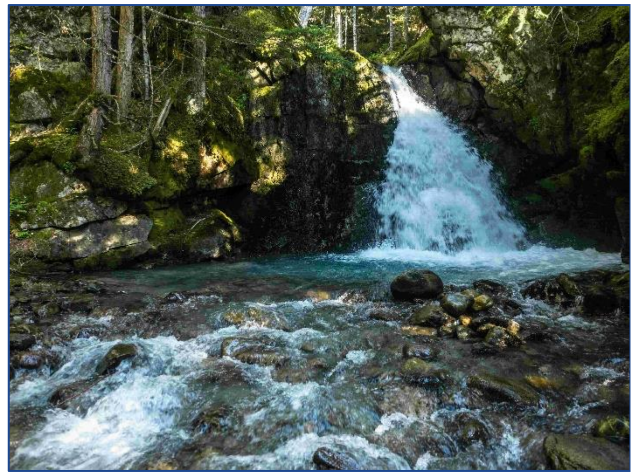


Photo 5-8. Blackcomb Creek at 942 m, accessed via Dark Crystal Trail. Water here measured 10.0 deg. C on September 5, 2020.

In spite of habitable water temperatures and the addition of two more sites, there were still no tadpoles detected in 2020. Habitat conditions were also not an obvious limiting since the sites had a similar structure and appearance to the most productive reaches surveyed elsewhere in Whistler (Photo 5-7 and Photo 5-8). There is therefore no confirmed reason for the lack of tadpoles (or at least detections) in Blackcomb Creek.

Blackcomb Creek was warm enough to support tailed frog development, at least in 2019 and 2020; how it warmed so much since 2006 is a mystery. It is possible measurements were either anomalous or faulty, but not very likely since the creek was measured at similar times of the year (between August 25th and September 5th), and reliable analogue thermometers were used for all measurements. To be sure, a second thermometer was used to confirm 2020 measurements.

The more likely cause of warming water is a reduction in glacial runoff from the shrinking Blackcomb Glacier. Although it is not possible to confirm glacial melt has warmed Blackcomb Creek, it is obvious that the volume of Blackcomb Glacier has melted and shrunk significantly since 2006. Areas that were skiable in 2006 were unskiable in 2020 due to that melt (e.g., Winky Pop and Surf's Up),[11] and the previously skiable snout of glacier had retreated so far it had been roped off. A further exploration of volume lost in adjacent (and measured) glaciers including Wedgemount and Horstman Glaciers could provide some scale for how much water flow and temperatures have changed in Blackcomb Creek.

[11] *For locations, see Brian Finestone and Kevin Hodder's book "Ski and Snowboard Guide to Whistler Blackcomb," 2015, Quickdraw Publications, Whistler BC, pp. 122-123.*

Even if temperatures have actually warmed enough to support a population of tailed frogs in Blackcomb Creek, why have none been detected? The first possible reason is that the surveys have been unlucky, but this possibility becomes even less likely each time an additional survey occurs (that is, the eight surveys conducted so far at this creek are unlikely to all have been false negatives). A second possible, though unexpected, reason would be that the 13 years between 2006 and 2019 actually represents a flip in habitability of the creek. If so, it would be such a short interval that adjacent populations (e.g., from Horstman Creek) would not have had the time to colonize the newly hospitable habitat in Blackcomb Creek, and certainly not enough time to fully populate the creek (occupy all suitable habitat). This is an intriguing possibility since it would provide evidence of the impact of climate change on wildlife habitat in an incredibly short timeframe.

As further information to its brief mention above (Section 5.3.1), a fourth survey in 2020 was aborted on Blackcomb Creek above the water intake at 860 m (Photo 5-9). Although this site was included in the 2006 survey (with no detections), the lack of water flow and embedded substrate precluded an accurate survey, at least with methods used elsewhere in this program. Flows were too strong to survey in the adjacent natural habitat and too dangerous to survey near the intake. Consequently, no results from this site were included in this report. It remains unknown whether any tailed frog tadpoles could survive passage through this water diversion to downstream habitat. If not, the connectivity of tailed frogs upstream and downstream of the intake would be compromised (Dale et al. 2020).

Photo 5-9.The water intake on Blackcomb Creek at 860 m. The natural streambed is interrupted by the dam (middle of the photo) and water flow is directed towards the intake (middle top). There is very little flow in the water at the uphill edge of the dam.

5.3.2.3 FJ West Creek

"FJ West Creek" is an unnamed creek that flows west of Van West Creek and meets the valleybottom just west of Function Junction (Figure 5-1). The lowest elevation site is at 648 m, at its junction with the South Flank Trail south of Function Junction (Photo 5-10). Access to the highest site, at 1119 m, is via the Into the Mystic bike trail (Photo 5-11). The creek follows a steep, incised valley between those two sites which has so far precluded the establishment of a mid-elevation site.

In past years, sampling at the lowest site (FJ West-1; Photo 5-10) has been hampered by logging debris and a streambed scoured by an extreme rain event in fall 2017 (Palmer and Snowline 2019, 2020). Although there is still logging debris across the stream, the actual streambed has re-formed with cobbles and other natural habitat features. No tadpoles were detected in the first two years of sampling at this site and, even with an apparent return to reasonable habitat conditions, no tadpoles were detected again in 2020. After three years of non-detections, it is reasonable to conclude that tadpoles are at most infrequent in this part of FJ West Creek even though they are present (albeit at low numbers) at subalpine elevations (FJ West-3). The steep habitat between these two sites almost certainly reduces habitat availability for tadpoles in this creek, and may even preclude a viable population near the valleybottom.

The upper half of the highest site (FJ West Creek-3) passes over granitic bedrock (Photo 5-11). The exposed rock presents some challenges for sampling, especially if cold weather or other variables (e.g., perceived predators, including humans) reduce the number of tadpoles foraging in the open, as they do at Archibald Creek. The lower half of this reach has some cobbles and other habitat features more suitable for the dipnet sampling method used here. In spite of these challenges, tadpoles have been detected at low frequencies in the past three years of sampling: one tadpole in each of 2018 and 2019, and four tadpoles in 2020 which has there is a viable population in this creek, even if only confirmed above the mid-elevation chasm.

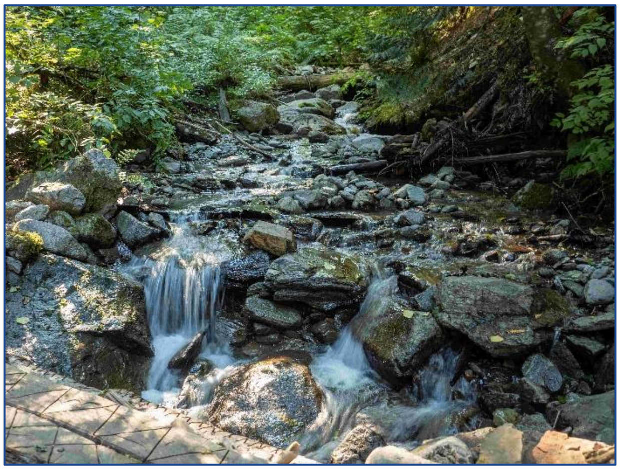


Photo 5-10. The West Creek-1 site crosses the South Flank Trail. It has been affected by past logging as well as a creek blowout that occurred in fall 2017.

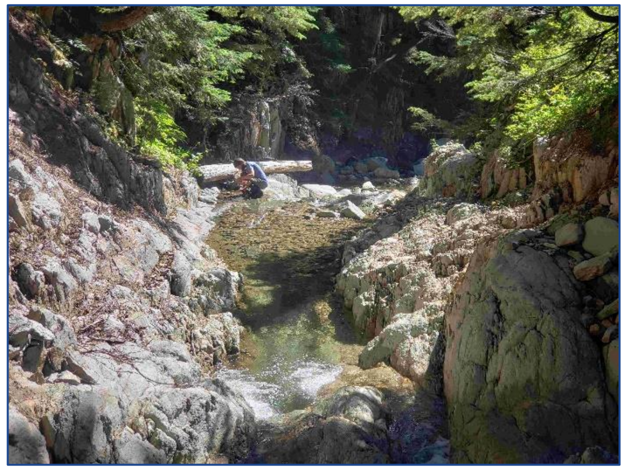


Photo 5-11. The FJ West Creek -3 is beside and just west of the Into the Mystic trail, and is surrounded by old forest. The substrate for much of this reach is bedrock.

5.3.2.4 Sproatt Creek

Based on streambed characteristics alone, Sproatt Creek may have some of the best potential habitat for tailed frogs on the west side of Whistler Valley (Photo 5-12 and Photo 5-13). As with all creeks on the west side of Whistler Valley, evidence of past logging is present up to and sometimes above the Mid-Flank Trail. In addition, the large rain event in fall 2017 mentioned above also had a significant impact on Sproatt Creek (Palmer and Snowline 2019). For example, it moved logging debris and altered the streambed on the mid-elevation site (Sproatt Creek-2; Figure 5-1; Photo 5-12) and severely scoured the streambed on the upper site at Sproatt Creek (Photo 5-13).

In spite of these impacts, the tailed frog population in this creek appears to be strong, especially at the highest site (Photo 5-13) where sampling has detected 10 tadpoles in 2018, nine in 2019, and eight in 2020. The other two sites were added in 2019 but have had much lower detections. One tadpole was found in 2019 and in 2020 at the lower site (Sproatt Creek-1). At the mid-elevation site (Sproatt Creek-2; Photo 5-12); one tadpole was detected in 2019 and five in 2020. In 2020, the streambed appeared to have recovered from the 2017 flood which may be why more tadpoles were detected, because: (a) there were actually more tadpoles in the creek; and/or (b) the greater presence of cobbles to turn over increased detection rates.

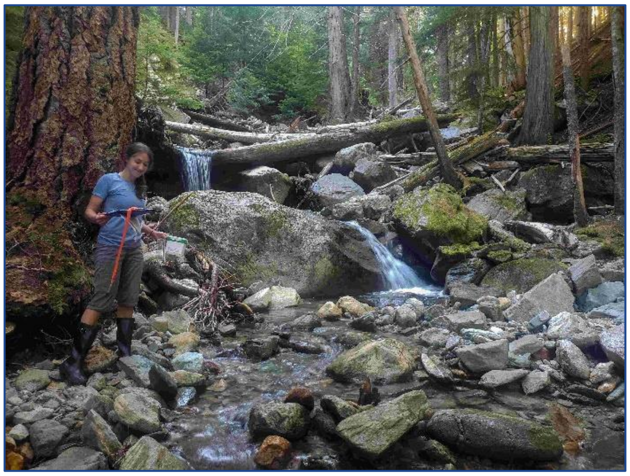


Photo 5-12. The 2017 flood moved logging debris in and around Sproatt Creek-2 and disrupted the streambed. By 2020, the actual streambed appeared undisturbed (other than the presence of that debris above it).

Photo 5-13. The fall 2017 flood severely scoured the streambed at the Sproatt Creek-3 site, at the Flank Trail bridge next to the Lord of the Squirrels bike trail exit. Boulders and cobbles were clearly pushed away from the bedrock substrate. (2019 photo.)

Dipnet sampling for tailed frogs sometimes results in bycatch of benthic invertebrates that are indicators of clean water, especially stoneflies and caddisflies (Photo 5-14; Section 3). These infrequent but consistent sightings reinforce the high quality of mountainside water in Whistler. If concerns arise about water quality in these creeks, surveys for benthic invertebrates could be add but, f so, sampling methods different than for tailed frogs would be needed.

Photo 5-14. Stoneflies and free-living caddisflies are two of the most common bycatches from dipnetting for tailed frogs. The stonefly at the top of the photo is in the Perlidae (common stoneflies) family. It was tentatively identified at Doroneuria baumanni by Karen Needham at the UBC Spencer Entomological Collection which is a first record for Whistler. She confirmed the lower specimen as Rhyacophila sp. (a free-living caddisfly not possible to identify further from a photograph).

5.3.2.5 Van West Creek

Van West is the third west-side creek added along with FJ West and Sproatt Creek in 2018. It shares some similarities with those creeks, including a steep midsection and abrupt toe slope just above the valley bottom. Debris from past logging is abundant at lower elevations but, unlike the two other creeks, impacts from the flood in fall 2017 are not obvious.

Only two sites were surveyed on Van West Creek in 2018 and 2019: a mid-elevation site where the Mid-Flank Trail descends south towards Function Junction (Van West Creek-1b;[12] Photo 5-15), and an upper elevation site where it crossed the Into the Mystic bike trail (Van West Creek-3; Photo 5-16). Widespread logging debris on Van West Creek-1b site has altered the streambed and also made survey access to it difficult. No tadpoles were detected in 2020 which is consistent with the past two years in which only one tadpole has been found (in 2018). The lack of tadpoles at this site contrasts with the apparent productivity of the highest site, Van West Creek-3 where 16 tadpoles were found in 2018, six in 2019, and eight in 2020. In contrast to lower elevations on the creek, the Van West Creek-site 3 occupies a streambed that has not been altered by logging and is mostly surrounded by old forest. As such, it presumably provides better and more abundant habitat for tailed frogs.

Photo 5-15. Van West Creek-1b is either side of the Mid- Flank Trail bridge that crosses it.

Photo 5-16. Van West Creek-3 is below the Into the Mystic bridge.

Similar to FJ West Creek, the steep topography of Van West Creek has prevented the establishment of a third site at mid elevations (ca. 800 m) to match the site selection criteria on other creeks (Section 5.2.1). Even though it much lower than desirable, a third site (Van West Creek-1a) was nonetheless established in 2020 where the creek passes through Function Junction (Figure 5-1; Photo 5-17). Although this new site was the best compromise found to date, it is not an ideal analogue for lower sites on other creeks since: (a) it is below the toe slope and therefore more of a valleybottom site; (b) its early September flow is usually too low to survey accurately for tadpoles. Higher than usual stream flow in 2020 dealt with that second concern and allowed surveying to occur, but the valleybottom influence of this location was shown to be much higher than at other low-elevations sites.

[12] This site was called Van West Creek-1 in the 2019 report (Palmer and Snowline 2020) with the expectation a mid-elevation site could be established.

In spite of abundant cobbles and apparently good streambed habitat for tailed frogs, no tadpoles were detected at the new site. More strikingly, this is the first creek (at least since the survey was changed in 2016) in which a fish was discovered (Photo 5-18). This small salmonid was found under a cobble, in exactly the same habitat a tailed frog would be expected. Its presence was not totally unexpected given that the junction with Miller Creek was only 175 m downstream but decreases the likelihood that this part of the creek supports tailed frogs (due to fish predation on frogs).

Photo 5-17. The Van West Creek-1 site in Function Junction is approximately 175 m upstream from Millar Creek.

Photo 5-18. This salmonid was found under a rock during tailed frog sampling at the Van West Creek-2 site.

5.3.2.6 Whistler Creek

Since being added to the program in 2016, more tadpoles have been detected on Whistler Creek than any other creek (Table 5-4). Habitat on this creek and its tributaries is mostly unaltered and the watershed probably supports a higher tailed frog population than any other sampled in the greater Whistler area.[13] One of the main reasons to resurvey Whistler Creek in 2016 was to measure possible impacts of the Whistler Bike Park which started expanding into the watershed at that time. To date, no ill effects from the Bike Park or other mountain operations has been detected.

Construction near the valleybottom on Whistler Creek, first observed in 2016 at the Whistler Creek-1 site (Photo 5-19) channelized the creek. Tadpole detections since have remained strong and the lowest recorded in that time was actually the most recent, the 2020 total of six tadpoles. Impacts of that in-stream work are no longer visible (Photo 5-20) and there is no indication of impacts to the tailed frog population in this creek.

[1313] *This statement is based on results from this program since 2013 as well as studies previously, especially Wind (2006 to 2010). Those surveys included additional tributaries of Whistler Creek, all of which had tailed frogs.*

Photo 5-19. Significant in-stream disturbance occurred at the Whistler Creek-1 site before the 2017 surveys.

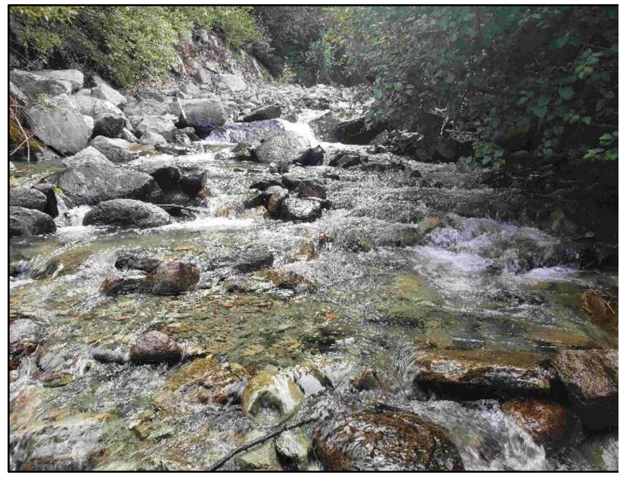


Photo 5-20. By 2019, that disturbance was no longer visible (2020 photo).

5.3.3 Tailed Frog Detections by Valley Side (East compared to West)

Since 2016, almost three times as many tadpoles have been detected per site on the east-side than on the west-side of Whistler Valley (Table 5-7). As discussed above (Section 5.2.1), glacier-fed creeks are predominantly on the east side of Whistler Valley where glacial run-off increases overall volume and provides more mid-summer flow than in 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, apparently have better habitat characteristics such as 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) affect 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, 2016 to 2020.

Valley Side	No. Sites	Elevation (m)	Survey Area (m^2)	Tadpoles /Site	Tadpoles /100m^2	Water Temp. (°C)
East	41	846	20.0	6.5	34.4	9.4
West	31	813	18.7	2.5	15.8	10.2
East to West Ratio	1.3	1.04	1.1	2.6	2.2	n/a

5.3.4 Classification by Cohort compared to Developmental Stage

Life stages are recorded during tailed frog sampling to allow insights into the age structure and survivorship of the population. This program has followed the standard approach in BC (as defined by Malt et al. 2014a,b; Section 5.2.2) and recorded tadpole "cohorts" which are based on life (or developmental) stage.[14]

[14] *See Section 5.2.2. for additional discussion of life stages, cohorts, and ages.*

Surveys in 2016 first raised questions about the applicability of those cohorts, or at least of their usefulness as reliable proxies for tadpole age, especially when comparing age structures across different creeks and, even further, when comparing with results outside of Whistler. These questions first emerged when surveyors found that the characteristics used to classify tadpoles into cohorts often overlapped. That is, surveyors found many tadpoles displayed development characteristics midway between two cohorts which led to some inconsistency in classification. During analysis, large overlaps between tadpole length and cohort classification became evident – many tadpoles assigned to an earlier cohort were significantly longer than many of those assigned to a later cohort, and vice-versa. For these reasons, additional data was collected starting in 2017 (Section 5.2.2; Table 5-2). The new approach maintained the ability to compare with past years by recording cohorts as before, but it also split the first two cohorts (T1 and T2) into sub-classes. The result was a second classification into five "Developmental Stages" which could be analyzed together with, or separately from, cohorts.

The 2019 report (Palmer and Snowline 2020) summarized findings based on the 229 tadpoles classified this way and concluded it was unnecessary to split cohort T1 into development stages DS1 and DS2 since it provided no additional information for analyses. It also concluded that the last cohort (T3; synonymous with DS5) was distinct enough to remain as a separate class. The only change it suggested was in cohort 2 which had the most overlap with adjacent classes. The purpose of this section is to revisit that conclusion now that an additional 51 tadpoles from 2020 have been measured (bringing the total to 280 since 2017). Two main questions will be addressed in this section:

1. Is the data better classed into three cohorts or five developmental classes, or perhaps another option?
2. What classification, if any, can be used as reliable proxy for the age of tadpoles in Whistler creeks?

Results from 2020 lead to a somewhat opposite conclusion to that from 2019. That is, the most overlap (noise) between classes is at earlier developmental stages, between cohorts T1 and T2 instead of cohorts T2 and T3 (Table 5-6). Median and mean values, which are almost identical for all classes, appear to support the cohort classification since they are well-separated at 32 mm, 43 mm, and 50 mm (T1, T2, and T3, respectively). Although the separation for the five Developmental Stages is not quite as distinct, it does show a clear upward trend from DS1 through DS5. Since simple tables (e.g., Table 5-6) do not do a good job representing the true distribution of this data, it was also plotted as box and whisker plots (Figure 5-4).

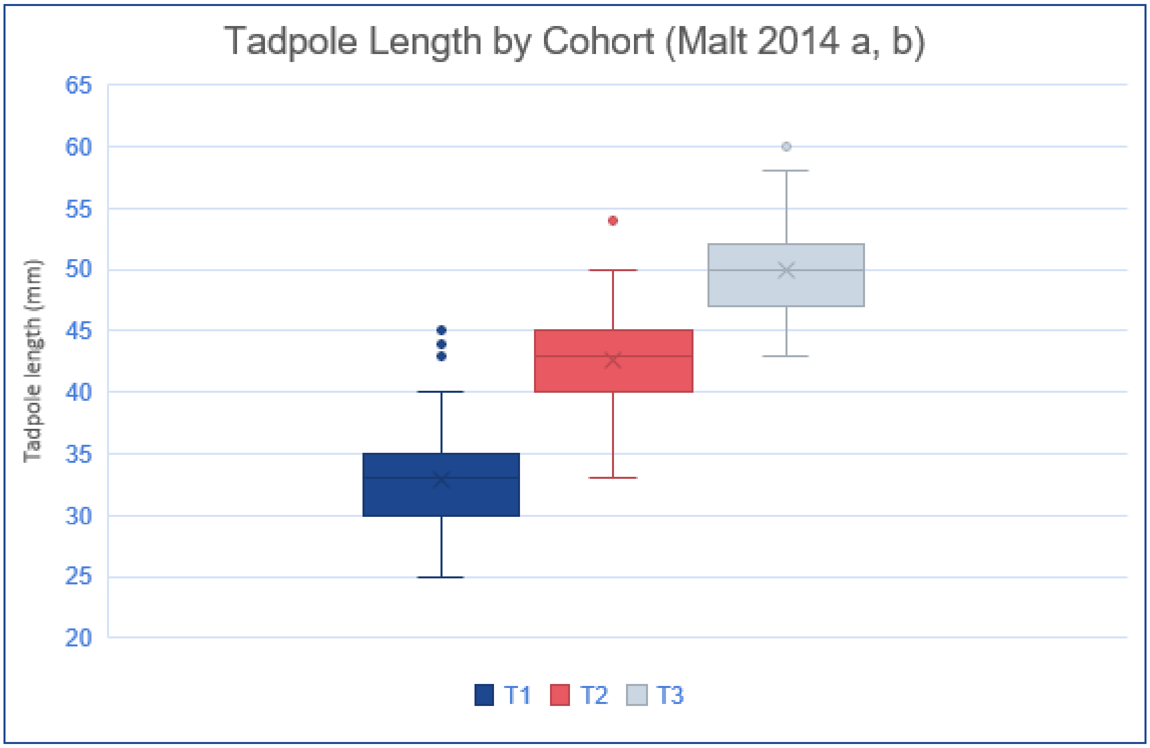
Table 5-8. Length comparisons between Developmental Stage (top) and Cohort classifications (bottom), 2017 to 2020.

	Development Stage				
	DS1	**DS2**	**DS3**	**DS4**	**DS5**
	No hind legs	Bulge only, hind legs not defined	Hind legs visible but covered	Hind feet protruding	Hind knees protruding
Number of Tadpoles	72	103	25	43	37
Mean Length (mm)	31	34	39	45	50
Median Length (mm)	30	35	38	45	50
Smallest (mm)	25	25	33	40	43
Largest (mm)	43	45	50	54	60
Length Range (mm)	1.7	1.8	1.5	1.4	1.4

	Age Class / Cohort (Malt et al. 2014a, b)		
	T1	**T2**	**T3**
Number of Tadpoles	175	68	37
Mean Length (mm)	32	43	50
Median Length (mm)	32	43	50
Smallest (mm)	25	33	43
Largest (mm)	45	54	60
Length Range (mm)	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. Tadpoles captured in 2016 were excluded from this table they were not classified by developmental stage.

Notes about box and whisker plots: Box and whisker plots can reveal characteristics of data without assumptions about how it is distributed, as required by standard (parametric) statistical analysis. The mean value of observations is shown as an X within the box, and the median value is shown as a horizontal line within the box. Each box includes one-half of all observations within that class, from the 25th percentile (lower line) to 75th percentile (upper line) of values. Typical minimum and maximum values are shown as lower and upper "whiskers," respectively. Dots outside those whiskers show observations whose values differ markedly from most others (outliers). Outliers are defined here as values greater than 1.5 x interquartile range as calculated by the difference between upper and lower quartile values (75% and 25% percentiles, respectively). A smaller (shorter) box indicates more consistent values for the middle half of observations than a larger (taller) box. If the distribution of values has a similar spread of values on either side of the median (a normal or bell-shaped distribution), the median will be close to the middle of the box and the whiskers will be approximately the same length.



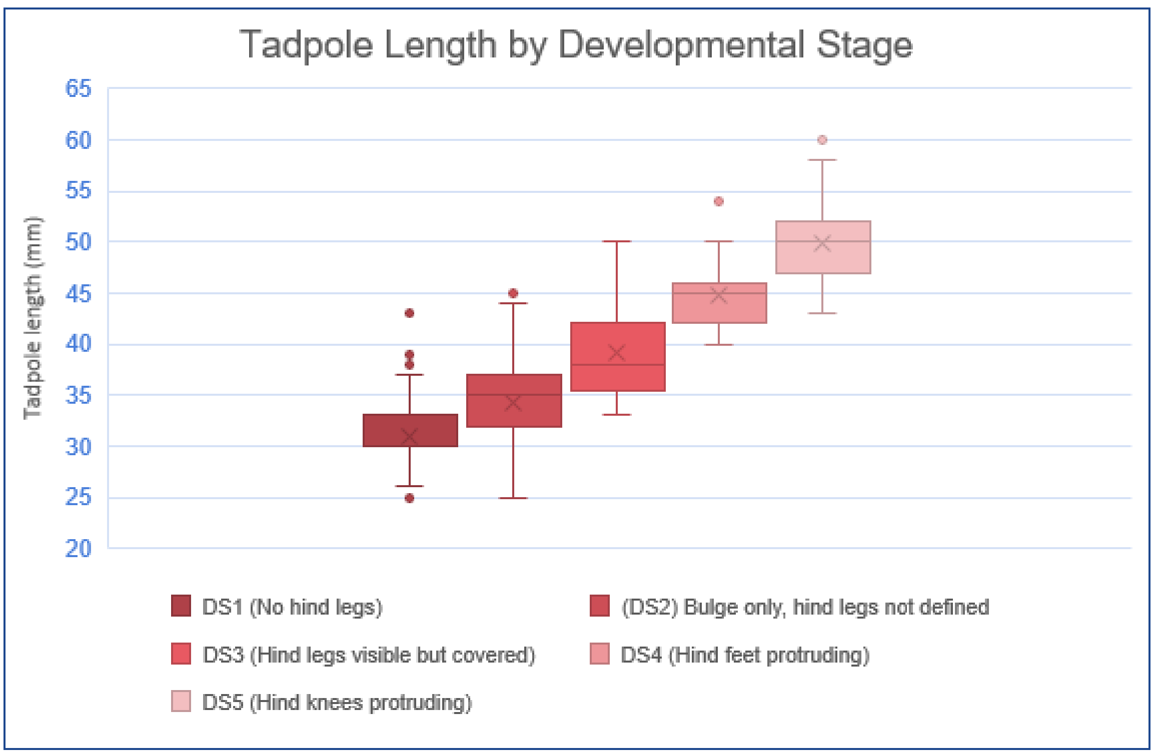


Figure 5-4. Tadpole Length by Cohort (top) and Developmental Stage. (See notes on previous page that describe how to interpret these plots.)

Surveyors have distinguishing between the morphological boundaries between cohorts T1 and T2 and between cohorts T2 and T3 (as defined in Malt et al. 2014a,b). In the first case, many tadpoles have been transitional between having an undefined “bulge” (T1) and defined legs contained within that bulge (T2; Photo 5-4). Box and whisker plots (Figure 5-4) highlight the overlap between the length of tadpoles and their classification into three cohorts compared to five Developmental Stages.

The boxes for each cohort, which include half of all observations, show a clear distinction between them (Figure 5-4, top) but additional information outside of those boxes indicates a great deal of overlap between the cohorts. For example, whiskers of those boxes extend to the middle line (median) in the adjacent boxes and show that most of the other half of observations overlap between cohorts. In addition, significant outliers (especially at the upper end of T1) extend into the outer edges of the distribution of observations in adjacent boxes (cohorts).

A similar comparison of tadpole length and Developmental Stage (Figure 5-4, bottom) shows a similar result. Dividing the observations into five Developmental Stages provides less clear distinction between them than between the three cohorts, though there is still a clear upward trend in length from DS1 through DS5. A number of additional observations emerge from this classification:

- The first three developmental stages (DS1, DS2, and DS3) were less distinct than the later developmental stages (DS4 and DS5).
- While DS1 overlapped somewhat with DS3, the greatest overlap was between DS1 and DS2, and between DS2 and DS3. That is, this area of the classification was least defined and therefore the most questionable.
- Length was not a reliable predictor for the first three developmental stages, particularly DS1 and DS2. The length of tadpoles in DS2 ranged from 25 mm (also the shortest length for DS1 tadpoles) to 45 mm (as long as some of the longest tadpoles in DS3). The middle half of tadpole lengths in DS2 (the orange box in Figure 5-4) also overlapped with both DS1 and DS3.
- The middle half of the tadpoles in DS4 (yellow box) were longer than those in earlier stages and shorter than those in DS5. Similarly, the middle half of tadpoles in DS5 (light blue box) were longer than those in DS4. There was, nonetheless still a significant overlap in lengths with adjacent stages for both.

The overall conclusion from these figures is that, while length is clearly related to classification by cohort or Developmental Stage, that relationship is not strong enough to reliably predict life stage (or age) from a tadpole’s length. In fairness, the cohort classification is meant as a proxy for age rather than size or length but, even taking that into account, the noisiness of the box plots raises questions about the reliability of the classification. It is still reasonable to assume tadpoles at later stages of development are older. Similarly, longer tadpoles tend to be at later stages of development (though not always) and therefore safely assumed to older. But two questions remain. First, what is the age relationship between cohorts (or Developmental Stages)? Are T2 tadpoles always one year younger than T3 tadpoles, for example? And second, is tadpole development consistent within or even across streams? For example, could two T3 tadpoles captured in different creeks actually be different ages? Answering these questions is outside the scope of the current program since it would require local, field studies of that age relationship. In the meantime, discussions about population trends based on age structure (e.g., mortality and survivorship) will remain inferential.

6. Beavers

6.1 Introduction

Beavers are a keystone species that literally shaped North America's landscapes before European settlers drastically reduced their populations (Goldfarb 2018). They are commonly referred to as ecosystem and wetlands engineers (e.g., Müller-Schwarze and Sun 2003) in recognition of their immense impact on landscapes that is second only to that of humans. The life history of beavers is predicated on altering landscapes to provide shelter, food, and security which thereby creates the dams, ponds, wetlands, channels, and wetland vegetation that provides critical habitat for countless other species (Morgan 1986; Müller-Schwarze and Sun 2003; Runtz 2015; Goldfarb 2018; Romansic et al. 2020).

Beavers no doubt exerted a vast impact on the Whistler area for centuries before the railway was built in 1913. The Whistler Valley contains five lakes in in a flat pass that, even now, are connected by creeks and wetlands and include functional beaver habitat. Before European settlement, that habitat would have been much larger and would have stretched north in a mostly continuous swath from what is now Function Junction through Meadow Park and the Nicklaus North Golf Course beside Green Lake. The first, and significant reduction of Whistler's beaver population was caused so much trapping that Racey and McTaggart-Cowan noted in their 1935 report that beavers had already been "completely trapped out in the district for over twenty years" (p. 24), even though their dams and meadows persisted.

Though the area covered by wetlands is approximately 72 percent smaller than before Whistler was developed (McBlane 2007), beavers still inhabit such notable wetlands as the Millar Creek Wetlands, the Rainbow Wetlands, the Wildlife Refuge, and the River of Golden Dreams wetland complex. Other former beaver habitats have been replaced by housing, industrial areas, golf courses and other developments.

Due to their critical role in creating and maintaining wetland habitats, beavers are arguably the most important species in Whistler. They also play an important role in flood management, erosion control, and water quality (Goldfarb 2018). Their dams raise the water table to keep areas inundated even through dry summer months, and reduce erosion by slowing streamflow. From an ecological perspective, it would be difficult to have too many beavers on the landscape.

Most land managers, however, view beavers differently. They have traditionally viewed beavers as pests to be trapped, killed, or otherwise dissuaded from maintaining any presence in the area that is being managed. In Whistler, that conflict has concentrated in the valley bottom. Much of the valley bottom habitat that once housed beavers has been transformed into low-lying developments where beavers are not welcome due to their propensity to cut valuable trees, raise water levels, and generally cause trouble for property owners. The ongoing challenge for the RMOW (among other land managers) is to balance the enormous ecological benefit of beavers on the landscape with other priorities such as protecting property.

Beavers are colonial animals. They maintain a family lodge which houses the adult parents, two yearlings, and two young-of-the-year (Müller-Schwarze and Sun 2003). Two-year-old beavers generally disperse to form new colonies except when is delayed by the lack of suitable habitat. Some lodges can remain active indefinitely, especially in prime habitats while others are periodically inactive or abandoned permanently (as shown by Whistler data). As a result, the location of Whistler's beaver population changes somewhat each year.

Beavers provide a unique situation for field biologists because, given enough effort and accumulation of data, 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 program but focussed only on a subset of lodges (Cascade 2014-2016). The 2016 surveys returned to a full census approach where all possible active beaver locations within Whistler Valley were enumerated (Palmer and Snowline 2017). The greater survey effort and geographic range that started in 2016 increased the number of documented colonies from nine in 2015 to 27 in 2019, and greatly expanded the geographic range of known colonies. Each year, these surveys have come closer to a full census of all beaver colonies in Whistler.

In 2018, the first mapping of beaver-affected wetlands was produced for the Whistler Valley (Palmer and Snowline 2019). That mapping was used to calculate the total area of beaver-affected wetlands in Whistler and therefore a monitorable metric for the RMOW. That is, if the area stays the same (or, less likely, increases), wildlife habitat benefits. If any of that area is developed, wildlife habitat suffers.

6.2 Methods

6.2.1 Sampling Design

The goal of the beaver survey starting in 2016 was to build a census of the beaver population in Whistler, with the recognition that this goal could only be achieved with intensive and cumulative effort. It started with lodges still documented as of 2015 and resurveyed other areas where the Whistler Biodiversity Project had earlier documented them. Surveys were also directed into areas that had anecdotal reports of beaver activity, as well as suitable habitats that were not known yet known to house beavers. This general approach has continued since, and each year benefits from knowledge accumulated in previous years.

Beaver activity is described at each site where evidence is found in a number of ways. All physical structures (lodges, dams, bank burrows) are mapped, and their activity status is recorded (that is, active or inactive). In most cases, it is possible to confidently identify where a lodge, burrow, or dam is active based on observations that include:

- Sightings of beavers, especially if entering and exiting structures;
- New construction or repair of lodges, especially in the fall when it shows a colony will overwinter in that lodge (Photo 6-1);
- 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 (Photo 6-2; 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).

Photo 6-1. Fresh mud is an example of recent activity and an active lodge. This freshly-mudded lodge, photographed in November 2017, was still active in Alta Vista Pond in 2020.

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

Until 2019, lodges for which activity status was unclear were recorded as having “Unknown” status. Starting in 2019, this uncertainty has instead 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. While those designations have typically been correct, any errors are generally corrected in the subsequent year. For example, a lodge recorded as “Active?” will typically be confirmed active in the subsequent year or, less often confirmed as inactive. No instances have occurred to date in which a lodge’s status remains inconclusive for two years in a row.

6.2.2 Data Analysis

Three factors introduce uncertainty into the reliability of estimates of Whistler’s beaver population. Firstly, and as discussed above, it is not always possible to conclude whether a lodge is occupied. Secondly, it is likely that not all occupied lodges are detected each year, though the number of undetected lodges continues to decrease as the census builds on past years’ results. Thirdly, the population estimate relies on a estimate of the average number of beavers per lodge based on data 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, which is why that number can vary widely. The 2008 beaver survey (Mullen 2008) applied a multiplier of 5.8 beavers per lodge from five studies elsewhere and this is the multiplier that has been used in beaver surveys since to estimate Whistler’s total beaver population. That multiplier continues to be a reasonable estimate because of two reasons:

1. It is consistent with the studies cited by Mullen, and also within the middle of the range of averages from studies in 12 locations reported in Müller-Schwarze and Sun (2003; Table 6-1); and,
2. It is consistent with a typical colony that contains two adults, two yearlings, and two young-of- the-year (Section 6.1).

Regardless of the multiplier chosen, it is still necessary to realize that it is only a broad estimate. For that reason, surveys since 2016 have included a range of multipliers that includes the middle half of the reported averages in Müller-Schwarze and Sun (2003; Table 6-1): a low estimate of 4.2 beavers per colony; a middle estimate of 5.8 beavers per colony; and a high estimate of 6.4 beavers per colony.

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. Cumulative knowledge has built over that time due to increased, annual efforts and each subsequent year of similar survey effort increases the likelihood all active lodges have been documented.

6.3 Results and Discussion

6.3.1 2020 Surveys

For the fifth consecutive year, beaver surveys detected more active lodges (colonies) and came closer to a full census of beavers in Whistler. The most lodges yet (78) were documented in 2020, of which 33 were determined to have active colonies (Table 6-2; Table 6-3; Figure 6-1; Appendix F). This result continues the upward trend of both the number of total lodges and active colonies recorded since full surveys resumed in 2016. It also reinforces the importance of two major beaver habitats in the Millar Creek Wetlands and the River of Golden Dreams. Together, these two habitats accounted for approximately half of all active lodges in 2020 (Section 6.3.3).

Table 6-2. Lodges by activity status, 2007 to 2020.

Status	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020
Lodge - Active	9	27	16	16	17	10	10	7	13	13	16	27	33
Burrow - Active	0	0	0	0	0	0	0	0	0	0	2?	0	0
Lodge - Inactive	9	12	13	7	21	5	14	18	11	21	32	36	45
Summer Only	0	0	0	0	0	0	0	0	0	2	2	0	0
Unknown	1	4	4	4	0	8	1	3	3	8	9	NR	NR
Total	**19**	**43**	**33**	**27**	**38**	**23**	**25**	**28**	**29**	**44**	**59**	**65**	**78**

Notes: NR = not recorded. Starting in 2019, surveyors classified lodges with an uncertain status as either "Active?" or "Inactive?" based on available evidence. No survey was conducted in 2012. See notes in Section 6.2.2 that explain why the 2008 tally of active lodges was almost certainly an error.

It becomes clearer with each subsequent survey that lodges can remain active for many years, presumably with the same mating pair and perhaps their descendants. While the most recent data (Table 6-3) shows that only five lodges were active for all four years between 2017 and 2017, the true number is certainly undercounted since many of the other active 2020 lodges were first discovered since 2017. A total of six more active lodges were detected in 2020 bringing the total to 33 lodges, up from the 27 lodges recorded in 2019 (Table 6-2). These additions reflect a combination of: (a) the first detection of seven already-active lodges, and (b) an almost equal number of lodges that were newly vacated and newly reactivated (Table 6-4).

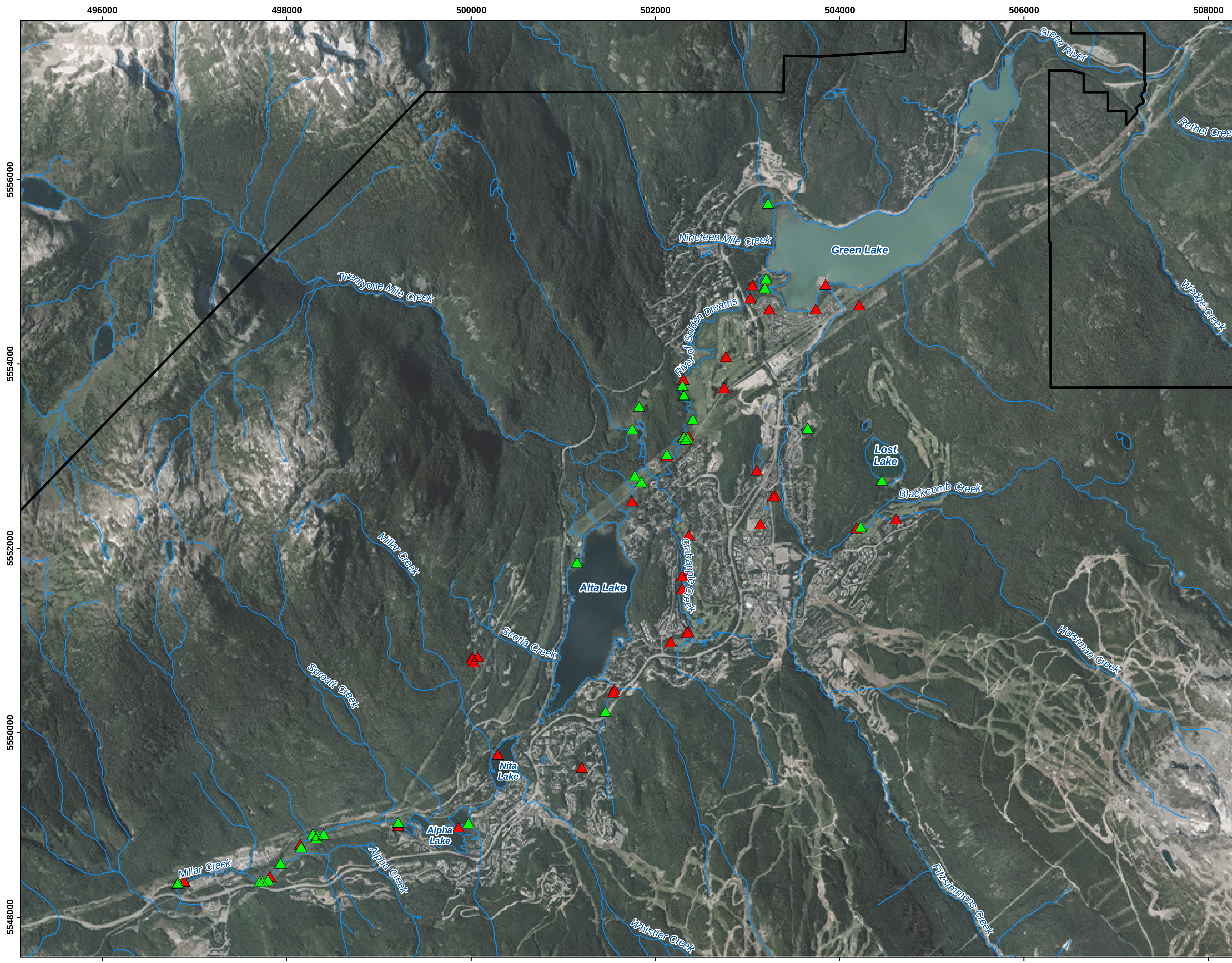
Table 6-3. Lodges and burrows documented in 2020.

Location	2020 Status	2019 Status	2018 Status	2017 Status	Easting	Northing
Alpha Lake, near dog beach	Active	Active	Active	Active	499970	5549027
Alpha Lake, outlet at Millar Creek	Active	Active	Active	NR	499208	5549034
Alta Vista Pond	Active	Active	Active	Active	501458	5550235
Chateau GC #18 main pond	Active	NR	NR	NR	504228	5552240
Lost Lake	Active	Active	Active	Unknown	504458	5552740
Millar Cr. Wetlands - bet. hydro tower and Valley Tr. bench	Active	Active	Inactive?	NR	498284	5548908
Millar Cr. Wetlands -FJ (Valley Trail access)	Active	Active	NR	NR	498321	5548863
Millar Cr. Wetlands -FJ (Valley Trail access)	Active	Active	NR	NR	498328	5548894
Millar Cr. Wetlands -FJ (Valley Trail access)	Active	Active	NR	NR	498398	5548903
Millar Cr. Wetlands -FJ (water access)	Active	Inactive	NR	NR	497931	5548588
Millar Cr. Wetlands -FJ (water access)	Active	Active	Active	NR	497706	5548388
Millar Cr. Wetlands -FJ (water access)	Active	NR	NR	NR	497737	5548390
Millar Cr. Wetlands -FJ (water access)	Active	Active	Active	NR	497796	5548408
Millar Cr. Wetlands -FJ (water access)	Active?	Active?	NR	NR	498156	5548764
Millar Cr., downstream of. wetland to Hwy 99	Active	NR	NR	NR	496821	5548379
Millar Cr., downstream of. wetland to Hwy 99	Active?	NR	NR	NR	496812	5548373
Rainbow Park, west side upstream of Alta Lake	Active?	Inactive	Inactive	Inactive	501148	5551850
Rainbow Wetlands, NE end near 21-Mile Creek	Active	NR	NR	NR	501777	5552792
Rainbow Wetlands, NE end near 21-Mile Creek	Active?	Active	Active	Active	501848	5552727
ROGD4 - RR bridge to bend nearest Valley Tr.	Active	Active	NR	NR	502312	5553214
ROGD4 - RR bridge to bend nearest Valley Tr.	Active	Active	Active	NR	502327	5553188
ROGD4 - RR bridge to bend nearest Valley Tr.	Active	Active	Active?	NR	502349	5553202
ROGD4 - RR bridge to bend nearest Valley Tr.	Active	Active	NR	NR	502406	5553403
ROGD4 - RR bridge to bend nearest Valley Tr.	Active?	Active	NR	NR	502126	5553026
ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active	NR	NR	NR	502294	5553771
ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active	Inactive	Inactive	NR	502311	5553661
ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active	Inactive?	Inactive	NR	502308	5553673
ROGD6 - Hwy. 99 bridge to Green Lake	Active	Active	Inactive?	NR	503187	5554830
ROGD6 - Hwy. 99 bridge to Green Lake	Active?	Inactive?	Unknown	NR	503202	5554930
Spruce Grove Park, entrance	Active	Active	Active	Active	503652	5553307
Wedge Pond	Active	Active	Active	Inactive	503223	5555744
Wildlife Refuge, middle pond	Active	Active	Active	Active	501825	5553543
Wildlife Refuge, middle pond	Active	NR	NR	NR	501750	5553298

Notes: Before 2017, surveyors included an "Unknown" classification for lodges with uncertain status. Since 2017, surveyors have instead assessed the evidence for these lodges decided in the field their likely status (recorded as "Active?" or "Inactive?"). Subsequent surveys typically resolve the correct designation, assuming a colony does not move in or out during that time.

Table 6-4. Changes in the status of Active lodges between 2019 and 2020.

2020 Change	Lodge Location	2020 Status	2019 Status	Net Change
New (Not Previously Recorded or Detected)	Chateau GC #18 main pond	Active	Not Recorded	**+7**
	Millar Cr. Wetlands -FJ (between Lynham Rd and Hwy 99)	Active		
	Millar Cr. Wetlands -FJ (between Lynham Rd and Hwy 99)	Active?		
	Millar Cr. Wetlands -FJ (water access)	Active		
	Rainbow Wetlands, NE end near 21-Mile Creek	Active		
	ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active		
	Wildlife Refuge, middle pond	Active		
Reactivated (inc. probable reactivations)	ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active	Inactive	**+5**
	ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active	Inactive?	
	Millar Cr. Wetlands -FJ (water access)	Active	Inactive	
	Rainbow Park, west side upstream of Alta Lake	Active?	Inactive	
	ROGD6 - Hwy. 99 bridge to Green Lake	Active?	Inactive?	
Vacated (inc. probable vacations)	Fitz Creek Pond - Blackcomb Way/Nancy Greene Dr.	Inactive?	Active	**-6**
	Millar Cr. Wetlands -FJ (water access)	Inactive	Active	
	Whistler GC, #15 fairway, s. of #16 outflow	Inactive	Active?	
	ROGD1 - Alta Lake entrance to fish weir	Inactive?	Active	
	Whistler GC, #6 green pond	Inactive?	Active	
	Whistler GC, Crabapple Cr. #10 sand trap	Inactive	Active?	
			Net Change	**+6**



Legend

2020 Beaver Lodge Status

- Active
- Inactive

- RMOW Boundary
- Watercourse

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

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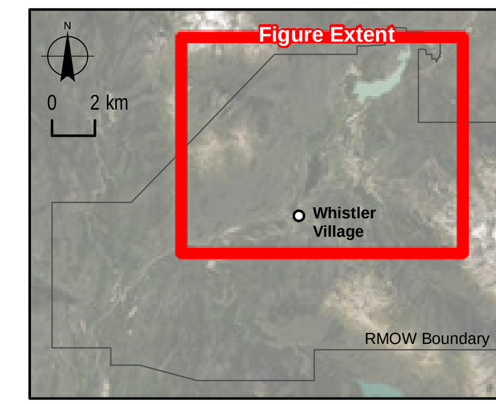

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SNOWLINE Ecological Research

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CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2020

Results of 2020 Census of Beaver Lodges in Whistler

FIGURE 6-1

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6.3.2 Population Estimates

The 33 lodges documented in 2020 again increases the estimate of how many beavers live in in Whistler. The middle estimate for the population, based on 5.8 beavers per lodge (Section 6.2.2) has risen from a low of 41 in 2015 to 191 in 2020 (Table 6-5; Figure 6-2). Even the lowest multiplier of 4.1 beavers per lodge yields an estimated population of 139 beavers living in Whistler in 2020.

Table 6-5. Estimated number of beavers in Whistler, 2007-2020. Surveys were not conducted in 2012.

	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020
Active colonies	9	27	16	16	17	10	10	7	13	14	18	27	33
4.2 beavers/colony	38	113	67	67	71	42	42	29	55	59	76	113	139
5.8 beavers/colony	52	157	93	93	99	58	58	41	75	81	104	157	191
6.4 beavers/colony	58	173	102	102	109	64	64	45	83	90	115	173	211

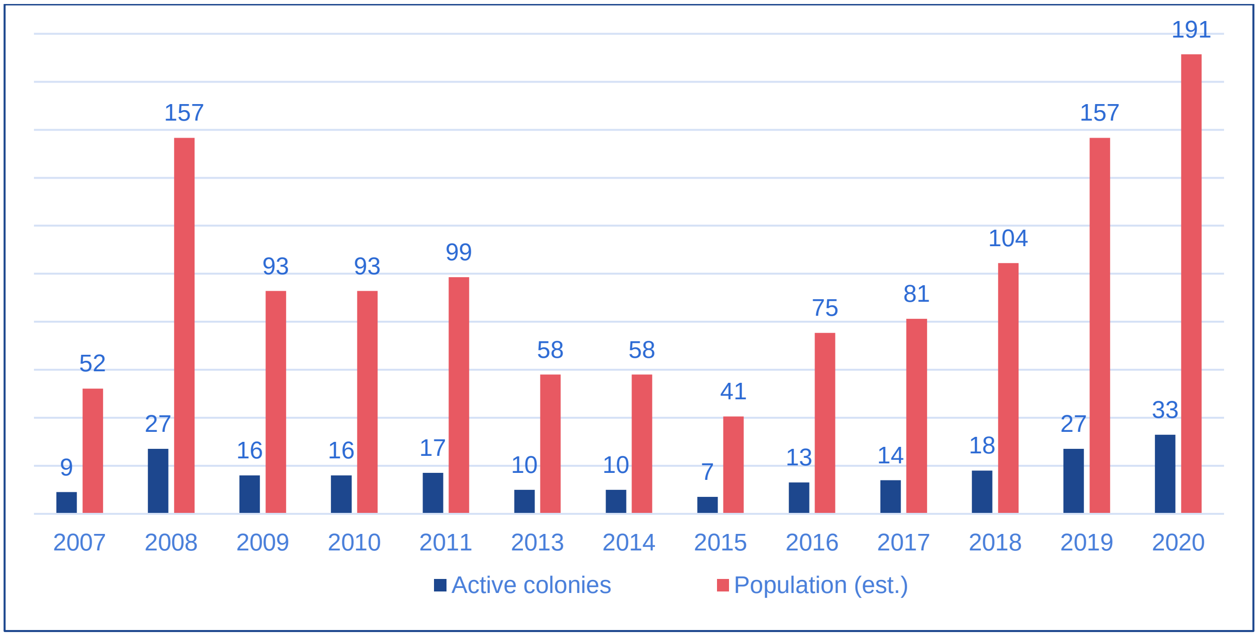

Figure 6-2. Estimated beaver population from 2007-2020 based on 5.8 beavers per colony (lodge). Surveys were not conducted in 2012.

Since only seven lodges were detected in 2015, the appearance of a growing population since then is clearly a result of increased knowledge rather than more beavers. Many of the lodges recorded for the first time since have been older lodges, and therefore represent colonies not included in the annual survey. Although some colonies likely still remained undetected in 2020, the upward curve slowed from 2019 to 2020, which may mean this year’s results are closer than ever to a full census. The main benefit of this increased confidence in survey completeness (as it continues towards its goal of becoming a full census) is that it coincides with a greater ability to detect true population trends, an ability that will also increase with future surveys conducted with similar effort.

Results from the first annual survey in 2007 through the 2020 survey (Table 6-2) reveal the different goals and geographic scope of three distinct phases:

1. 2007 to 2011: Beaver surveys started by Whistler Biodiversity Project (WBP) in 2007 continued through 2011 (Brett 2007; Mullen 2008, 2009; Pevec 2009; Tayless 2010; Tayless and Burrows 2011). Those first five survey years built cumulative knowledge towards a full census of beavers in Whistler Valley. By its last year, its census of the River of Golden Dreams was probably as reliable as in 2019 or 2020. Other areas in Whistler were under-represented or absent (for example, no lodges were reported from the Millar Creek Wetlands). Although the original goal of building a full census was therefore only partially realized, by 2011 more active before lodges were documented than ever before.
2. 2013 to 2015: The RMOW Ecosystem Monitoring Program restarted the survey in 2013 after one year with no survey (Cascade 2013 to 2015). The geographic focus for this three-year period was narrower than for WBP surveys and the search effort was apparently lower given that the number of lodges it documented (both inactive and active) was the lowest since the first year of surveys in 2007.
3. 2016 to Present: In 2016, the RMOW program returned to the original WBP goal of a full census of beavers in Whistler Valley (Palmer and Snowline 2017-2020; this report). By 2018, after three years of rebuilding, the survey first surpassed what was known in 2011. Since then, it has continued to build towards a full census that: (a) provides a reliable baseline population estimate by area; and (b) allows more accurate trend analysis of that population and the habitat it uses and creates.

Presented graphically (Figure 6-2), these three phases show as a minor peak in 2011 (the 2008 count was almost certainly an overcount), [15] a lower maintenance phase through 2015, then a revival starting in 2016 that has resulted in an upward trend since (Figure 6-3). While additional areas with active colonies may remain unrecorded in 2020, each subsequent annual survey reduces that likelihood and brings the program closer to the goal of achieving a full census.

6.3.3 Two Major Beaver Habitats

6.3.3.1 Importance of River of Golden Dreams and Miller Creek Wetlands

The impact and presence of beavers in Whistler was well-known long before annual surveys started in 2007 (e.g., Racey and McTaggart-Cowan 1935). Well before 2007, paddlers encountered multiple beaver dams on the River of Golden Dreams (ROGD) and knew the area supported many beavers. The first full survey of the ROGD in 2008 confirmed the importance of the area, a fact reinforced each year since then (Table 6-6). Before the 2019 survey first documented the extent of beaver activity in the Millar Creek Wetlands, approximately half of all active lodges in Whistler documented by annual surveys were on the ROGD.

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[15] It should be noted that the appearance of a higher peak in 2008 of active lodges is almost certainly due to an overcount on the River of Golden Dreams (Mullen 2009) as shown by much more consistent numbers between 2009 and 2011 (Table 6-2; Figure 6-2).

Table 6-6. Active lodges detected on the River of Golden Dreams and Millar Creek Wetlands, 2007 to 2020.

	River of Golden Dreams (ROGD)	Millar Creek Wetlands (MCW)	Other Areas	ROGD + MCW	Total Inc. Other Areas	ROGD + MCW (%)	ROGD (%)
2007	1	ND	8	1	9	11%	11%
2008	15	ND	12	15	27	56%	56%
2009	7	ND	9	7	16	44%	44%
2010	7	ND	9	7	16	44%	44%
2011	10	ND	7	10	17	59%	59%
2013	5	ND	5	5	10	50%	50%
2014	5	ND	5	5	10	50%	50%
2015	4	ND	3	4	7	57%	57%
2016	3	ND	10	3	13	23%	23%
2017	2	ND	12	2	14	14%	14%
2018	5	2	11	7	18	39%	28%
2019	7	7	13	14	27	52%	26%
2020	10	9	14	19	33	58%	30%

Notes: The 2008 count of lodges on the River of Golden Dreams is almost certainly an overcount as shown by subsequent surveys through 2011. No survey occurred in 2012. The 2018 total for the ROGD includes 2 burrows which have not been active since. There are no records of surveys in the Miller Creek Wetlands before 2016.

The 2017 survey found abundant evidence of beaver activity in the Millar Creek Wetlands, but it was not until 2018 that the first two active lodges were located (Table 6-6). The intensive 2019 survey there was the first to report the true extent of that activity when it found seven active lodges and established for the first time that it supported a beaver population similar in size to that on the ROGD. As of 2020, and even with many other areas being confirmed as active beaver habitat over the past few years, the ROGD and Millar Creek Wetlands still support more than half of all known active lodges (Figure 6-3).

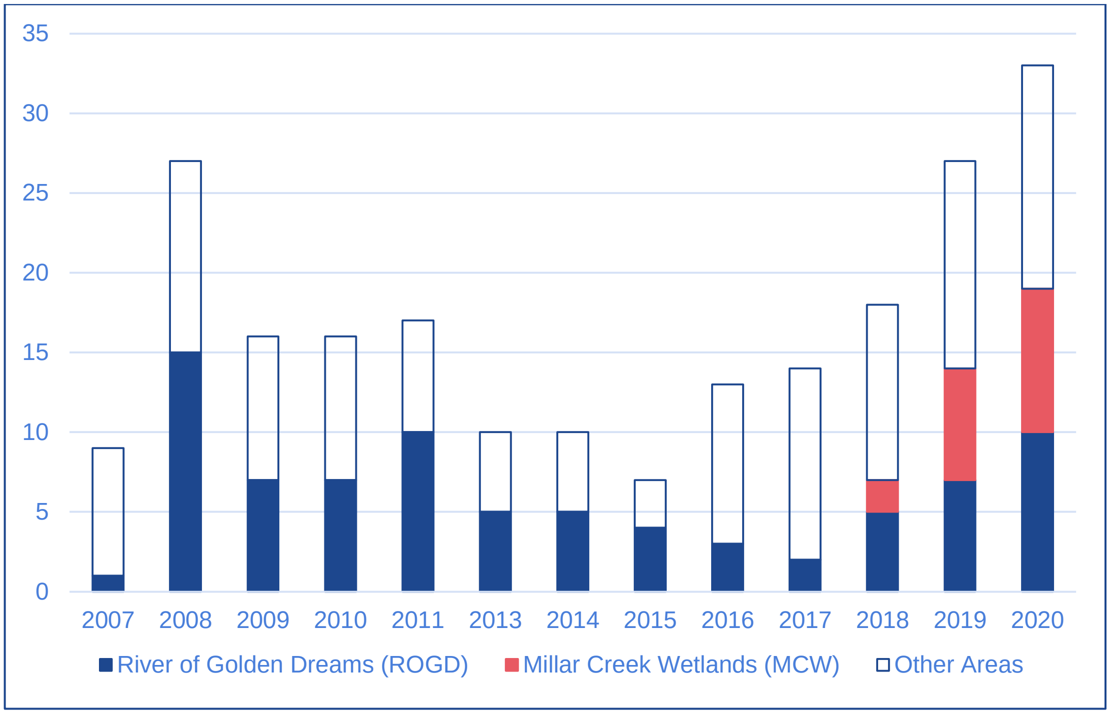

Figure 6-3. Active lodges detected on the River of Golden Dreams and Millar Creek Wetlands, 2007 to 2020, as a percentage of all lodges.

6.3.3.2 River of Golden Dream (ROGD)

The 2020 beaver survey on the River of Golden Dreams (ROGD) found 10 active lodges, of which four were newly confirmed since 2019 (Table 6-3; Appendix F). The 2020 survey marks five years of cumulative effort (2016 to 2020) to rebuild a reliable count of lodges on this creek. The 2020 documentation of 10 active lodges matches the previous high[16] from 2011 which also took five years to document (2007 to 2011). Based on that comparison, it is likely the population of beavers on the River of Golden Dreams has been mostly stable since at least 2008 in spite of variations in survey totals during that time. These results again demonstrate how knowledge accumulates with annual surveys, especially when lodges are as difficult to detect as on the River of Golden Dreams (Photo 6-3).

[16] The 2008 total of 2015 was almost certainly an overcount, as shown by subsequent surveys from 2009 to 2011.

Photo 6-3. The lodge at the bottom left of the photo is at least two metres from the water's edge and not visible without extensive search effort on land (2019 photo). Some lodges only become detectable when leaves fall off the hardhack (Spiraea douglasii) and other shrubs.

One of the most obvious and long-active lodges in Whistler (especially in winter) is in the first section of the ROGD, upstream of the fish weir and visible from the Valley Trail bridge (Photo 6-4). Beavers were very actively maintaining the associated dam between the lodge and bridge in 2019 and early 2020. As a result, the dam height in spring 2020 was high enough to alarm nearby residents who lobbied the RMOW to lower the water level by breaching the dam. As in past years, the dam was also often frequently breached due to the passage of canoes and kayaks.

Photo 6-4. The green arrow indicates the location of the lodge in the first section of the entrance to the River of Golden Dreams (February 2020 photo). This lodge is most easily seen in winter when it is highlighted by snow and not hidden by hardhack and other shrubs.

Perhaps because of the difficulty of maintaining a dam after so many breaches, or perhaps for other reasons, this colony apparently abandoned the lodge sometime in early fall, 2020. No dam maintenance or other activity was detected after that time and, shortly thereafter, new activity around the previously abandoned lodge at Rainbow Park suggested the colony may have relocated there. (See Section 6.3.4.1 for additional details about the Rainbow Park lodge.)

All but two of the lodges active on the ROGD in 2020 were located in the middle section between the bridge over the CN railway tracks and Meadow Park (Figure 6-1; Photo 6-5), which is no doubt also why most of the active dams were also concentrated in that area (Section 6.3.5). Beaver activity has also been common for many years in the last section of the ROGD, from the Highway 99 bridge to the outlet at Green Lake (next to the old Fisherman's Loop Trail). Finding lodges in this area has nonetheless been challenging, again due to the cryptic nature of the lodges amongst the hardhack. In 2020, one lodge that was reoccupied in 2019 remained active (Photo 6-6), and a second was found that was most likely active (listed as "Active?"). A full-perimeter search of Green Lake in September 2020 found no evidence of recent beaver activity, including at the now long-inactive lodge near the Nicklaus North Clubhouse. These two lodges on the last section of the ROGC and the one in Wedge Pond (Figure 6-1) are therefore the source for beaver sightings or beaver activity seen on and around Green Lake.


Photo 6-5. One of the few obvious lodges on the River of Golden Dreams.


Photo 6-6. An active lodge near the outlet of the River of Golden Dreams into Green Lake (April 2020 photo).

6.3.3.3 Millar Creek Wetlands

In hindsight, it is remarkable that the extent of beaver activity and number of lodges were not reported before 2018. Then again, surveys in this habitat require time and dedication due to difficult access, as described in last year's report (Palmer and Snowline 2020). The 2020 survey built on knowledge gained especially in 2019 to add two active lodges and bring the total to nine. As noted above and based on obvious evidence, these newly detected lodges are definitely not new. For example, two of the very large lodges are part of the overwhelming evidence of longstanding presence of beavers in the area (Photo 6-7 and Photo 6-8). Since 2018, line work by Fortis BC and Valley Trail construction have occurred at the edge of this important beaver complex (see Section 6.3.8 for additional details).

Photo 6-7. This large lodge is on the main stem of the Millar Creek.

Photo 6-8. This lodge is one of the largest found since Whistler surveys began in 2007. It is in the upstream interior of the Millar Creek Wetlands and not visible without extensive bushwhacking.

6.3.4 Other Notable Activity in 2020

6.3.4.1 Rainbow Wetlands

Spring surveys in 2020 took advantage of better lodge visibility (since leaves were not obscuring them) to survey for previously undetected lodges. One of these was in the Rainbow Wetlands and barely visible from the railway tracks. Field surveys in fall confirmed it was active, probably for many years given the abundant canals, old dams, and other evidence of past activity (Photo 6-9). This was one of two active lodges found in the Rainbow Wetlands in 2020 and it is possible (even likely) there is at least one more undetected colony, perhaps at the west end towards Rainbow Park (Photo 6-10).

Photo 6-9. Kristen Jones surveys an active beaver lodge in the Miller Creek Wetlands that was first detected in 2020 (the lodge is barely visible directly left and in front of her).

Photo 6-10. The Miller Creek Wetlands, looking west from the south gravel pit in the Emerald Forest. The green arrow on the left shows the location of an active lodge first detected in 2017. The green arrow on the right shows where an active lodge was first detected in 2020. Based on evidence nearby, it is almost certainly many years old. The orange area at the top highlights the area near Rainbow Park that has old dams and where an undetected colony may have a lodge.

6.3.4.2 *Wildlife Refuge*

Only one long-active lodge was reported in the Wildlife Refuge before 2020, in the part of the wetland that was closest to the Emerald Forest (Photo 6-11; Figure 6-1). In 2020, the west side of the wetland was surveyed for the first time. A second active lodge was found there amidst an area that had been significantly impacted by beaver activity for many years (Photo 6-12). While no other lodges were located, it is very possible one or more additional colonies are present farther west where access is even more challenging.

Photo 6-11. This lodge in the Wildlife Refuge has been active for many years. It is in the wetland fairly close to the Emerald Forest and Bird Box Trail. This photo is facing towards the north Emerald Forest gravel pit.

Photo 6-12. A second active lodge was found farther west in the wetland, in an area with abundant signs of past and present beaver activity, including several small ponds impounded by old dams such as this one. Surveyor Kristen Jones is seen standing on the lodge in the middle of the photo.

6.3.4.3 Rainbow Park

A beaver lodge that was active for many years at Rainbow Park then vacated approximately five years ago was apparently reoccupied in fall 2020. A dam with nearby tree falling was discovered adjacent to the old lodge in late October by Karl Ricker and further visits confirmed further activity through the end of 2020 (Photo 6-13). While it is clear that beavers have returned to the area and likely that lodge has been reoccupied, habitation could not be confirmed. The lodge was classed as probably active ("Active?"; Table 6-3) which was justified by the fact that there is at least one active colony somewhere in the vicinity.[17] As mentioned above (Section 6.3.3.2), it appears likely that the colony that vacated the lodge in the first section of the River of Golden Dreams may have reactivated this lodge at Rainbow Park.

[17] As mentioned above, it is possible there is an undetected lodge on the far side of the railway tracks in Rainbow Wetlands. A shoreline search of Alta Lake in fall 2020 found no other recent beaver activity, other than the recently-vacated lodge in the first section of the River of Golden Dreams (Section 6.3.3.2).

Photo 6-13. The long-dormant lodge at Rainbow Park was apparently reoccupied in fall 2020, possibly by the colony that vacated the nearby lodge in the first section of the River of Golden Dreams. The lodge is visible as a white dome in the middle background. Recent activity included these cut trees in the foreground and two dams nearby, all of which appeared after the middle of October (photo December 8, 2020).

6.3.4.4 Golf Courses

Much of the area on which in the two valleybottom golf courses (Whistler and Nicklaus North) were built was previously beaver habitat, and at least some wetlands were replaced by the otherwise upland Chateau Golf Course. It is therefore not surprising that beavers continually migrate into these areas to establish lodges, and equally unsurprising that the courses do their best to minimize beaver impacts. This section discusses beaver activities on the course during 2020; for more historic context about beavers on the golf courses, see Section 6.3.8.

Overall, beaver activity on the three courses in 2020 is among the lowest of any year surveyed since 2007. As much as can be determined, especially since course staff is often reluctant to discuss the topic, the decreased activity in 2020 was not due to beaver trapping or other control measures. In fact, the three golf courses have expressed a desire to allow as much beaver activity as possible within their overarching priority of protecting infrastructure on their courses.[18] There was no shortage of potential in-migration given the large and apparently stable beaver population elsewhere in the valley (Section 6.3.2), and rare signs on the courses of control efforts such as dam removal. Surveys in 2020 will help determine if this decrease represents a long-term trend or just a brief anomaly.

Whistler Golf Course:

In most years, beavers have been more active on the Whistler Golf Course than the other two courses, often with two or more active lodges (Appendix F). Overwinter in 2019-20, at least one lodge was active, at the #6 pond (Photo 6-14). Two others were classified as probably active ("Active?") at long-standing locations on Crabapple Creek beside the #10 green and #15 fairway There was no apparent reason for the absence of at least one beaver colony overwinter in 2020-21. No evidence of lodge damage or dam removals was found, and the course superintendent had no knowledge of other reasons.[19]

Photo 6-14. Pond 6. Yellow arrow shows lodge. Cut trees in foreground. Active overwinter. Photo taken April 18, 2020.

Later in fall 2020, however, recent beaver activity was found at the edge of the pond beside the #4 green (Photo 6-15). Although the two freshly-gnawed alders would normally suggest habitation nearby, the trees were left in place and no lodge was found in a subsequent search. The tentative conclusions from this single instance of renewed beaver activity are: (i) that there actually was an overwintering colony nearby,

[18] *Based on many communications during 2020 and prior years between Bob Brett and Stu Carmichael and Geoff Barnett (Whistler Golf Course), Gerrit Woods and Aaron Mansbridge (Nicklaus North), and Dan Nash (Chateau Golf Course).*

[19] *Personal communication between Geoff Barnett and B. Brett by phone and email various times throughout 2020.*

even though the lodge was not detected; or, (ii) a dispersing beaver considered overwintering in this area but decided against it.

Photo 6-15. Freshly gnawed alders beside the pond adjacent to the #4 tee and #5 green (video screenshot taken November 1, 2020).

Chateau Golf Course

There have been lodges for many years in the two valleybottom ponds on the Chateau Golf Course, the #2 pond and the #18 pond. Horstman Creek passes through both of them as it flows to meet Blackcomb Creek downstream of the #18 pond (Photo 6-16). The previously long-active lodge on the #2 pond has now been vacant for two years (Appendix F). While the three lodges on the #18 pond have not been active for many years, a fourth lodge was found for the first time in spring 2020. Frequent surveys throughout the year did not detect any beaver activity in the pond until mid-October when fresh clippings were found on the main dam (Photo 6-16). That lodge was therefore classified as active in 2020, and it was likely also active at least one year prior (when beaver activity was found but not an adjacent lodge, hence deemed "Active?"). The dam on the #2 pond is still functional and the lodge appears sound, so potentially re-inhabitable.

Photo 6-16. The main pond beside the #18 fairway on the Chateau Golf has provided beaver habitat for many years, though in recent years it has been intermittent. In spite of repeated visits throughout 2020, it was not until October 31st (when this photo was taken) that new cuttings on the dam confirmed it was active. The lodge presumed to house the colony that maintained this dam is hidden amidst the snags on the left side of the pond.

Nicklaus North Golf Course

There has been no active beaver lodge on the Nicklaus North Golf Course since one on the #10 pond was vacated sometime in 2016 (Appendix F). Another old lodge on the #15 pond is decrepit. The proximity of this course to the active beaver habitat on the River of Golden Dreams would suggest dispersing beavers would try to re-colonize the area, but this has not happened in recent years.

6.3.4.5 Millar Creek (Downstream)

Given how many lodges are active in the Millar Creek Wetlands, it is not surprising beavers inhabit the creek downstream of it as well. Even with this knowledge, it took until 2019 for the annual survey to detect any evidence of habitation when a large dam was found beside the west end of Function Junction and directly upstream of the CN railway tracks (Photo 6-17). While 2019 surveys were unable to detect an associated lodge, 2020 surveys found two active lodges for the first time, directly upstream of the dam. These lodges are farther south and west of any so far documented within the RMOW, and at the edge of the Development Footprint that defines the main study area.

Photo 6-17. This Millar Creek dam downstream of Function Junction was first discovered during 2019 surveys but the associated lodge(s) were not found. In 2020, two active lodges were confirmed upstream of it, and within approximately 100 m.

6.3.5 Beaver Dam Survey on the River of Golden Dreams (ROGD)

6.3.5.1 Reasons for a Survey of Beaver Dams

The ROGD is heavily used for summer commercial and non-commercial recreation. Paddlers in and on various watercraft (canoes, kayaks, inflatable boats, and paddleboards) crowd the river. Warm summer days are especially busy, for example, over 100 people per hour passed by a counter one sunny day in 2020.[20] Since each of these users needs to negotiate the many beaver dams they encounter, dams are frequently breached. Breaches and/or dam removals are also caused by concerns related to flooding and to the passage of spawning fish.

Not everyone sees beaver dams as impediments to be breached or removed. Wildlife ecologists and some land managers welcome beaver dams since they create habitat, reduce impacts of flooding, reverse erosion through the aggradation of sediments, and retain water through dry seasons (Runtz 2015; Goldfarb 2018; Section 6.3.6). One less-known benefit of beaver dams is that they not only slow and impound the open water upstream of the dam; they also distribute and store water in the surrounding (wet)lands (Goldfarb 2018). This impact is almost certainly large and therefore important for flood and wildlife concerns within the ROGD wetlands and other areas in Whistler (Section 6.3.6).

[20] *Tara Schaufele, by video conference with Bob Brett, November 17, 2020.*

Local commercial operators are another group with a positive view of beavers and beaver dams (as long as dams still allow passage of watercraft). They cite two main reasons why beaver dams help their businesses:

1. their guests enjoy connections with nature such as evidence or sightings of beavers;[21] and,
2. they help maintain mid-summer water at levels that prevent or reduce closures.[22]

As recreation levels continue to grow, the RMOW has been increasingly challenged to manage interests that often conflict, and never more than in 2020. Recreational use of the ROGD reached new peaks due to the Covid 19 pandemic as local and regional residents searched for outdoor experiences,[23] Commercial operators saw a decrease in revenue from non-BC tourists and were also challenged by river closures to protect spawning kokanee. Water levels were high in spring due to a beaver dam next to Adventures West in the first section of the ROGD, and residents called the RMOW with fears of flooding. And the protection of spawning kokanee in late summer remained a prime concern for the RMOW. As a result, beaver dams were thrust into the spotlight more than ever. To help take stock of the situation and inform future management actions, the RMOW therefore requested an inventory of beaver dams on the ROGD. The survey was done on September 11, 2020.

6.3.5.2 Survey Methods

In preparation for the survey, various measurements to describe the dams were tested, some of which proved unworkable or unnecessary. The data form was therefore modified to include the following information about ROGD dams:

- Location (UTM);
- Width of the creek at the dam;
- Width of breach (if any);
- Height of water impoundment including: (i) actual height at the time of the survey, (ii) estimated height if there were no breach; and (iii) maximum (flood) height based on upstream height of the dam;
- Activity level (active or inactive) based on condition of dam and recent maintenance; and
- Comments, including those related to river users (difficulty of passage, cause of breach, etc.).

Impoundment heights were estimated based on the difference, if any, in the height of water adjacent to the upstream and downstream sides of the dam. While the original plan was to also measure water depths at those locations, the aggradation of sediments upstream of many dams (as well as some scouring below those dams) reduced the potential utility of those measurements and they were therefore abandoned.[24]

6.3.5.3 Survey Results

The survey was done by canoe on September 11, 2020 when a total of 12 dams were documented between Alta Lake and Green Lake (Table 6-7; Figure 6-4; Appendix G). Most of the dams were in the middle

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[21] *Eric Wight, by video conference, November 17, 2020.*

[22] *Keenan Moses, Eric Wight, and Craig Ross, by video conference, November 17, 2020.*

[23] *Ibid.*

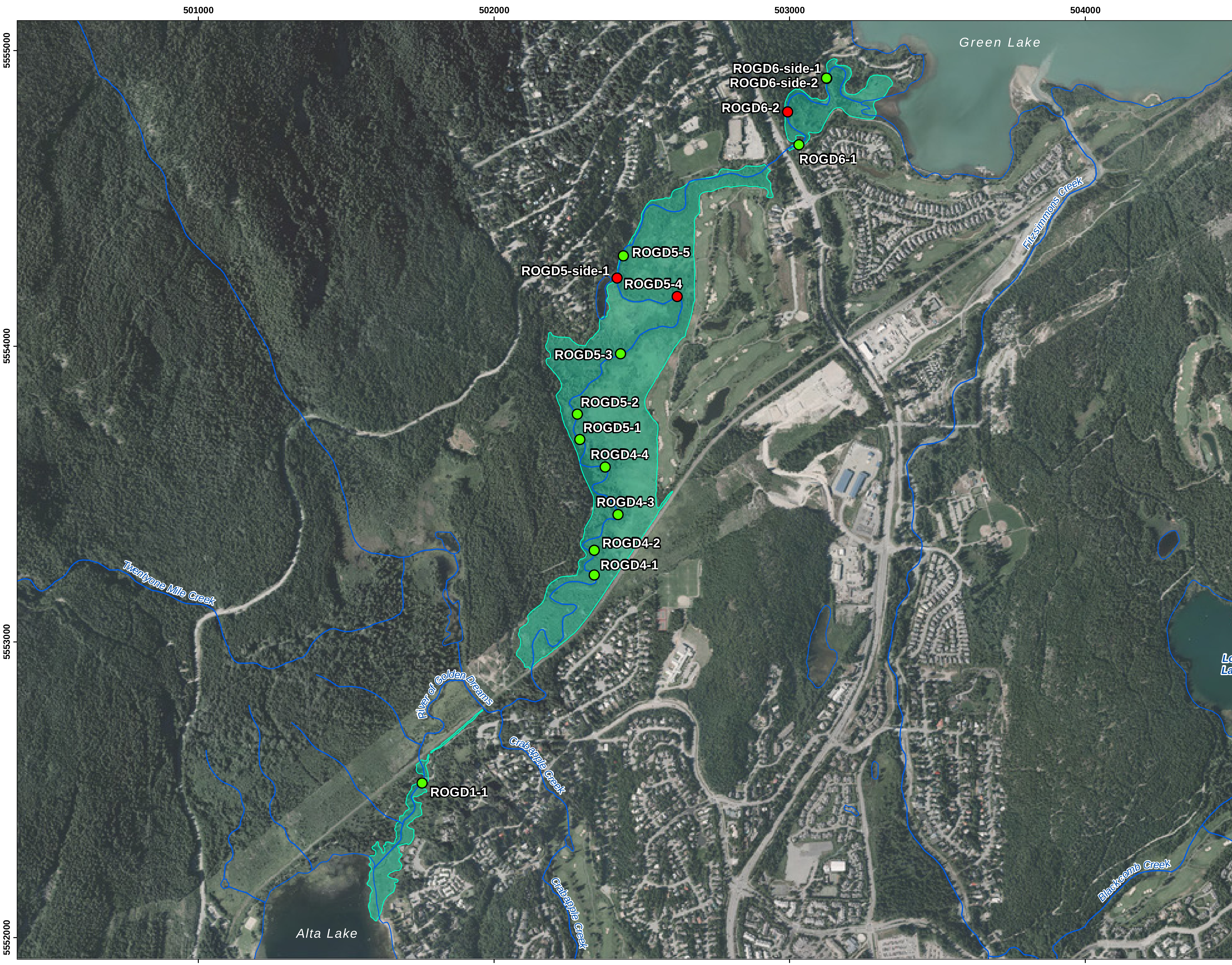
[24] *Measuring aggradation upstream of dams is still of interest, especially where dams have been in place for many years. To measure them accurately (e.g., differentiating between depths with and without dams), a more involved method than attempted in 2020 would be needed.*

sections (Sections 4 and 5[25]), especially the largest and most active ones, and were associated with the largest concentration of active lodges on the river (Figure 6-1).

Table 6-7. Dams on the River of Golden Dreams, September 11, 2020.

Dam No.	Status	Impoundment Height (cm)			Dam Width (m)	Breach Width (m)
		Actual	Without Breach	Maximum (Flood)		
ROGD1-1	Active	15	15	25	8	1
ROGD4-1	Active	25	30	50	8	1
ROGD4-2	Active	25	30	35	9	1
ROGD4-3	Active	40	40	40+	7	none
ROGD4-4	Active	40	50	75	8	1
ROGD5-1	Active	40	50	60	8	2
ROGD5-2	Active	10	15	30	9	4
ROGD5-3	Active?	5	15	15	10	3
ROGD5-4	Inactive?	0	10	15	9	3
ROGD5-5	Active	30	40	60	11	2
ROGD6-1	Active	20	20	20	13	1
ROGD6-2	Inactive	0	0	0	10	5

[25] *Section 4 extends from the CN railway bridge to the meander that is closest to the Valley Trail. Section 5 extends from that point to the upstream side of the bridge over Highway 99. The border between the two is between Dam 4-4 and Dam 5-1 (Figure 6-4).*



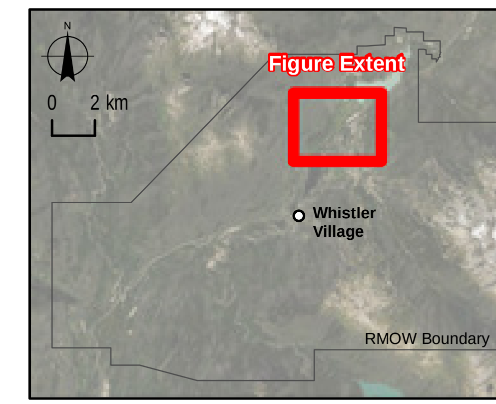
Legend

2020 Beaver DamStatus

- Active
- Inactive

- Beaver Affected Wetland Along the River of Golden Dreams
- RMOW Boundary
- Watercourse

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



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DATE: Feb 10, 2021

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UTM Zone 10N
NAD 1983

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PROJECT: Annual Monitoring 2020

Beaver Dams Along the River of Golden Dreams 2020

FIGURE 6-4

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

All but one of the dams was breached, presumably by paddlers, but the actual water level measured on that day was generally not much different that the estimated level without a breach (Table 6-7). In addition, the tops of the dams, which would be the maximum possible water level they could impound in a flood, was not more than 25 cm above the non-breach level. The dams were thus not as large as would be expected in undisturbed areas (e.g., Morgan 1986; Runtz 2015; Goldfarb 2018) and showed evidence consistent with frequent breaching by boaters. Maybe more surprisingly, many dams had been recently maintained with fresh twigs but not enough to not enough to significantly raise water levels, at least while paddlers were on the river (Appendix G).

This baseline survey served as a test for what could be learned from inventorying dams on the ROGD, and of which data to collect. In future, two changes could be made to the surveys:

1. The addition of surveys in spring and late fall (if stream flow permits) would help quantify the impact of recreation on dams. That is, when traffic is low in spring and later fall, breaches should be fewer and water levels higher than when most paddlers use the ROGD. The non-peak survey(s) could then be compared to the peak surveys.
2. Significant aggradation of sediments was observed at some of the larger, longer-established dams (Photo 6-18). It could be useful to quantify the amount of sediment deposition, both as an indication of the age and impact of those dams, and as an indication of their impact on raising water levels in the adjacent wetlands.

Photo 6-18. (left) Sands and other fine materials aggrade on the uphill edge of dams, especially when they have occupied the same location for many years. (right) This photo of the same dam (ROGD4-1) shows its full width, a breach caused by boaters, as well as fresh twigs used unsuccessfully by beavers to restore the intended height of the dam. This dam has been impounding water for at least 35 years (Photo 6-20).

6.3.5.4 *Additional Observations*

The largest impoundment pond on the ROGD for many years is upstream of dam ROGD4-1 (Photo 6-18 and Photo 6-19). Based on RMOW online imagery, this dam has been active at least since 1995 (Photo 6-20) and likely for many decades before. Not coincidentally, it also has the highest concentration of active and inactive lodges so far found on the ROGD. One very large and very long-active lodge that is not visible from the water is hidden behind hardhack shrubs at the north end of the pond. Other currently inactive lodges are nearby and also extremely cryptic (Photo 6-4).

Photo 6-19. The ROGD4-1 dam (Figure 6-4) impounds the most water of any dam on the River of Golden Dreams and has the largest concentration of active and inactive lodges so far found. One large and long-active lodge is hidden behind the hardhack shrubs on the far side of the river, in the middle of the photo.

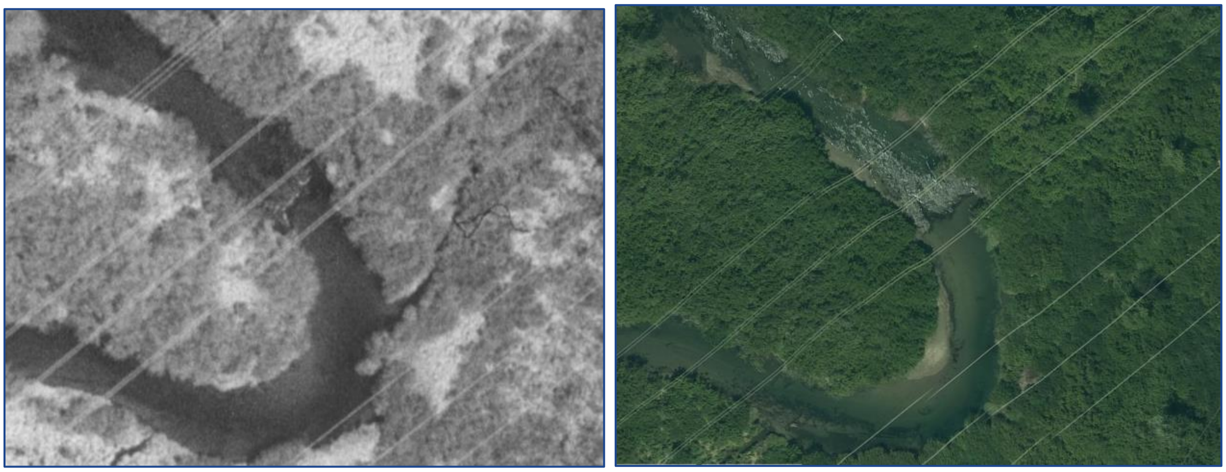

Photo 6-20. RMOW imagery of dam ROGD4-1 in 1995 (left) and 2018 (right).[26] The dam is near the middle of the photo, under the middle power line.

Boaters observed during the survey had varying levels of difficulty navigating the dams (Photo 6-21). Constant passage over breaches in the dams presumably offset daily maintenance by beavers.

Photo 6-21. Paddleboarders navigating dam ROGD4-1.

[26] https://webmap.whistler.ca/HTML5Viewer/Index.html?viewer=ExternalGIS. *Accessed February 21, 2021.*

Although a single survey cannot quantify the impact of paddlers on beaver dams, there were indications that more water would be impounded if dams weren't constantly breached (Photo 6-22). On the other hand, and in spite of such frequent disturbance, most dams continue to be functional, albeit at a lower level.

Photo 6-22. Dam ROGD4-2 impounded less water than those seen in less-disturbed areas. The numerous branches used in its construction are no longer stacked on top of each other and presumably impounded more water when they were. Similar to most of the dams surveyed, fresh twigs in the breach show recent maintenance efforts.

Other dams, especially downstream on the ROGD, were not functional when surveyed (Photo 6-23). Without previous data, it was not possible to determine when it was last maintained by beavers. For example, twigs with brown leaves were on the non-functional dam ROGD5-3 which could have been a result of past and fairly recent (2019?) maintenance, or simply that the twigs had been swept downstream from another, active part of the river.

Photo 6-23. Dam ROGD5-3 was non-functional and not recently maintained as of September 11, 2020.

6.3.6 Beaver-affected Wetlands

6.3.6.1 Updated Calculation of Total Area

As mentioned above (Section 6.1), a beaver's life is inextricably involved in creating its own habitat. Their incredible ability to alter and saturate landscapes is recognized in their description as "wetlands engineers." By creating and maintaining wetlands, beavers provide habitat for countless plants and animals, reduce erosion, and mitigate floods (Müller-Schwarze and Sun 2003; Goldfarb 2018). The first attempt to quantify the local effect of beavers on the landscape was included in the first mapping of "beaver-affected wetlands" (Palmer and Snowline 2019), that is, the area of wetlands that have been created and/or directly affected by beavers within Whistler Valley.

The goal of the 2018 maps was to create a baseline calculation of how much area beavers have created in Whistler Valley, and to monitor that area over time. The 2018 report included a discussion of the challenges in producing accurate maps of beaver-affected wetlands, since the only way to confirm that area would be to remove beavers until their dams no longer impounded water. Nonetheless, it produced maps that yielded areal totals that could be monitored over time. There has only been a minor change in area since then, when in 2019 field-truthing revealed more wetted area in the Millar Creek Wetlands than was evident from air photos (Palmer and Snowline 2020).

As of 2020, the area of beaver-affected wetlands has therefore remained at just over 100 ha (Table 6-8; Figure 6-5). These results show that no appreciable beaver habitat was either gained or lost since 2018, and an indication that wetlands have been protected by the RMOW during that time.

The River of Golden Dreams (ROGD) continues to account for almost half of all beaver-affected wetlands in Whistler (Table 6-9). The middle section, ROGD-4 and ROGD-5, accounts for the largest area and is also where most of the active beaver lodges were located in 2020 and past years. Two of the next largest beaver-affected wetlands are the Rainbow Wetlands and the Wildlife Refuge (Table 6-5). Before the railway and subsequent developments, the ROGD wetland would have been directly connected to the Wildlife Refuge and Rainbow Wetlands in a complex spanning from Alta Lake to Green Lake, and which would have included what are now the Whistler and Nicklaus North Golf Courses (McBlane 2007). In addition, connections would have extended south through Alpha Lake to the Millar Creek Wetlands and no doubt provided much more beaver habitat than now. Descriptions of these and the other wetlands in Table 6-8 are included in the next section.

Table 6-8. Location and area of beaver-affected wetlands in Whistler, 2020.

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

Note: Although Alpha Lake is not classified as a wetland, the long-active dam that raises the water level by up to 1 m increases the area of the lake by approximately 7.1 ha.[27] When added to the total above, it brings the area affected by beavers to over 107 ha

Table 6-9. Area of beaver-affected wetlands on 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 Twenty-one Mile Creek and railway bridge; this section is not included because no beaver activities have yet been detected there.

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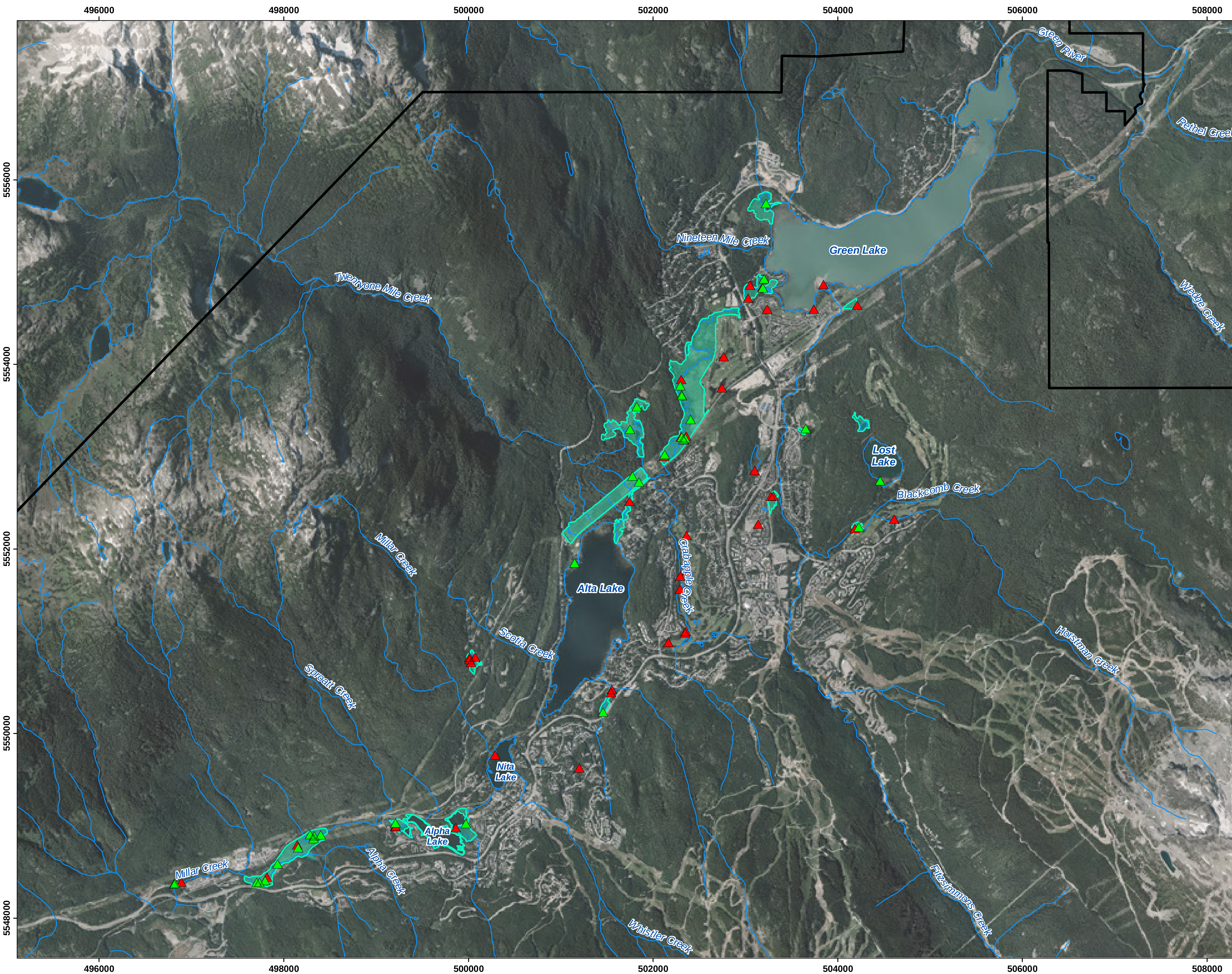
[27] *This estimate is based on GIS analysis performed for the 2018 report.*



Legend

2020 Beaver Lodge Status

- Active
- Inactive

- Beaver Affected Wetland
- RMOW Boundary
- Watercourse

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

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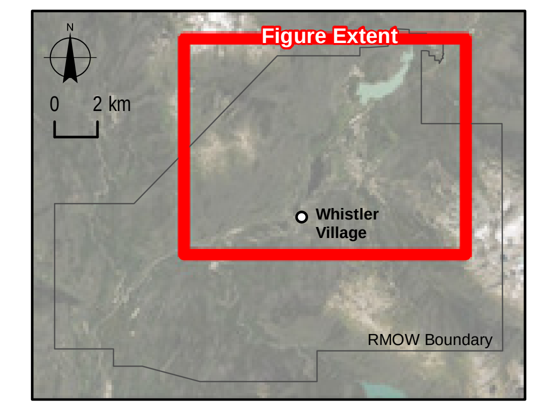

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Results of 2020 Census of Beaver Lodges and Beaver Affected Wetlands in Whistler

FIGURE **6-5**

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6.3.6.2 Historic Context

Among other impacts, there were four main changes that that significantly impacted beavers since the railway was built in 1913:

1. The railbed raised water flows in some areas and lowered them elsewhere.
2. The railway facilitated the development of Whistler which brought more people.
3. Beavers were mostly extirpated from the valley within a few years after the railway opened, presumably due to trapping for pelts (Racey and McTaggart-Cowan 1935); and,
4. The expanded development that began with the opening of Whistler Mountain in 1966 and significant loss of beaver habitat since.

The railway bisected the large wetland complex mentioned above[28] 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 6-10; Figure 6-5). The loss of wetlands has definitely slowed since McBlane's (2007) calculations, though it is not possible with current data to provide exact figures. The RMOW's most recent mapping in 2014 showed that approximately 25% of the wetland area remained below 800 metres and within the Development Footprint[29] (Table 6-10).

Table 6-10. Wetland area in the RMOW by year and scope.

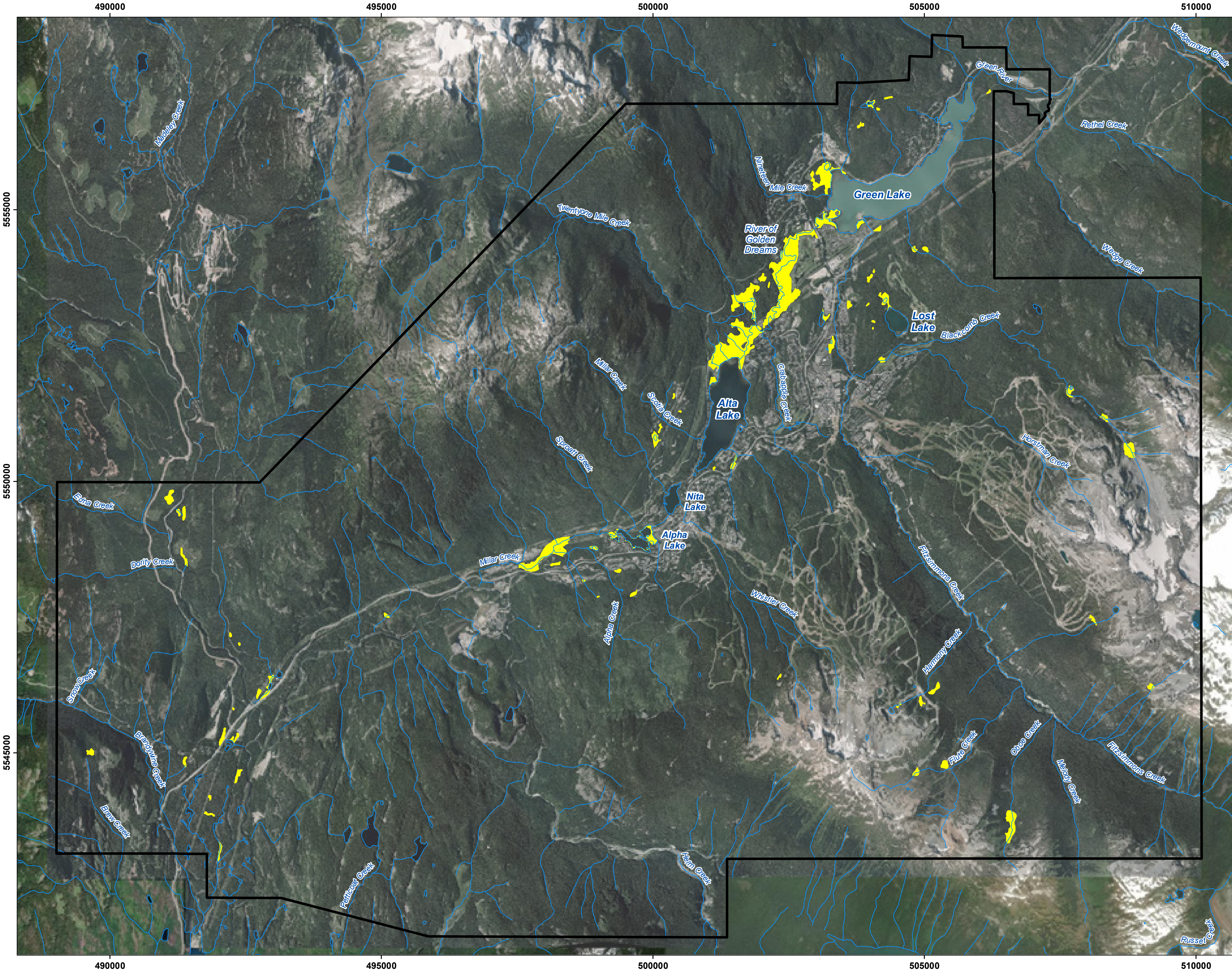
Year	Wetland Scope	Area (ha)	Compared to 1946	Source
1946	All RMOW	604.4	100%	McBlane 2007
2003	All RMOW	169.9	28%	McBlane 2007
2014	All RMOW	193.4	32%	Palmer and Snowline (unpubl. mapping)
2014	All RMOW <800 m	169.7	28%	Palmer and Snowline (unpubl. mapping)
2014	<800 m, study area only	150.7	25%	Palmer and Snowline (unpubl. mapping)
2018	Beaver-affected, study area only	94.7	16%	Palmer and Snowline 2019
Current	Beaver-affected, study area only	100.3	17%	Palmer and Snowline 2020

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.

A comparison of wetlands affected by beavers (Figure 6-5 and all wetlands (Figure 6-6)) 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 2020 (Table 6-7).

[28] Rainbow Wetlands, Wildlife Refuge, and River of Golden Dreams, and Whistler Golf Course.

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



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).

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Wetlands

FIGURE 6-6

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

Millar Creek Wetlands

Ground-truthing the area affected by beavers in the Miller Creek Wetlands in 2019 brought the total to 13.3 ha (Photo 6-24). In spite of the very large population of beavers in this wetland (Section 6.3.3), further expansion of it through damming is limited by topography and, to a less extent, the new Valley Trail that acts as a berm (discussed in Section 6.3.6.3).

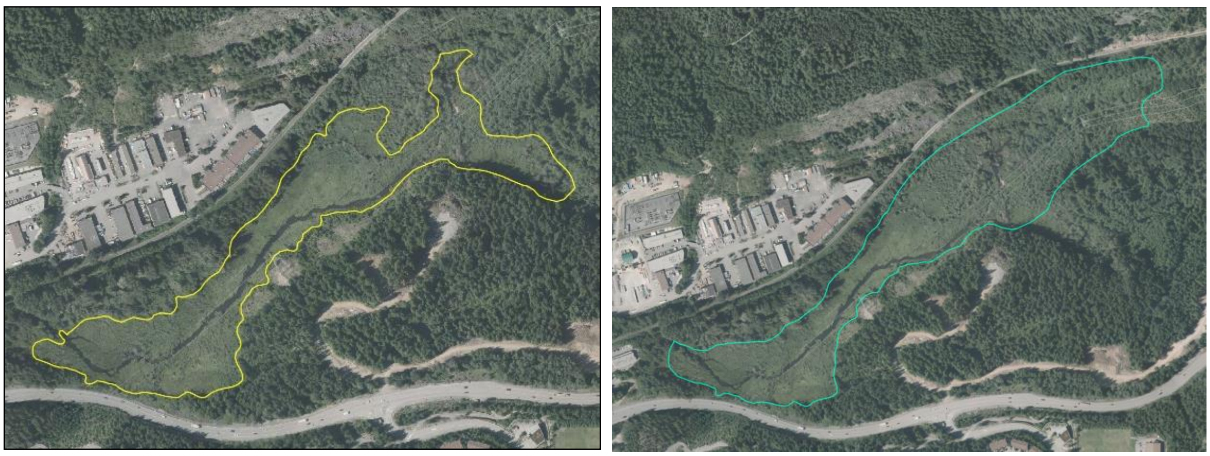

Photo 6-24. (left) Air photo analysis in 2018 estimated that 7.6 ha were by beavers in the Miller Creek Wetlands. (right) Ground-truthing in 2019 showed 13.3 ha were actually affected by beavers. Most of this increase was due to flooded areas under tree cover that were not detectable from air photos. This area has remained mostly unchanged in 2020, in spite of Valley Trail construction and gas pipeline installation.[30]

Beaver Lake

Beaver Lake had four active lodges for many years that have now been inactive for at least a decade. While active lodges are not present, the old lodge structures are still visible, and the related dams still impound water (Photo 6-25). There is no known impediment to recolonization by beavers in this location.

[30] Since the roadbed was widened during pipeline construction (Lorne Russell, personal communication with Bob Brett by phone, February 22, 2021), the wetland area would be slightly less. Once construction is finished, the area should be measured again.

Photo 6-25. 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; (Photo 6-26). In September 2019, RMOW crews installed a pipe to lower the water level approximately 1.0 to 1.5 m.[31] As of summer 2020, the situation stabilized into two ponds, the higher of which contains the active lodge. Topography precludes much further expansion of this pond, as does the adjacent roadbed and RMOW efforts to protect it.

Photo 6-26. (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 (2019 photo).

Rainbow Wetlands

The Rainbow Wetlands complex is a large swath of partially-inundated land with a long history of beaver activity (Photo 6-27, left; Section 6.3.4.1). Before the railbed was built in 1913, this wetland would have been continuous with the River of Golden Dreams Wetland complex (Section 6.3.6.2). The RMOW's wetland layer of the Rainbow Wetlands area (Figure 6-6) includes moist, forested areas especially on the upstream side of Twenty-one Mile Creek which means that the area mapped here likely underestimates

[31] *Described in the 2019 report (Palmer and Snowline 2020).*

the full extent of wetted area. The northern half of the wetland has had active lodges for many years, but none have yet been found in the southern half where there is still a large, long-standing dam that impounds water adjacent to associated channels and ponds (Photo 6-27). These prominent features show that beavers have definitely inhabited this area for many years and may mean there is also at least one undetected colony nearby.


Photo 6-27. (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

The active lodge in the pond at the north end of the Fitzsimmons Wetland (southeast of the corner of Blackcomb Way and Nancy Green Drive; Photo 6-28; Figure 6-1), first reported in 2018 by the RMOW's Hillary Williamson, remained active in 2019. Although the dams at the outlet from the beaver pond to Fitzsimmons Creek still impounded water in fall 2020, no recent evidence of activity near the dams or lodge were detected. The lodge was therefore classified as probably inactive ("Inactive?"), which will be confirmed in next year's survey. There is also a second, long-inactive lodge in this wetland and abundant evidence of past beaver use that probably predates the orphaning of the wetland when Blackcomb Way was in the late 1980s.

This wetland is the only remaining remnant of the large wetland that the Village North development replaced in the late 1980s and the 1990s. Even when inactive (for an unknown number of years before 2017), old beaver dams kept water levels high and current dams have likely raised them even further. In spite of this activity, the construction of the Montebello bioswale in 2007 apparently reduced water flow north into the Fitzsimmons Wetland enough to allow encroachment by cattails (*Typha latifolia*) and bulrushes (*Scirpus* spp.). Beavers and their dams perform an important role in keeping water levels high and preventing the replacement of open water by emergent aquatic plants. Surveys in spring 2021 will help confirm if this lodge was actually active overwinter and fall surveys will determine if it is still occupied, reoccupied, or vacant.

Photo 6-28. The beaver-affected wetlands at Fitzsimmons Wetland: outlline (left) and the lodge that was active until 2019 but likely inactive overwinter in 2020-21 (right).

Chateau Golf Course #18 Pond

The Chateau Golf Course #18 Pond (Photo 6-29) is another remnant of a historically larger wetland. A very large dam (Photo 6-30) has impounded water in this the wetland for many years, at least dating back to the first beaver surveys, but likely for many years previous to that. The main pond drained in 2018, apparently due to lack of maintenance by beavers,[32] and highlighted the role of beavers in creating wetlands. Since 2019, the pond has reached most of its previous size due to renewed maintenance (Photo 6-16).

Photo 6-29. Chateau Golf Course #18 Pond.

[32] *Dan Nash, the course Superintendent, confirmed his staff did not drain the pond (personal communication with Bob Brett, Oct. 2018).*

Photo 6-30. The Chateau Golf Course #18 pond in fall 2017 (top); fall 2018 (middle), and fall 2020 (bottom). In late 2018, the long-standing dam failed and the pond drained, presumably due to lack of

beaver maintenance. Beaver activity was again detected below the dam in 2019 but the associated lodge was not found until late 2020.

Wildlife Refuge Wetland

There is evidence of beaver habitation for at least 20 years in the Wildlife Refuge Wetland (Photo 6-31),[33] but it is almost certain beaver activity predated the railway in 1913. Beaver dams have raised water levels enough to maintain open water in various parts of the wetland and signs of beaver activities are common in the area. A second active lodge was discovered in 2020 in the western half of the wetland where old dams have significantly raised water levels. Without these dams, the wetted area would be much smaller.

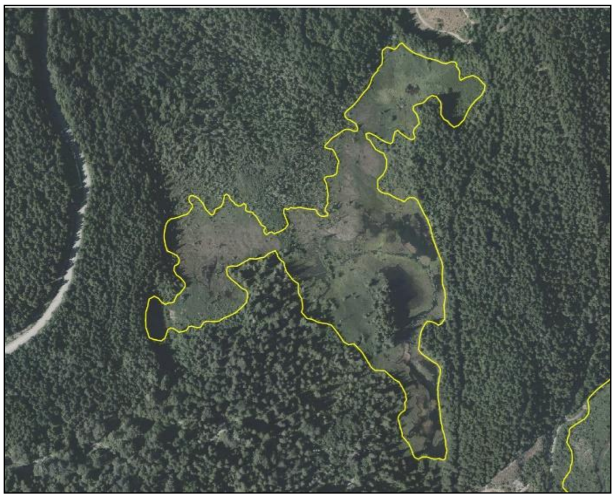

Photo 6-31. Beaver-affected wetlands in the Wildlife Refuge.

Photo 6-32. The beaver-affected wetland at Spruce Grove Park.

Spruce Grove Wetland

There has been beaver activity in Spruce Grove Park for at least the last three years and water levels are contingent on how the flow at the outflow weir is maintained by the RMOW. The active lodge was located for the first time in 2017 and still active in 2020 (Photo 6-33). The extent of the wetland is restricted by pavement on its west side and the water level acceptable to, and maintained by, the RMOW.

[33] *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).*

Photo 6-33. The active lodge at Spruce Grove Park is a classic defensive lodge surrounded by water. If water levels dropped due to RMOW management, it would probably preclude use of this lodge.

Lost Lake – Sawmill Wetland

The 2020 surveys found evidence of feeding and repairs to the outflow dam in the old sawmill site north of Lost Lake (Photo 6-34). 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 on Lost Lake itself. As long as this dam is maintained and intact, it will retain the larger wetted area that has remained the same for many years.

Photo 6-34. The beaver-affected wetlands north of Lost Lake at the old sawmill site.

Photo 6-35. The beaver-affected wetland at Buckhorn Pond.

Buckhorn Pond

Buckhorn Pond is connected to the River of Golden Dreams Wetlands and is the only large pond within that complex (Photo 6-35). Water levels are maintained by a dam that, although functional, has not been repaired by beavers in at least three years. Based on the presence of sawn logs, nearby residents have helped keep it functional. 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 pond for foraging.

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 6-8; Table 6-9). This is a challenging system to survey 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 Twenty-one Mile Creek);
- ROGD-3 (Twenty-one 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 in recent years.

ROGD-1 (Alta Lake entrance to fish weir)

The first segment of the River of Golden Dreams (Photo 6-36; left) includes one large, long-standing lodge upstream of the Valley Trail bridge. The dam was higher than usual in spring 2020 which led to flooding concerns from neighbouring residents, but also showed this part of the wetland could be larger if it weren't adjacent to housing. The lodge was apparently vacated in fall 2020 (Sections 6.3.3 and 6.3.4).

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

The second segment of the River of Golden Dreams is a narrow, constructed channel defined by the CN railbed adjacent to it and constructed as an outlet from Alta Lake (Photo 6-36, right). Active lodges also have been previously observed in this area (e.g., Tayless 2010), but none in recent years. Similarly, no dams have been recorded on this channel for many years and therefore the wetland area surrounding it is almost non-existent.

Photo 6-36. 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 6-37; Table 6-9), and also supports the highest beaver population (Section 6.3.3). As of fall 2020, dams in this area raised the water level by up to 40 cm (Section 6.3.5), thereby raising the water table in surrounding areas and maintaining a larger wetland than would otherwise occur.

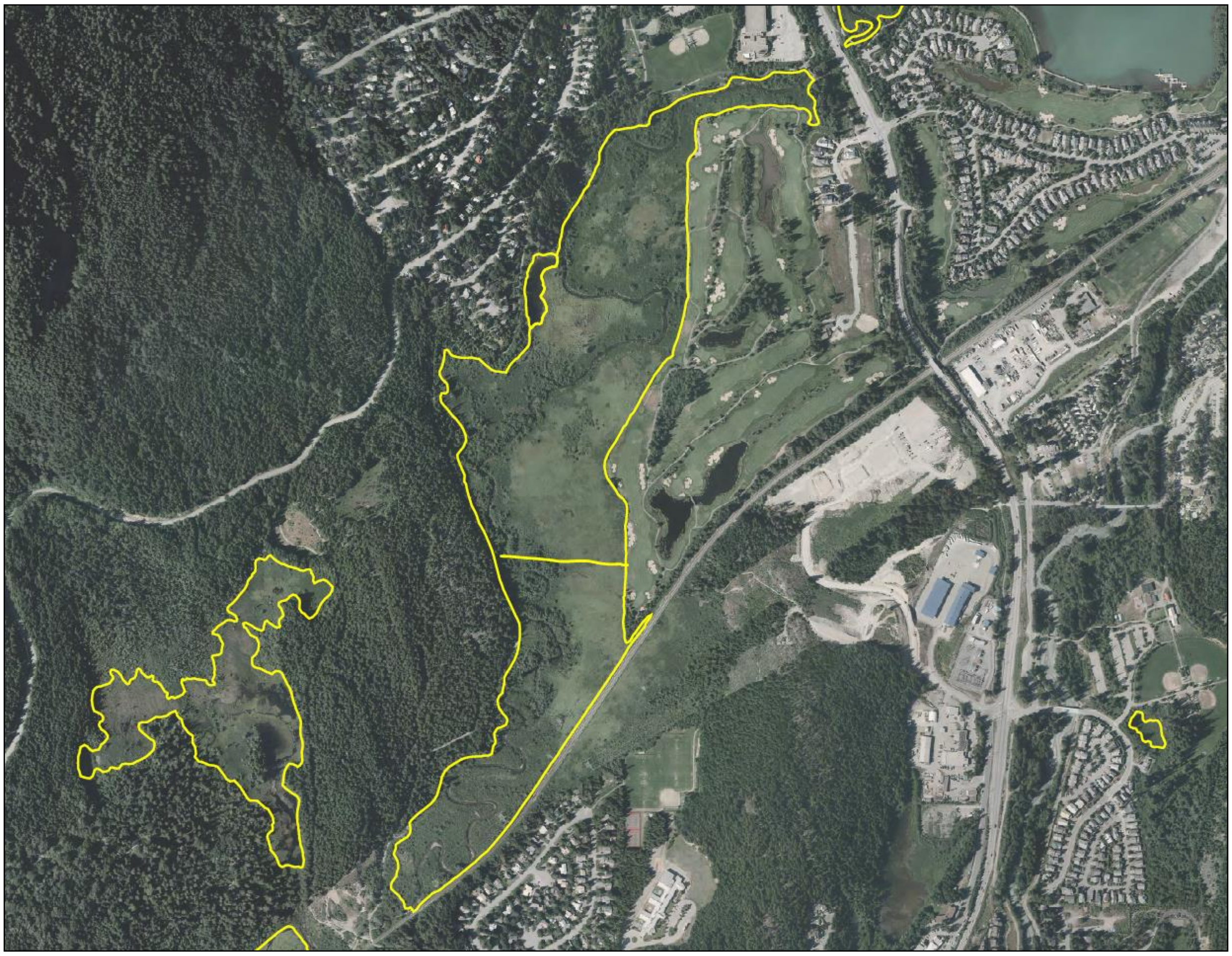

Photo 6-37. The largest contingous wetland that the River of Golden Dreams passes between the railway bridge to the south and bridge over Highway 99 to the north. This area is coded as ROGD-4 (south end of the polygon) and ROGD-5 (north end of the polygon). The Wildlife Refuge Wetland is shown to the 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 6-38). Although small dams are found each year, they seldom to impound much, if any, water (Section 6.3.5) and therefore have not had much of an impact on water levels in the surrounding wetland. Two lodges were active in this section, near the outlet to Green Lake.

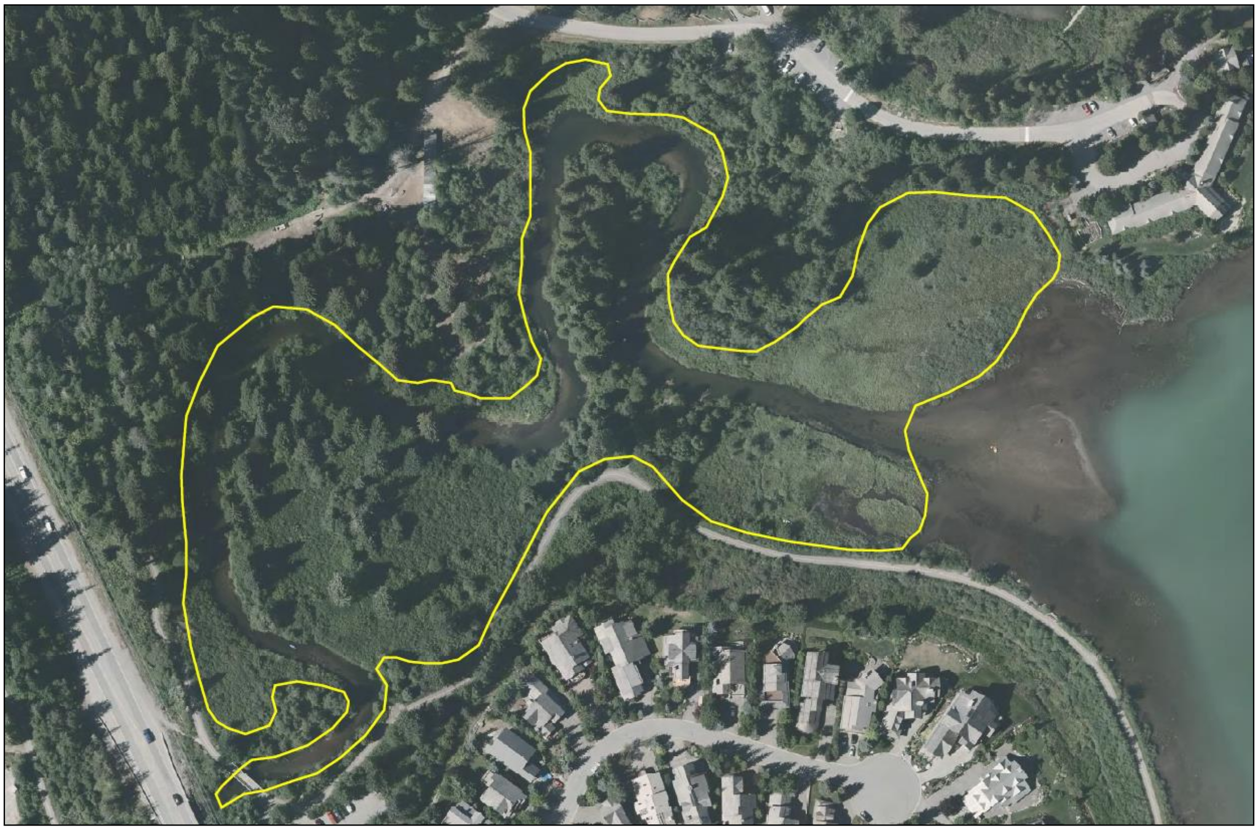

Photo 6-38. The northmost section of the River of Golden Dreams wetland, ROGD-6, is located between the Highway 99 bridge and Green Lake.

Fitzsimmons Creek Back Channels

The Fitzsimmons Creek back channels (Photo 6-39; left) 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 (Figure 6-1). Extensive beaver activity was first documented in this location in 2016 but no active structures were detected until 2018 when one large, active lodge and six burrows were found. Surveys since have found evidence of beaver activity including feeding and caches but have concluded there there is no acive lodge nearby. (Assuming that conclusion is correct, the beaver activity must be from the lodges at the mouth of the River of Golden Dreams.) It is unclear whether the construction of the Muffin Man bike trail in 2018 and 2019 (Photo 6-39; right) had any role in beavers vacating the area. This area is different than most beaver-affected wetlands in Whistler since it is likely wetter now than before the overflow channel from Fitzsimmons Creek was created.

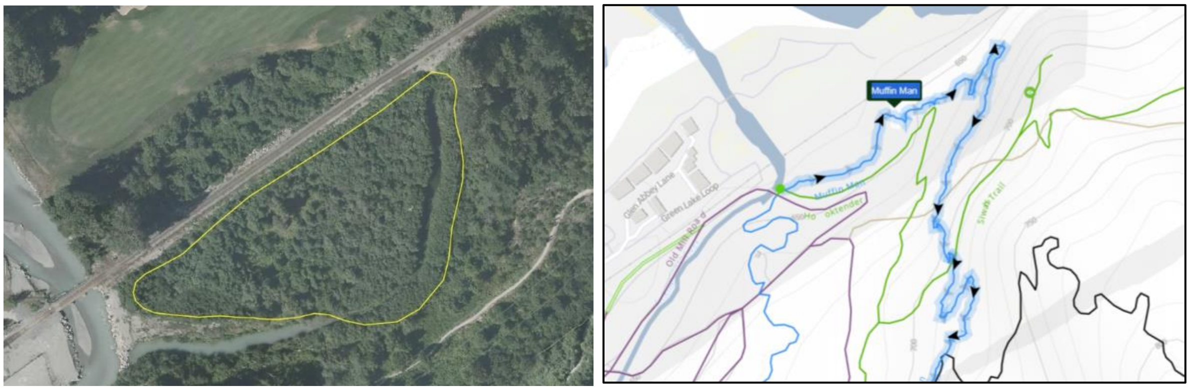

Photo 6-39. The approximate area influenced by beavers at the Fitzsimmons Creek back channels.

<u>Wedge Pond</u>

A lodge at Wedge Pond (Photo 6-40) has been active since at least 2018. Although active lodges have not been found in many survey years, there has always been extensive evidence of their presence and the dams have remained intact enough to maintain the wetland area.

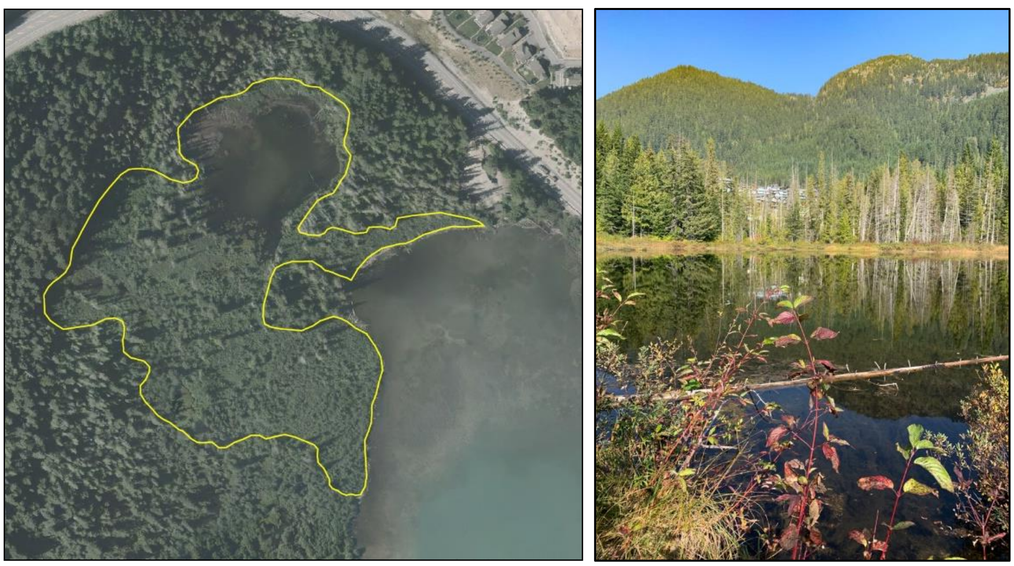

Photo 6-40. The beaver-affected wetlands at Wedge Pond.

<u>Alpha Lake (non-wetland)</u>

Alpha Lake is the only non-wetland area included in the discussion of beaver-affected habitats. 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 (Photo 6-41). 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 again detected in 2020. For comparison, long-time resident Don

Maclaurin saw six lodges on Alpha Lake when he moved to Whistler in the 1960s.[34] He did not mention if the dam was higher at that time, that is, if the lake covered even more area due to beaver activity.

Photo 6-41. 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.

6.3.7 Population Proxies – Historic Mapping and Trapping Records

Before surveys began in 2007, there was no valley-wide documentation of Whistler's beaver population. Nonetheless, it is safe to assume the loss of habitat combined with trapping has reduced that population, at least since the railway was built in 1913. There are currently three possible sources of information that could establish a reliable estimate of the past population:

- Historic accounts, e.g., Racey and McTaggart-Cowan (1935);
- Trapping records; and
- Estimated extend of wetlands now compared to pre-development (e.g., McBlane 2007).

Ken Racey and Ian McTaggart-Cowan (1935) provide the only reliable data found so far about beavers in the early days of the PGE Railway and the settlement of Alta Lake (pre-Whistler). They noted that trapping (probably for pelts) had virtually eliminated beavers twenty years prior (ca. 1915), which must have been related to new access via the railway that opened in 1913. They also noted that there was extensive evidence of past beaver occupation in areas near the River of Golden Dreams, but didn't extend their observations to other parts of Whistler.

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

If available, government trapping records for the Whistler area would be another useful indication about the past beaver population. That information has proved to be elusive, either because it does not exist or because it has (so far) been mostly inaccessible. The first search for trapping records last year (Palmer and Snowline 2020) was unsuccessful. Government agencies either did not have that information, it was too geographically vague to extract local records, or it only recorded trapping for pelts and not for nuisance control. Although no further information has been found in time to include in this report, efforts will continue with the goal of including them in the 2021 report.

In spite of this lack of information, it is possible to make two conclusions about the beaver population in Whistler's past:

1. Trapping significantly reduced the beaver population in the early 1900s (Racey and McTaggart-Cowan 1935).
2. That population loss was compounded by the estimated loss of 72% of wetland habitat since. (McBlane 2007).

Using McBlane's (2007) estimate, Whistler's wetland area was approximately 3.6 times the area it occupies in 2020. Assuming a direct correlation with beaver habitat, that means that Whistler once supported a population of roughly 700 beavers (based on 3.6 x the estimated 2020 population of 192; see Section 6.3.2), at least before trapping so significantly affected the local population.

Although it is reasonable to assume a strong relationship between habitat size and population, there is no basis to estimate beaver density pre-development. Since density is variable across different habitats (Müller-Schwarze and Sun 2003), it is impossible to determine conclusively if densities were different in the past. That said, Don MacLaurin's observation of three times more lodges in Alpha Lake in the 1960s than in 2020[35] provides at least one example of higher beaver density in the past. It also helps validate the contention that at least 700 beavers inhabited Whistler before human developments replaced beaver habitats and trapping killed significant numbers of them.

6.3.8 Conflict Areas in 2020

Beavers have a long history of conflict with humans especially when, as in Whistler, most development occurs in the valleybottom. Beaver conflicts are often not made public, thus limiting the ability to report on them (see previous section). All available information about 2020 conflicts is discussed below.

<u>*Millar Creek Wetlands*</u>

Line work by Fortis Gas began in this area in 2018 by Fortis Gas and continued into 2019. A new Valley Trail meanwhile began construction in 2019 along the same alignment between Alta Lake Road and Function Junction, at the edge of the densest population of beavers in Whistler Valley (Section 6.3.3). During this process, Fortis BC applied for a trapping permit but was able to achieve their goals instead by breaching some of the dams.[36] Lowering water levels with perforated pipes is another strategy still in place in 2020 (Photo 6-42). The RMOW started building an elevated roadbed for the new Valley Trail to better

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[35] *See previous section.*

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

accommodate flooding and otherwise leave beavers undisturbed as much as possible,[37] but impacts (if any) of that work on the beaver population have not been assessed.

Photo 6-42. These perforated pipes lower water levels at this dam beside the new Valley Trail in the Miller Creek Wetlands.

Alta Vista Pond

The 2019 report described extensive efforts by the RMOW to reduce water levels by at least 1 m in Alta Vista Pond to protect the adjacent roadbed (Palmer and Snowline 2020). In spite of concerns expressed in that report, the colony has remained active and appears to be thriving based on how many alders continue to be fallen by them. The only difference evident in 2020 is that the lowered water level resulted in two pond levels separated by a dam, rather than the single, large pond prior to the RMOW's efforts (Photo 6-43).

[37] *https://www.whistler.ca/sites/default/files/2020/Mar/bid-opportunity/pdf/26611/itt_millar_crk_vt_x13802-e32002-2020.pdf*

Photo 6-43. Alta Vista Pond in April 2019 before draining (top) and in September 2019 after draining (bottom). Water levels in since recovered enough to cover the lower area of the pond in the right-hand. The pond is currently split by a large beaver dam so that the pre-draining water level is maintained in the upper half (where the lodge is), and the lower half is covered to a lower depth.

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, but it may be why the two active lodges found in 2020 were both more distant from the railway tracks than another, now inactive lodge.

River of Golden Dreams

See Section 6.3.5.

Golf Courses

Prior to being built, wetlands occupied much of the area now occupied by the Whistler Golf Course and Nicklaus North Golf Course, when those wetlands still connected to the larger wetland complex that includes the Rainbow Wetlands, Wildlife Refuge, and River of Golden Dreams (Section 6.3.6.2). Although difficult to document fully, it is obvious that beavers were an integral component of those wetlands. For example, the developers of the Whistler Golf Course recognized the past role of beavers when they adopted beavers as the original symbol for their course since, as they explained, beavers were "the original course designers who created this land."[38], While much of the Chateau Golf Course is uphill of the valleybottom, its south end was also built at least partially on a wetland.[39]

Given their history as beaver habitat, it is not surprising that each of the courses has a long history of beaver activity and conflict. It is also not surprising that the courses have taken varying measures to control them, up to and including extermination (trapping).

Management and staff at the three golf courses constantly monitor for beaver activity due to the potential for flooding and damage to vegetation. When beavers move in and damage starts, the courses have to decide whether or not to do anything. Trapping records from past years have so far not been accessible, and the courses generally prefer to keep any trapping private. That said, superintendents for each course have been interested in beaver conservation as much as allowed by the situation on their course.

[38] *https://blog.whistlermuseum.org/tag/whistler-golf-club/*

[39] *The Whistler Golf Course was first opened as a nine-hole course in 1973, then expanded to an 18-hole course that opened in 1983. The Chateau Golf Course opened in 1993, and the Nicklaus North Golf Course opened in 1995 (https://blog.whistlermuseum.org/2019/03/19/whistler-golf/ and https://blog.whistlermuseum.org/tag/whistler-golf-club/). Google Earth has recently added 1986 imagery that, while low-resolution, shows the Nicklaus North and Chateau Golf Course areas before development.*

Whistler Golf Course

Of the three courses, past trapping has likely occurred most at the Whistler Golf Course. It has had frequent in-migration of beavers which have inhabited lodges mainly on Crabapple Creek beside the #15 fairway and #10 green, the #5 green pond and, most recently, the pond at the end of the #6 green. Beavers pose more of a challenge here than the other two courses since the level of Crabapple Creek is not much lower than the course itself, especially beside the #15 fairway. Any damming can start to flood the edge of fairways which the course staff deals with in different ways, first by breaching dams, then more lethal methods if necessary. Although no active beaver lodges were found on the Whistler Golf Course in 2020 (Section 6.3.4), neither was any evidence that the absence of beavers was caused by golf course control measures.

Chateau Golf Course #2 and #18 Ponds

The Chateau Golf Course was the only one of the three courses to have an active colony overwintering in 2020-21. Due to its position that is mostly above the valleybottom, the course is more elevated above the water adjacent to it (in its case, Blackcomb and Horstman Creeks) and flooding is therefore generally less of a concern that at the other two courses. In addition (and maybe related), the management has expressed a desire to accommodate beavers in the #2 and #18 ponds as much as possible. Beaver activity was found in the #18 pond in 2019, but the associated lodge was only confirmed active in 2020. This location is probably the one least likely to cause conflicts with golfing operations since the pond is well below the fairway and there is abundant vegetation between it and the Horstman Creek junction with Blackcomb Creek.

Nicklaus North Golf Course

Whistler's third golf course has a long history with beavers, understandably given that it occupies former wetlands that were formerly part of the Alta Lake to Green Lake wetland complex. 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 2020.

Spruce Grove Park

In recent years, and based only on observations, RMOW road crews have maintained a working relationship with the beavers in this pond. The weir guarding a culvert under the road is frequently maintained but, so far, the beavers have otherwise been left in peace. This site is one of many in which the RMOW is the land manager (others include Fitzsimmons Wetland, Alta Vista Pond, Millar Creek Wetlands, and the Fitzsimmons Creek Back Channels) and an opportunity to develop formal policies that ensure coexistence with beavers wherever possible.

7. Additional Species

7.1 Covid-19 Effects on 2020 Work Plan

The Provincial lockdown in spring 2020 precluded exploratory surveys of Western Toads and Northern Goshawks during breeding season since virtually no field work occurred in the first two to three months of that lockdown. As a result, most of that fieldwork effort was redirected towards additional beaver surveys including the first survey of dams on the River of Golden Dreams (Section 6.3.5). This section has therefore been modified to include a brief update of Northern Goshawk records for 2020.

7.2 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). [40] 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).

Surveys over the past decade have established that Whistler includes some of the most active breeding habitat for goshawks on BC's South Coast, presumably due to the availability of old forest habitat in this area (Brett 2020). Due to their rarity and affiliation with old forests (Photo 7-1), Northern Goshawks were therefore selected by the Working Group (Brett 2018) for inclusion within this program. Reports since have compiled and updated records available since 2001 (Palmer and Snowline 2019, 2020).

The first nest documented in the area (at least from available data) occurred in 2011 when a survey for the BC Government reported an active nest uphill and west of the current Whistler RV Park (Figure 7-1).[41] 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 in 2016 and 2017 in a patch of old forest above Millar's Pond by this program (Palmer and Snowline 2017, 2018). In 2019, after several years without surveys in the area, evidence of an active nest was again found near the Comfortably Numb Trail (Photo 7-1; Brett 2020).

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

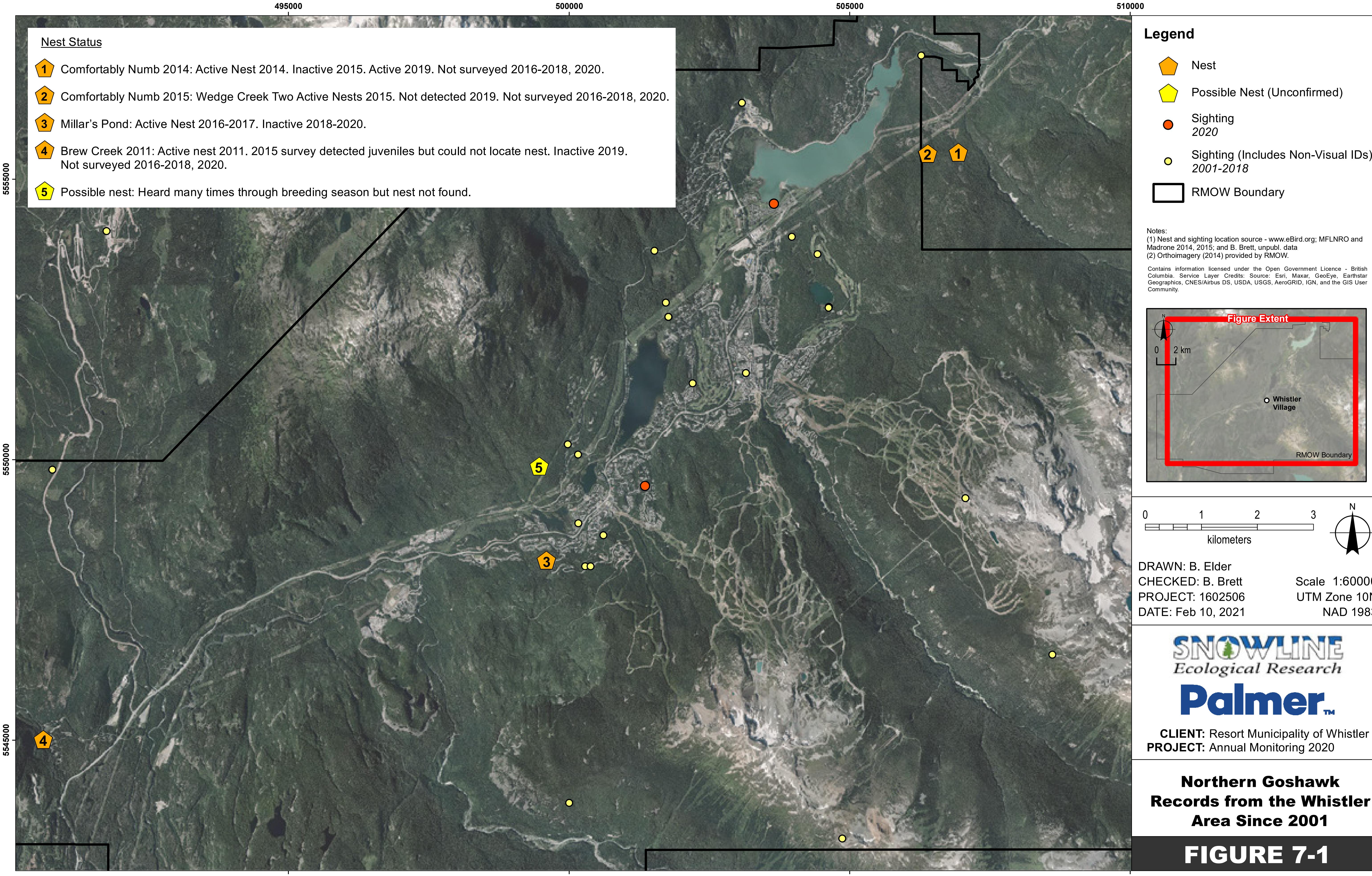
[41] *BC Conservation Data Centre (CDC) Species Occurrence Report Shape ID 106601. This area was recorded as Brew Creek.*

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).

These nest records show that goshawks have maintained a presence in Whistler and typically have at least one active nest in the area each year. In addition, and even though additional nest records have not been found, there have been enough additional visual and auditory records ("sightings") in recent years to suggest more than one breeding pair may be active in at least some years. Records from 2020 again showed that goshawks were active in the area, though no breeding was found.

Goshawk records since 2001 now total 66, of which nine were recorded in 2020 (Appendix H; Figure 7-1). Records from 2020 unfortunately did not include any update on goshawks near the Comfortably Numb bike trail where the majority of active nests have been recorded in recent years. They do, however, show that at least one goshawk is still active in the Kadenwood/Nordic area (based on frequent records near the Powderwood development), and possibly related to the Millar's Pond nest that was active in 2016 and 2017. Another activity centre was in the Lost Lake area, from lower Blackcomb Mountain to Green Lake (Appendix H). While those records are not detailed enough to determine if there was one bird or multiple birds in that area, they are far enough from the Kadenwood/Nordic activity centre that they are almost certainly different bird(s).

A new activity centre was reported by resident Bruce Worden in 2020, uphill of the Alta Lake Road and near the 3 Birds bike Trail (Figure 7-1). He walked through that area frequently in late spring and summer and repeatedly heard calls in a relatively concentrated area that likely meant one or more birds were nesting in the area, and that a breeding pair was possible. This possibility will be investigated further in 2021.



DRAWN: B. Elder
CHECKED: B. Brett
PROJECT: 1602506
DATE: Feb 10, 2021

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SNOWLINE Ecological Research

Palmer™

CLIENT: Resort Municipality of Whistler
PROJECT: Annual Monitoring 2020

Northern Goshawk Records from the Whistler Area Since 2001

FIGURE 7-1

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

8. Alta Lake Ice Data

8.1 Comparison with Past Years

The timing and duration of ice on Alta Lake was introduced as a climate indicator in this program in 2013 (Cascade 2014). The discontinuous dataset now includes sometimes incomplete data for a total of 33 winters between 1942-43 and 1975-76 ("early"), and 18 winters between 2001-02 to 2019-20 ("recent"'; Appendix I). No data was recorded during one winter in each of the reporting periods: 1974-75 and 2004-05. Data was incomplete for an additional four winters in the earlier reporting period and seven years in the most recent period; that is, only the ice-on or ice-off date was recorded. As a result, the total duration of ice on the lake is not known for those years.

The 2015 report (Cascade 2016) noted that recent Alta Lake ice records showed a weak warming compared to the mid-1900s. Evidence of this trend has strengthened with the five years of data added since (Table 8-1). In recent years, Alta Lake has frozen an average of 7 days later and melted an average of 17 days earlier than in the mid 1900s (Table 8-1). Overall, Alta Lake has been free of ice almost one month longer than in the mid-1900s.

Table 8-1. Summary of available ice records from Alta Lake.

		Early (1942-1976)		Recent (2001-2020)		Recent vs. Early Records
		Date	**Day Count**	**Date**	**Day Count**	
Ice-On	No. of Records	n/a	31	n/a	12	19 records fewer
	Earliest	1945-11-08	312	2006-11-30	334	22 days later
	Latest	1970-01-15	380	2006-01-06	371	9 days earlier
	Median	Dec. 12th	346	Dec. 21st	355	9 days later
	Average	Dec. 12th	346	Dec. 19th	353	7 days later
Ice-Off	No. of Records	n/a	31	n/a	18	13 records fewer
	Earliest	1963-03-23	82	2015-02-20	51	31 days earlier
	Latest	1952-05-21	142	2008-04-29	120	22 days earlier
	Median	April 22nd	113	April 10th	101	12 days earlier
	Average	April 22nd	113	April 5th	96	17 days earlier
Days Frozen	No. of Records	29		12		17 records fewer
	Median	133		109		24 days shorter
	Average	134		107		27 days shorter
	Minimum	81		51		30 days shorter
	Maximum	163		120		43 days shorter

Notes: No records are available for winters from 1976/77 through 2000/01. Ice-on and ice-off dates were not recorded for all years; days frozen was calculated only for those years in which both were recorded.

Data Source: Stephen Vogler, The Point Artist-Run Centre[42]

[42] *Annual data has been supplied by Stephen Vogler. The 2020 data was emailed by him to Bob Brett on January 10, 2020.*

These observations should be considered within the context of the incomplete and noisy data, especially since 1976 (Figure 8-1). The duration of freezing was relatively consistent in the early period – ice on Alta Lake lasted from 120 to 160 in all but five of the 29 years. While the average duration in the recent period is clearly shorter (Table 8-1), it is also much more variable. Combined with the lack of records for years in the intervening period, this variability precludes the meaningful use of statistical analysis (e.g., regression) to detect trends.

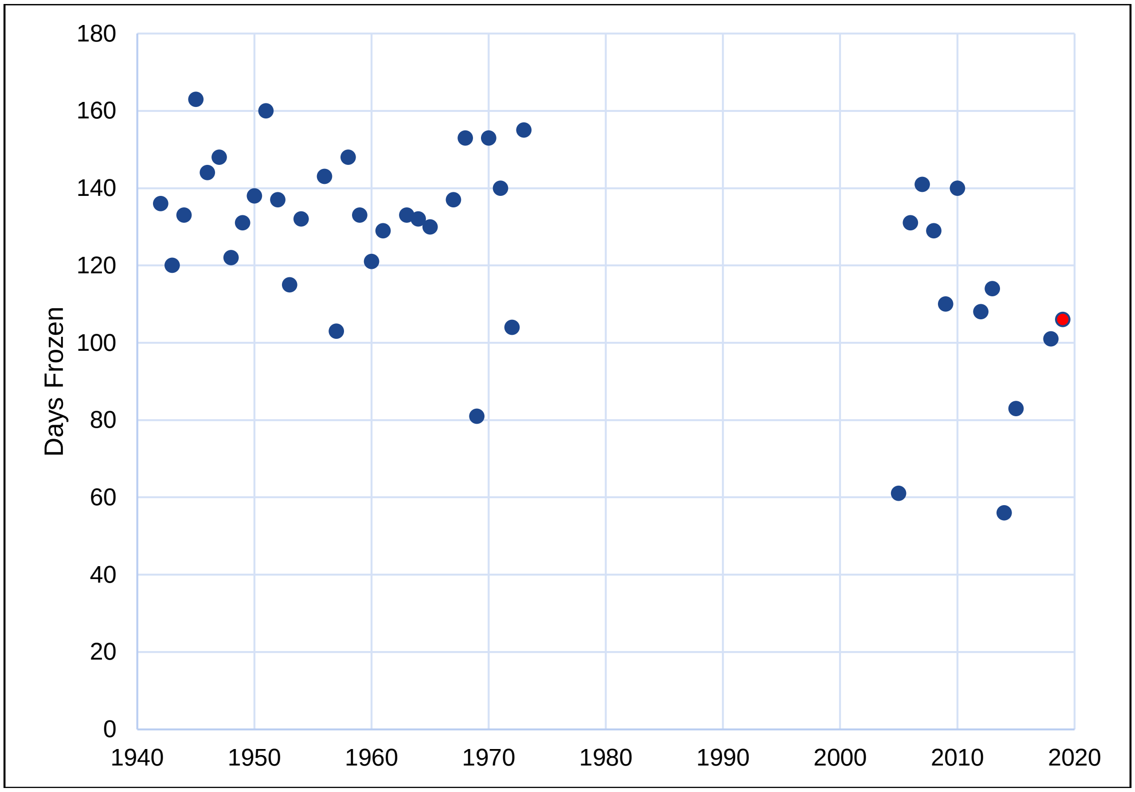

Figure 8-1. Number of days Alta Lake was frozen since the 1942/43 winter.

A simple linear regression of the whole dataset shows that ice duration has decreased from approximately 140 days to just over 100 days since 1942, but that the variability in the data is too great to conclude that trend is real ($r^2 = 0.27$). Even separating the two datasets (to reduce the leverage of the recent data) does not allow meaningful statistical analysis since the influence of single years is too great. For example, a simple regression from the early period shows a slight decrease in ice duration with weak significance ($r^2 = 0.020$), and a steeper but insignificant ($r^2 = 0.067$) decrease in the recent period. But the removal of a single record from each dataset nullifies the validity of any perceived trends. When the 1969 low of 81 days is removed from the early dataset, the trendline becomes essentially flat (that is, no trend). Similarly, any significance of the trendline from recent years is nullified by the removal of 2005 when ice lasted for only 61 days – the trendline steepens but further loses significance ($r^2 = 0.385$). Even without statistical analysis, however, there is compelling evidence that less ice on Alta Lake is a result of warmer winters.

Nine of ten years in which Alta Lake remained frozen for more than 140 days occurred in the early period (Figure 8-1). In contrast, seven of ten of the years with shortest ice duration occurred in the recent period. And while the ice-on date has been relatively stable and within a similar range in the two reporting periods (usually occurring in December or early January), the ice-off date in recent years is clearly earlier (Figure 8-2). Since 2001, the average day that ice has come off Alta Lake has been April 5th, 17 days earlier than the April 22nd average for the early period (Table 8-1). These records increasingly indicate that the main change in Whistler's winters has been earlier (warmer) springs rather than late winters, at least in the valleybottom.

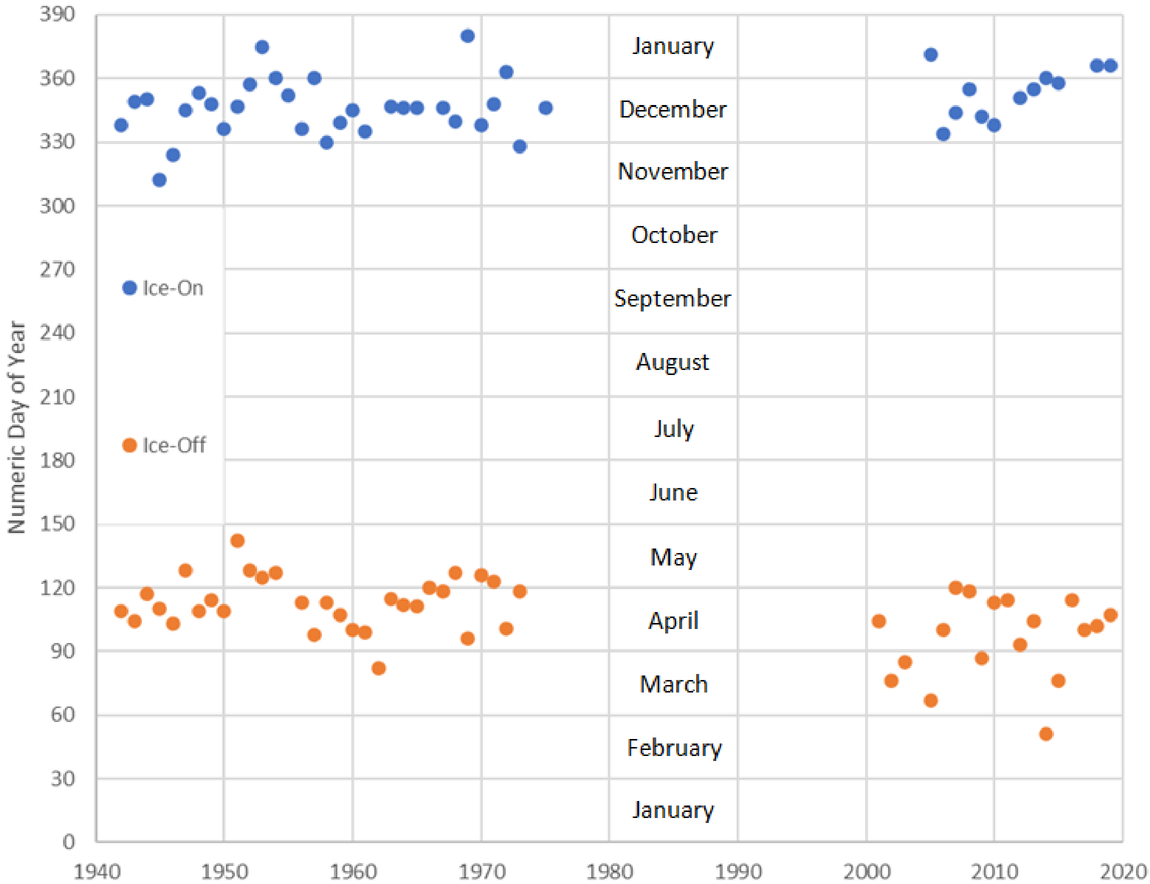

Figure 8-2. Alta Lake Ice-on (top) and ice-off (bottom) by numeric day of year.43

After the first three years of interpreting this dataset, the 2015 report (Cascade 2016) concluded that the weak trend towards warmer weather shown by Alta Lake ice did not provide enough evidence to support the hypothesis of "rapid and observable climate change."[44] In 2020, the addition of five years of Alta Lake ice records strengthens the evidence that winters have become shorter in Whistler's valleybottom, and that earlier springs (as shown by earlier ice-off/melt dates) are the likely reason.

Although Alta Lake records are not on their own enough to conclude with certainty that Whistler's climate has warmed since the mid-1900s, the warming trends they reveal are consistent with other local observations, notably the rapid retreat of local glaciers in that period (e.g., Blackcomb Glacier, Section

[43] *This chart is best understood by assessing the ice-on dates at the top then comparing them to the ice-off dates at the bottom – note that the ice-off dates for the same winter occurred in the following calendar years. In the 1942/43 winter, for example, ice-on happened on day 338 (December 4, 1942) and ice-off happened on day 109 (April 19, 1943).*

[44] *Cascade 2016, p. 59.*

5.3.2.2). In addition, the fact that Alta Lake appears to be melting earlier in the spring may be related to the overall trend towards a longer, warmer summer which has resulted in more evidence of climate change in summer months than in winter months.[45]

[45] For example, Arthur DeJong's analysis of glacier data and temperatures on Whistler Mountain showed that rising overnight temperatures in the summer were the main cause of glacial recession (personal communication with B. Brett).

9. Certification

This report was prepared and reviewed by the undersigned:

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Appendix A

Stream Temperature Data

Table A-1: Average, minimum, and maximum monthly stream temperatures in the RMOW for 2019-2020.

Site	Year	Month	Average Monthly Temperature (°C)	Minimum Average Monthly Temperature (°C)	Maximum Average Monthly Temperature (°C)
Alpha Creek	2019	January	1.25	1.25	1.25
		February	0.45	0.45	0.45
		March	1.27	1.27	1.27
		April	2.41	2.41	2.41
		May	5.26	5.26	5.26
		June	9.13	9.13	9.13
		July	10.51	10.51	10.51
		August	-	-	-
		September	-	-	-
		October	-	-	-
		November	-	-	-
		December	-	-	-
Blackwater	2019	January	0.49	0.49	0.49
		February	-0.20	-0.20	-0.20
		March	0.71	0.71	0.71
		April	2.33	2.33	2.33
		May	6.44	6.44	6.44
		June	9.32	9.32	9.32
		July	10.93	10.93	10.93
		August	-	-	-
		September	-	-	-
		October	-	-	-
		November	-	-	-
		December	-	-	-
Crabapple Creek	2019	January	1.54	1.54	1.54
		February	0.39	0.39	0.39
		March	2.25	2.25	2.25
		April	4.33	4.33	4.33
		May	8.20	8.20	8.20
		June	11.81	11.81	11.81
		July	12.97	12.97	12.97
		August	13.72	13.72	13.72
		September	9.35	9.35	9.35
		October	4.97	4.97	4.97
		November	3.09	3.09	3.09
		December	1.72	1.72	1.72
	2020	January	1.13	1.13	1.13
		February	1.69	1.69	1.69
		March	2.19	2.19	2.19
		April	4.36	4.36	4.36
		May	6.15	6.15	6.15
		June	9.42	9.42	9.42
		July	12.21	12.21	12.21
		August	12.95	12.95	12.95
		September	11.50	11.50	11.50
		October	6.85	6.85	6.85
		November	3.11	3.11	3.11
		December	2.20	2.20	2.20

Site	Year	Month	Average Monthly Temperature (°C)	Minimum Average Monthly Temperature (°C)	Maximum Average Monthly Temperature (°C)
Jordan Creek	2019	January	1.80	1.80	1.80
		February	1.00	1.00	1.00
		March	1.94	1.94	1.94
		April	5.66	5.66	5.66
		May	8.76	8.76	8.76
		June	12.78	12.78	12.78
		July	16.22	16.22	16.22
		August	18.10	18.10	18.10
		September	13.87	13.87	13.87
		October	7.57	7.57	7.57
		November	4.61	4.61	4.61
		December	2.22	2.22	2.22
	2020	January	1.74	1.74	1.74
		February	2.28	2.28	2.28
		March	2.50	2.50	2.50
		April	5.35	5.35	5.35
		May	-	-	-
		June	-	-	-
		July	-	-	-
		August	-	-	-
		September	-	-	-
		October	-	-	-
		November	-	-	-
		December	-	-	-
Nita Creek	2020	January	-	-	-
		February	-	-	-
		March	-	-	-
		April	6.15	6.15	6.15
		May	7.51	7.51	7.51
		June	9.20	9.20	9.20
		July	13.05	13.05	13.05
		August	16.54	16.54	16.54
		September	15.43	15.43	15.43
		October	10.03	10.03	10.03
		November	5.55	5.55	5.55
		December	4.63	4.63	4.63
River of Golden Dreams	2019	January	1.40	1.40	1.40
		February	0.83	0.83	0.83
		March	2.12	2.12	2.12
		April	4.43	4.43	4.43
		May	4.96	4.96	4.96
		June	7.93	7.93	7.93
		July	12.48	12.48	12.48
		August	13.30	13.30	13.30
		September	9.30	9.30	9.30
		October	4.65	4.65	4.65
		November	3.06	3.06	3.06
		December	1.56	1.56	1.56
	2020	January	0.87	0.87	0.87
		February	1.63	1.63	1.63
		March	2.33	2.33	2.33
		April	4.56	4.56	4.56
		May	4.70	4.70	4.70
		June	5.56	5.56	5.56
		July	10.49	10.49	10.49
		August	12.37	12.37	12.37
		September	11.37	11.37	11.37
		October	7.23	7.23	7.23
		November	3.14	3.14	3.14
		December	1.98	1.98	1.98

Site	Year	Month	Average Monthly Temperature (°C)	Minimum Average Monthly Temperature (°C)	Maximum Average Monthly Temperature (°C)
Scotia Creek	2019	January	-0.04	-0.04	-0.04
		February	-2.06	-2.06	-2.06
		March	1.29	1.29	1.29
		April	3.03	3.03	3.03
		May	5.73	5.73	5.73
		June	9.30	9.30	9.30
		July	12.36	12.36	12.36
		August	-	-	-
		September	-	-	-
		October	-	-	-
		November	-	-	-
		December	-	-	-
Twenty-One Mile Creek	2020	January	-	-	-
		February	-	-	-
		March	-	-	-
		April	3.95	3.95	3.95
		May	4.64	4.64	4.64
		June	5.63	5.63	5.63
		July	10.37	10.37	10.37
		August	12.60	12.60	12.60
		September	11.40	11.40	11.40
		October	6.45	6.45	6.45
		November	2.26	2.26	2.26
		December	1.55	1.55	1.55

" - " Represents months where data is not available

Appendix B

Benthic Invertebrate Taxonomy Results and CABIN Outputs

Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	21M-DS-AQ21
Sampling Date	Aug 04 2020
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	640
Local Basin Name	Twenty-One Mile Creek
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach

Down Stream

Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 28, 2020
Taxonomic Level	Family

Cabin Assessment Results

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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					
Probability of Group Membership	0.0%	0.0%	0.0%	56.3%	33.1%	10.5%
CABIN Assessment of 21M-DS-AQ21 on Aug 04, 2020	Similar to Reference					

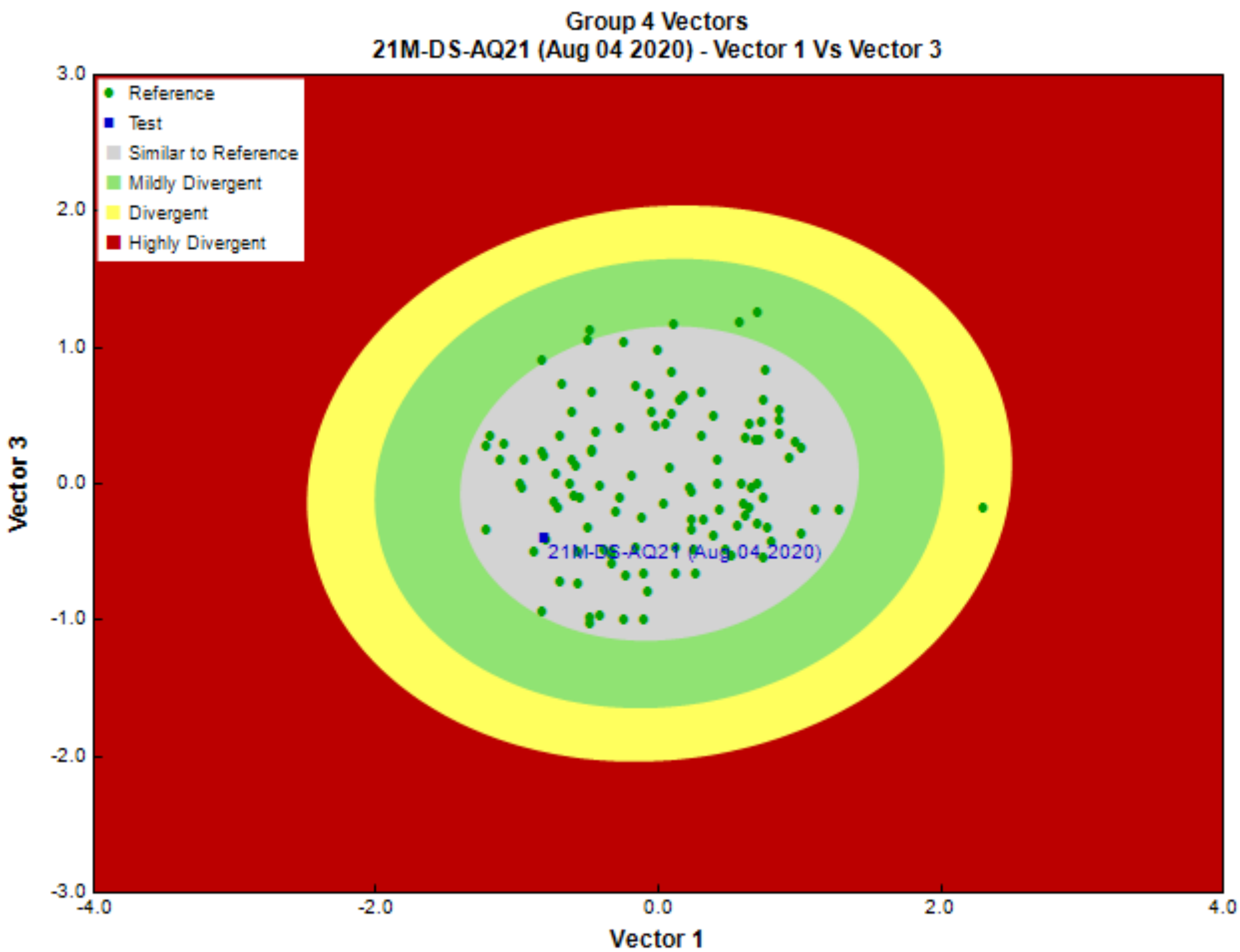


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Scott Finlayson, Cordillera Consulting
	-
Sub-Sample Proportion	34/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	3	8.8
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	6	17.6
			Lebertiidae	2	5.9
			Sperchontidae	3	8.8
	Insecta	Diptera		2	5.9
			Ceratopogonidae	1	2.9
			Chironomidae	30	88.1
			Empididae	4	11.7
			Simuliidae	19	55.8
			Tipulidae	2	5.8
		Ephemeroptera	Ameletidae	10	29.4
			Baetidae	85	250.0
			Ephemerellidae	9	26.4
			Heptageniidae	74	217.6
		Plecoptera		3	8.8
			Capniidae	3	8.8
			Chloroperlidae	11	32.3
			Nemouridae	7	20.6
			Perlidae	20	58.8
			Perlodidae	3	8.8
		Trichoptera		2	5.9
			Glossosomatidae	1	2.9
			Hydropsychidae	1	2.9
			Limnephilidae	1	2.9
			Rhyacophilidae	6	17.6
			Total	308	905.0

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.36	0.5 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.9	4.3 ± 1.8
Hilsenhoff Family index (North-West)	3.9	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	2.0	1.7 ± 0.9
Tolerant individuals (%)	--	1.3 ± 1.4
Functional Measures		
% Filterers	--	17.2 ± 42.4
% Gatherers	26.3	57.6 ± 27.3
% Predatores	30.5	31.3 ± 20.3
% Scrapers	58.8	37.4 ± 22.0
% Shredder	4.2	16.1 ± 11.0
No. Clinger Taxa	23.0	15.8 ± 6.3
Number Of Individuals		
% Chironomidae	10.0	22.3 ± 19.9
% Coleoptera	0.0	0.7 ± 1.9
% Diptera + Non-insects	23.3	32.8 ± 26.0
% Ephemeroptera	59.1	42.2 ± 21.6
% Ephemeroptera that are Baetidae	47.8	29.6 ± 25.6
% EPT Individuals	76.7	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	52.8	58.1 ± 13.7
% of 5 dominant taxa	75.7	82.2 ± 8.7
% of dominant taxa	28.2	39.9 ± 14.9
% Plecoptera	14.6	14.7 ± 11.2

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	11.1	19.9 ± 23.1
% Tricoptera	3.0	9.2 ± 10.9
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.7 ± 0.2
Total Abundance	905.9	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	5.0	3.2 ± 1.3
Ephemeroptera taxa	4.0	3.6 ± 1.1
EPT Individuals (Sum)	679.4	1501.0 ± 1294.6
EPT taxa (no)	13.0	10.8 ± 3.5
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	5.0	4.1 ± 1.8
Shannon-Wiener Diversity	2.3	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	22.0	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 21M-DS-AQ21
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.33
Ametropodidae	0%	0%	0%	0%	0%	6%	0.01
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.00
Apataniidae	7%	2%	5%	11%	8%	8%	0.10
Arrenuridae	0%	2%	0%	0%	15%	0%	0.05
Asellidae	0%	2%	0%	0%	0%	0%	0.00
Athericidae	0%	8%	0%	9%	8%	0%	0.07
Aturidae	4%	6%	0%	5%	0%	2%	0.03
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%	0.28
Caenidae	0%	0%	0%	1%	38%	0%	0.13
Capniidae	81%	60%	37%	65%	31%	69%	0.54
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.35
Chironomidae	100%	100%	89%	99%	100%	100%	1.00
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.70
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%	0.01
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%	0.23
Empididae	51%	65%	47%	62%	8%	51%	0.43
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.34
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%	0.01
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%	0.05
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%	0.83

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	
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%	0.52
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%	0.08
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%	0.47
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.35
Leptoceridae	1%	15%	0%	5%	62%	2%	0.23
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%	0.27
Limnephilidae	36%	24%	21%	26%	0%	39%	0.19
Limnesiidae	7%	13%	5%	9%	46%	25%	0.23
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%	0.00
Muscidae	0%	2%	0%	4%	0%	6%	0.03
Naididae	26%	47%	5%	46%	85%	33%	0.58
Nemouridae	93%	73%	53%	81%	15%	73%	0.58
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%	0.04
Perlidae	32%	29%	11%	32%	8%	20%	0.22
Perlodidae	64%	60%	79%	75%	31%	76%	0.61
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%	0.25
Planorbidae	1%	3%	0%	1%	31%	0%	0.11
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.01
Psychodidae	33%	21%	0%	22%	0%	4%	0.13
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.11
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.43
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%	0.41
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.03
Stygothrombiidae	3%	0%	0%	4%	0%	2%	0.03
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.41
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%	0.58
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.28
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.02
Uenoidae	9%	8%	37%	17%	0%	10%	0.11
Unionicolidae	0%	0%	0%	0%	15%	0%	0.05
Valvatidae	3%	2%	0%	3%	8%	2%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	7.58
RIVPACS : Observed taxa P>0.50	10.00
RIVPACS : O:E (p > 0.5)	1.32
RIVPACS : Expected taxa P>0.70	4.17
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	1.20

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	28.74839 ± 35.48825
Channel		
Depth-BankfullMinusWetted (cm)	40.00	60.67 ± 44.73
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.92 ± 1.11
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	0	0 ± 0
Reach-Rapids (Binary)	0	0 ± 0
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.5000000	0.0249850 ± 0.0294369
Veg-Coniferous (Binary)	0	1 ± 0
Veg-Deciduous (Binary)	0	1 ± 0
Veg-GrassesFerns (Binary)	1	0 ± 1
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.54	0.45 ± 0.19
Velocity-Max (m/s)	0.79	0.68 ± 0.25
Width-Bankfull (m)	11.6	35.9 ± 41.6
Width-Wetted (m)	11.6	17.8 ± 20.2
XSEC-VelMethod (Category(1-3))	1	3 ± 0
Climate		
Precip02_FEB (mm)	155.11000	94.95103 ± 61.64910
Temp07_JULmax (Degrees Celsius)	18.24000	17.48320 ± 2.57900
Landcover		
Natl-SnowIce (%)	26.43000	4.62982 ± 9.77010
Natl-Water (%)	2.82000	1.55060 ± 2.36345
Natl-WetlandHerb (%)	0.00000	0.18446 ± 0.50703
Substrate Data		
%Bedrock (%)	0	0 ± 1
%Boulder (%)	0	11 ± 11
%Cobble (%)	24	53 ± 11
%Gravel (%)	1	5 ± 4
%Pebble (%)	75	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	1 ± 3
D50 (cm)	4.30	8.04 ± 4.60
Dg (cm)	4.7	8.2 ± 3.1
Dominant-1st (Category(0-9))	5	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 1
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
SlopeAvg (%)	39.45000	31.09165 ± 12.51836
Water Chemistry		
General-Conductivity (µS/cm)	39.7000000	92.7298969 ± 75.6979499
General-DO (mg/L)	8.0400000	11.4180702 ± 1.2821697
General-pH (pH)	9.4	7.7 ± 0.7
General-SpCond (µS/cm)	46.5000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	34.0	12.1 ± 4.3
General-TempWater (Degrees Celsius)	13.7000000	7.6535897 ± 3.4680513

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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	10.3%	5.3%	33.1%	24.2%	17.2%	9.9%
CABIN Assessment of 21M-DS-AQ21 on Jul 30, 2019	Mildly Divergent					

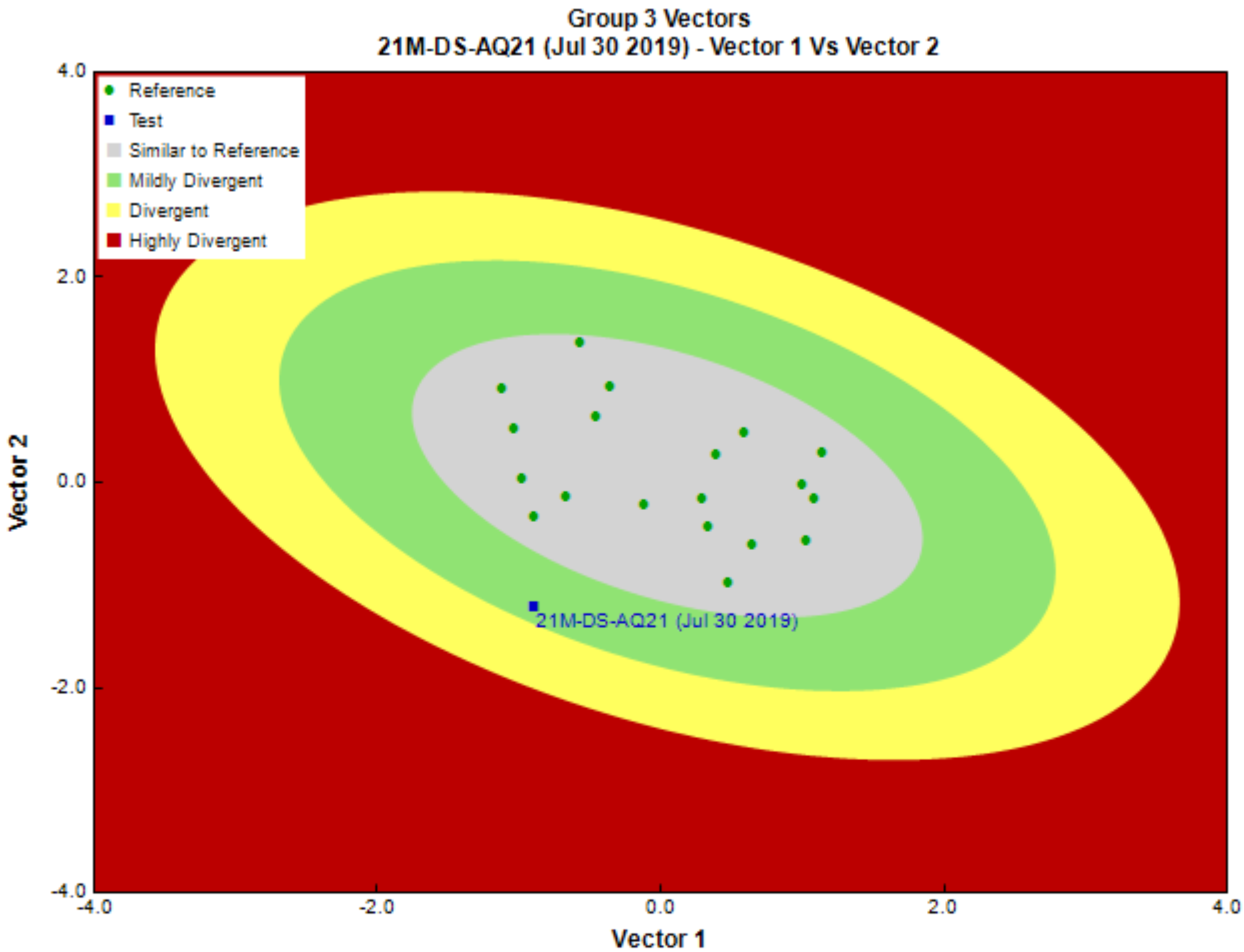


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
	Insecta	Diptera	Ceratopogonidae	2	11.1
			Chironomidae	21	116.8
			Empididae	2	11.2
			Simuliidae	41	227.8

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.5	3.5 ± 1.1
Hilsenhoff Family index (North-West)	4.5	3.4 ± 0.9
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	2.0	1.5 ± 0.6
Tolerant individuals (%)	--	1.2 ± 1.0
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		
% Chironomidae	6.5	15.2 ± 13.8
% Coleoptera	0.0	0.9 ± 3.1
% Diptera + Non-insects	24.9	20.6 ± 17.1
% Ephemeroptera	62.3	42.0 ± 19.3
% Ephemeroptera that are Baetidae	41.0	33.7 ± 27.0
% EPT Individuals	75.1	78.2 ± 17.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	53.3	61.7 ± 12.7
% of 5 dominant taxa	77.6	86.1 ± 8.2
% of dominant taxa	27.7	42.0 ± 14.3
% Plecoptera	10.9	30.6 ± 25.8
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	16.7	14.8 ± 22.6
% Tricoptera	1.9	5.6 ± 7.7
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

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
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
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

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	
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
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
Stygothrombiidae	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 ± 1

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
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	0.68 ± 0.20
Width-Bankfull (m)	11.4	85.0 ± 66.5
Width-Wetted (m)	11.3	23.1 ± 31.8
XSEC-VelMethod (Category(1-3))	1	3 ± 0
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	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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	10.3%	4.8%	22.1%	17.4%	39.0%	6.5%
CABIN Assessment of 21M-DS-AQ21 on Jul 31, 2018	Mildly Divergent					

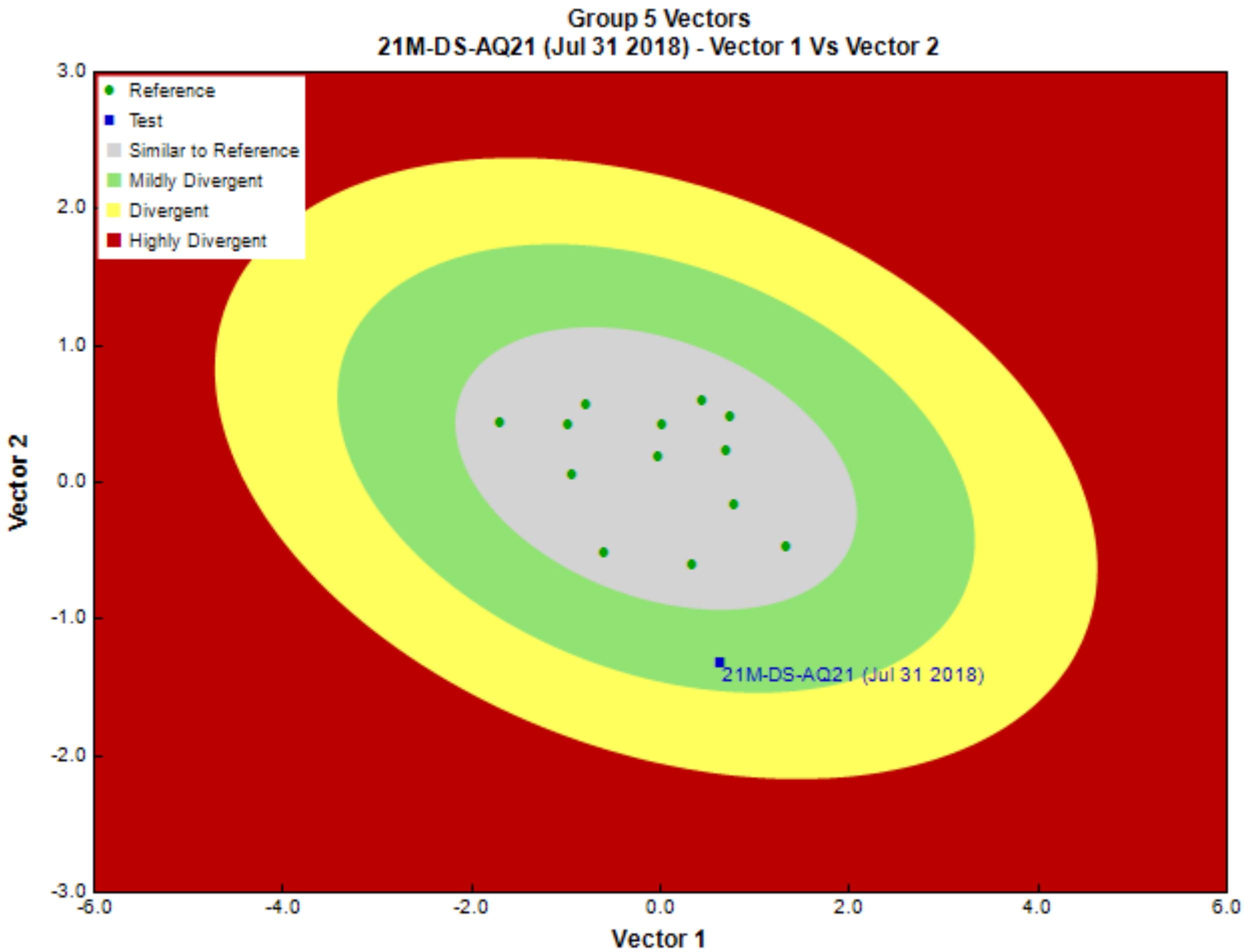


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
			Simuliidae	489	488.9
			Tipulidae	1	1.0
		Ephemeroptera	Ameletidae	28	27.8
			Baetidae	361	361.1

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.5	4.7 ± 2.2
Hilsenhoff Family index (North-West)	4.5	4.8 ± 1.3
Intolerant taxa	1.0	
Long-lived taxa	2.0	1.8 ± 0.9
Tolerant individuals (%)	--	1.1 ± 1.4
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		
% Chironomidae	7.3	34.9 ± 20.4
% Coleoptera	0.0	2.6 ± 5.0
% Diptera + Non-insects	39.5	47.4 ± 26.3
% Ephemeroptera	43.1	34.2 ± 22.7
% Ephemeroptera that are Baetidae	42.2	38.4 ± 28.2
% EPT Individuals	60.5	49.6 ± 26.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	45.4	64.4 ± 13.7
% of 5 dominant taxa	77.3	86.1 ± 8.4
% of dominant taxa	24.6	44.7 ± 15.5
% Plecoptera	14.8	9.7 ± 9.0
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	17.3 ± 27.0
% Tricoptera	2.5	5.7 ± 7.1
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

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
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
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%	0.22
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%	0.14
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%	0.80
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

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	
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%	0.49
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
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%	0.33
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
Stygothrombiidae	3%	0%	0%	4%	0%	2%	0.01
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.48
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%	0.22
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	4.55
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

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
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
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 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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	10.3%	5.3%	33.2%	24.1%	17.2%	9.9%
CABIN Assessment of 21M-DS-AQ21 on Jul 25, 2017	Divergent					

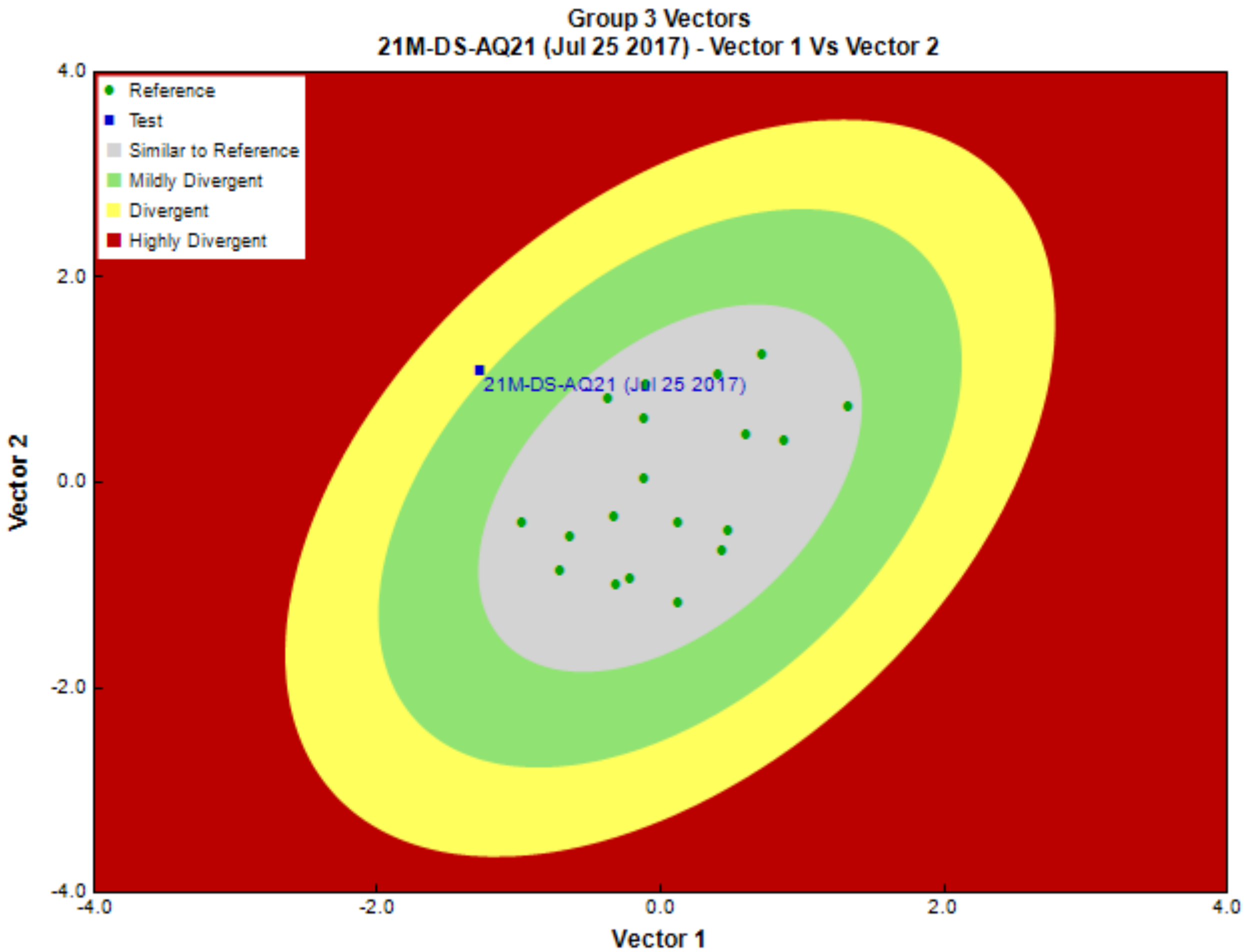


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
		Plecoptera	Chloroperlidae	15	62.5
			Nemouridae	2	8.3
			Perlidae	3	12.5
			Perlodidae	1	4.2

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Total	391	1,629.1

Metrics

Name	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.78	0.4 ± 0.2
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.3	3.5 ± 1.1
Hilsenhoff Family index (North-West)	4.3	3.4 ± 0.9
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	1.0	1.5 ± 0.6
Tolerant individuals (%)	--	1.2 ± 1.0
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		
% Chironomidae	2.8	15.2 ± 13.8
% Coleoptera	0.0	0.9 ± 3.1
% Diptera + Non-insects	19.2	20.6 ± 17.1
% Ephemeroptera	75.4	42.0 ± 19.3
% Ephemeroptera that are Baetidae	29.2	33.7 ± 27.0
% EPT Individuals	80.8	78.2 ± 17.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	75.4	61.7 ± 12.7
% of 5 dominant taxa	94.9	86.1 ± 8.2
% of dominant taxa	53.5	42.0 ± 14.3
% Plecoptera	5.4	30.6 ± 25.8
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	--	14.8 ± 22.6
% Tricoptera	0.0	5.6 ± 7.7
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

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	
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
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

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	
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
Stygothrombiidae	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	28.3 ± 10.9
Depth-BankfullMinusWetted (cm)	48.00	163.00
Depth-Max (cm)	38.0	43.6 ± 19.2
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
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	0.68 ± 0.20
Width-Bankfull (m)	11.5	85.0 ± 66.5
Width-Wetted (m)	48.0	23.1 ± 31.8
XSEC-VelInstrumentDirect (Category(1-3))	1	1 ± 1

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
XSEC-VelMethod (Category(1-3))	3	3 ± 0
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
%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	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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	5.6%	4.0%	29.2%	29.2%	20.6%	11.5%
CABIN Assessment of 21M-DS-AQ21 on Aug 03, 2016	Mildly Divergent					

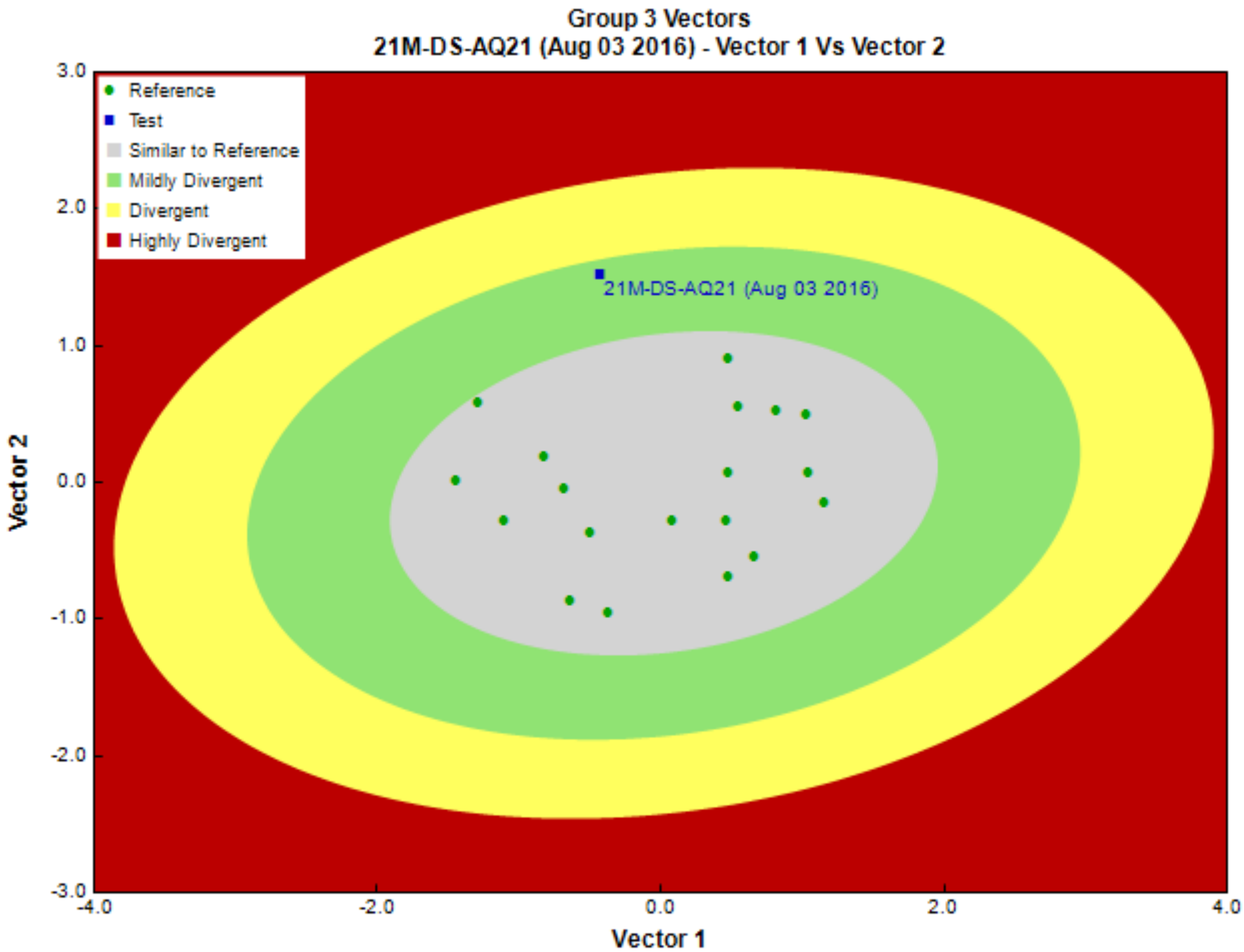


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
			Heptageniidae	48	240.0
		Plecoptera	Chloroperlidae	12	60.0
			Nemouridae	65	325.0
			Perlodidae	2	10.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.3	3.5 ± 1.1
Hilsenhoff Family index (North-West)	4.3	3.4 ± 0.9
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.5 ± 0.6
Tolerant individuals (%)	--	1.2 ± 1.0
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		
% Chironomidae	7.2	15.2 ± 13.8
% Coleoptera	0.0	0.9 ± 3.1
% Diptera + Non-insects	20.7	20.6 ± 17.1
% Ephemeroptera	51.0	42.0 ± 19.3
% Ephemeroptera that are Baetidae	66.5	33.7 ± 27.0
% EPT Individuals	79.3	78.2 ± 17.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	55.3	61.7 ± 12.7
% of 5 dominant taxa	87.8	86.1 ± 8.2
% of dominant taxa	33.9	42.0 ± 14.3
% Plecoptera	26.0	30.6 ± 25.8
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	14.8 ± 22.6
% Tricoptera	2.3	5.6 ± 7.7
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

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%	0.08
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
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

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%	0.66
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
Simuliidae	52%	29%	16%	32%	8%	24%	0.22
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
Stygothrombiidae	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	28.3 ± 10.9
Depth-BankfullMinusWetted (cm)	100.00	163.00
Depth-Max (cm)	29.0	43.6 ± 19.2
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
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	0.68 ± 0.20
Width-Bankfull (m)	11.2	85.0 ± 66.5

Habitat Description

Variable	21M-DS-AQ21	Predicted Group Reference Mean ±SD
Width-Wetted (m)	9.6	23.1 ± 31.8
XSEC-VelInstrumentDirect (Category(1-3))	1	1 ± 1
XSEC-VelMethod (Category(1-3))	3	3 ± 0
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 (%)	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

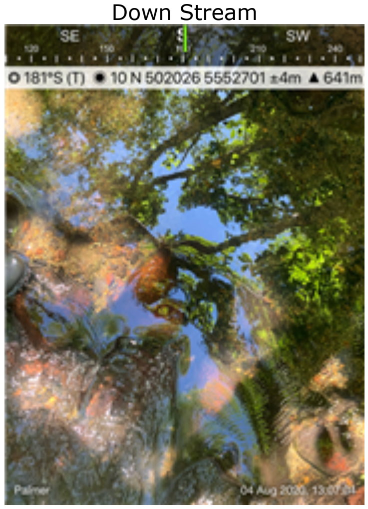
Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	CRB-DS-AQ01
Sampling Date	Aug 04 2020
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	639
Local Basin Name	Crabapple Creek
	River of Golden Dreams
Stream Order	2

Figure 1. Location Map

Across Reach

Down Stream



Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 28, 2020
Taxonomic Level	Family

Cabin Assessment Results

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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					
Probability of Group Membership	0.0%	0.0%	0.0%	9.6%	90.3%	0.2%
CABIN Assessment of CRB-DS-AQ01 on Aug 04, 2020	Mildly Divergent					

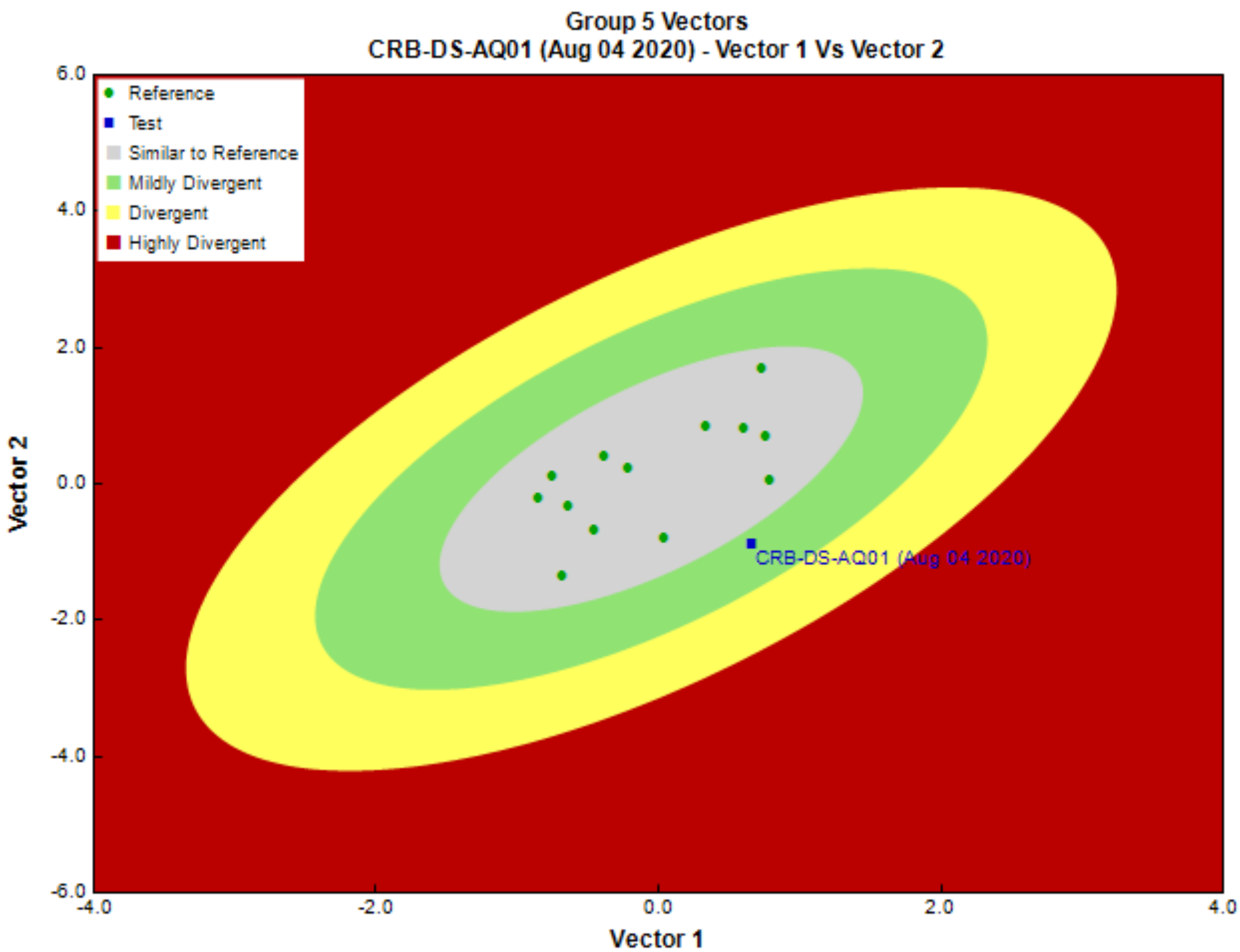


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Scott Finlayson, Cordillera Consulting
	-
Sub-Sample Proportion	14/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	3	21.4
		Tubificida	Naididae	1	7.1
Arthropoda	Arachnida	Trombidiformes	Aturidae	2	14.2
			Hygrobatidae	5	35.7
			Lebertiidae	2	14.3
	Insecta	Diptera		2	14.3
			Chironomidae	53	378.3
			Empididae	1	7.1
			Simuliidae	12	85.7
			Tipulidae	7	50.0
		Ephemeroptera	Baetidae	88	628.6
			Ephemerellidae	1	7.1
			Heptageniidae	4	28.6
			Leptophlebiidae	22	157.1
		Plecoptera		7	50.0
			Chloroperlidae	37	264.3
			Nemouridae	53	378.6
			Taeniopterygidae	3	21.4
		Trichoptera	Brachycentridae	1	7.1
			Limnephilidae	1	7.1
Mollusca	Bivalvia	Veneroida	Pisidiidae	3	21.4
			Total	308	2,199.4

Metrics

Name	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.74	0.6 ± 0.2
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.9	4.7 ± 2.2
Hilsenhoff Family index (North-West)	3.9	4.8 ± 1.3
Intolerant taxa	--	
Long-lived taxa	--	1.8 ± 0.9
Tolerant individuals (%)	--	1.1 ± 1.4
Functional Measures		
% Filterers	--	11.5 ± 10.5
% Gatherers	51.9	67.6 ± 30.3
% Predatores	24.7	41.1 ± 20.2
% Scrapers	35.1	34.3 ± 21.0
% Shredder	21.1	13.7 ± 9.2
No. Clinger Taxa	13.0	13.0 ± 5.7
Number Of Individuals		
% Chironomidae	17.7	34.9 ± 20.4
% Coleoptera	0.0	2.6 ± 5.0
% Diptera + Non-insects	29.8	47.4 ± 26.3
% Ephemeroptera	38.5	34.2 ± 22.7
% Ephemeroptera that are Baetidae	76.5	38.4 ± 28.2
% EPT Individuals	70.2	49.6 ± 26.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	47.2	64.4 ± 13.7
% of 5 dominant taxa	84.6	86.1 ± 8.4
% of dominant taxa	29.4	44.7 ± 15.5
% Plecoptera	31.1	9.7 ± 9.0
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	17.3 ± 27.0
% Tricoptera	0.7	5.7 ± 7.1
No. EPT individuals/Chironomids+EPT Individuals	0.8	0.6 ± 0.2

Metrics

Name	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Total Abundance	2200.0	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)	1500.0	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	3.0	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	0.3	0.3 ± 0.1
Total No. of Taxa	19.0	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 CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.05
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%	0.14
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%	0.00
Baetidae	97%	92%	79%	93%	62%	84%	0.65
Blephariceridae	1%	0%	0%	2%	0%	2%	0.00
Brachycentridae	42%	53%	5%	35%	15%	27%	0.17
Caenidae	0%	0%	0%	1%	38%	0%	0.35
Capniidae	81%	60%	37%	65%	31%	69%	0.34
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.51
Chironomidae	100%	100%	89%	99%	100%	100%	1.00
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.37
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.07
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%	0.17
Empididae	51%	65%	47%	62%	8%	51%	0.13
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.31
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.65
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%	0.14
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.03
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%	0.58
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%	0.28

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	
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.22
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.00
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.01
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
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%	0.53
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.25
Leptoceridae	1%	15%	0%	5%	62%	2%	0.56
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.00
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.18
Leuctridae	35%	26%	11%	39%	8%	25%	0.11
Limnephilidae	36%	24%	21%	26%	0%	39%	0.03
Limnesiidae	7%	13%	5%	9%	46%	25%	0.43
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.43
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%	0.00
Naididae	26%	47%	5%	46%	85%	33%	0.81
Nemouridae	93%	73%	53%	81%	15%	73%	0.22
Oxidae	0%	2%	0%	1%	15%	0%	0.14
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%	0.10
Perlodidae	64%	60%	79%	75%	31%	76%	0.35
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%	0.50
Planorbidae	1%	3%	0%	1%	31%	0%	0.28
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%	0.02
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.15
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.06
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.10
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%	0.07
Stygothrombiidae	3%	0%	0%	4%	0%	2%	0.00
Tabanidae	0%	0%	0%	1%	0%	4%	0.00
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.19
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%	0.41
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.24
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.00
Uenoidae	9%	8%	37%	17%	0%	10%	0.02
Unionicolidae	0%	0%	0%	0%	15%	0%	0.14
Valvatidae	3%	2%	0%	3%	8%	2%	0.07

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	5.29
RIVPACS : Observed taxa P>0.50	6.00
RIVPACS : O:E (p > 0.5)	1.13
RIVPACS : Expected taxa P>0.70	1.81

RIVPACS Ratios

RIVPACS : Observed taxa P>0.70	2.00
RIVPACS : O:E (p > 0.7)	1.11

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	0.33000	15.90266 ± 33.91726
Channel		
Depth-BankfullMinusWetted (cm)	10.50	188.00
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)	1.0000000	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)	0.38	0.23 ± 0.24
Velocity-Max (m/s)	0.54	0.31 ± 0.35
Width-Bankfull (m)	4.8	75.1 ± 72.8
Width-Wetted (m)	3.2	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
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 (%)	26	58
%Gravel (%)	44	1
%Pebble (%)	20	41
%Sand (%)	0	0
%Silt+Clay (%)	9	0
D50 (cm)	1.50	3.30
Dg (cm)	1.5	6.6
Dominant-1st (Category(0-9))	3	4 ± 2
Dominant-2nd (Category(0-9))	4	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)	166.9000000	79.0846153 ± 50.3407694
General-DO (mg/L)	9.1400000	9.3400000 ± 2.0171679
General-pH (pH)	9.0	6.8 ± 1.0
General-SpCond (µS/cm)	216.3000000	176.1000000
General-TempAir (Degrees Celsius)	20.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	13.3000000	13.2730769 ± 4.7663725

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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	0.0%	0.0%	0.0%	88.0%	11.9%	0.1%
CABIN Assessment of CRB-DS-AQ01 on Jul 30, 2019	Mildly Divergent					

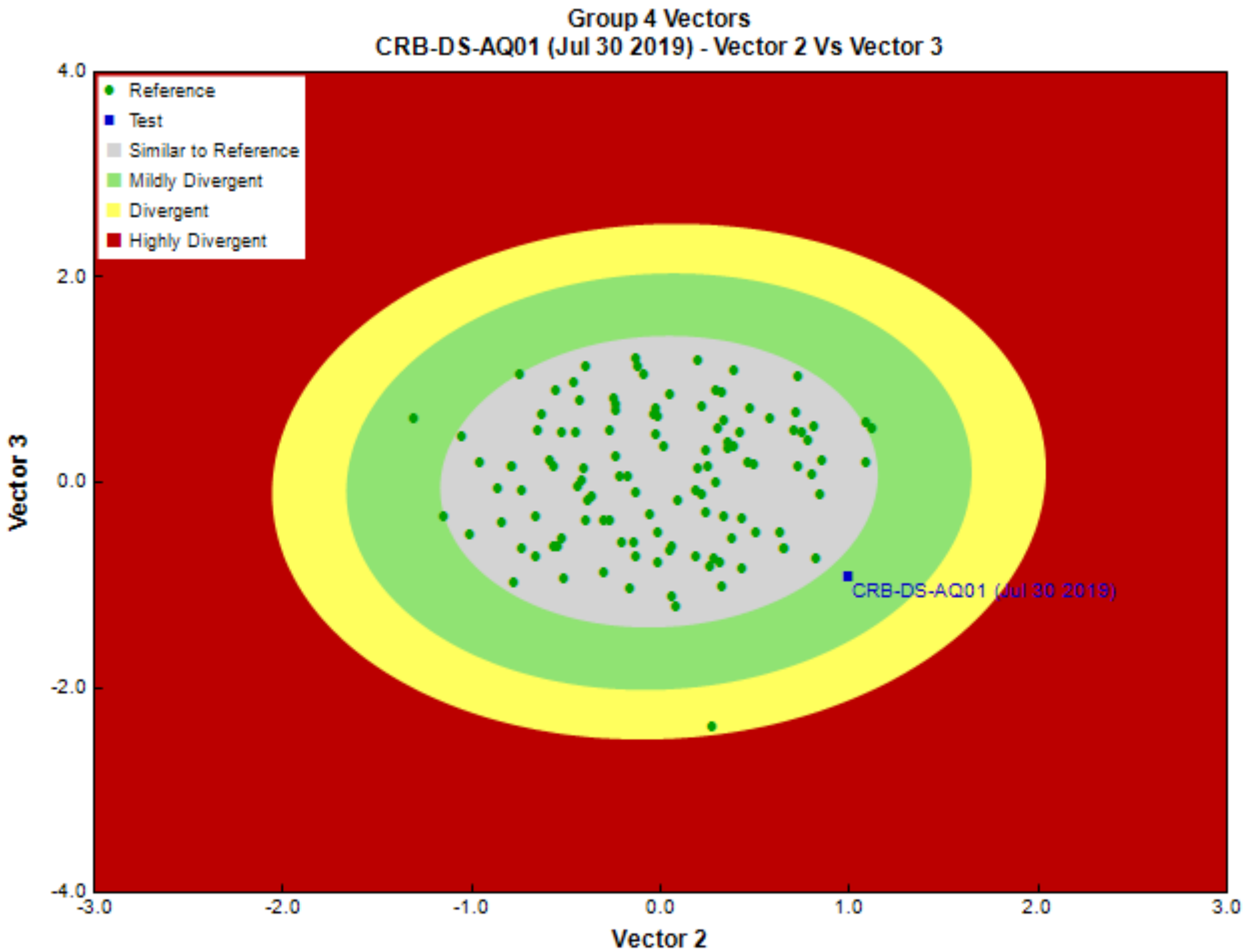


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
			Stygothrombiidae	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
		Ephemeroptera	Baetidae	161	1,610.0
			Ephemerellidae	1	10.0
			Heptageniidae	1	10.0
			Leptophlebiidae	14	140.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		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	0.79	0.5 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.9	4.3 ± 1.8
Hilsenhoff Family index (North-West)	3.9	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	--	1.7 ± 0.9
Tolerant individuals (%)	--	1.3 ± 1.4
Functional Measures		
% Filterers	--	17.2 ± 42.4
% Gatherers	48.6	57.6 ± 27.3
% Predatores	24.9	31.3 ± 20.3
% Scrapers	50.0	37.4 ± 22.0
% Shredder	22.3	16.1 ± 11.0
No. Clinger Taxa	15.0	15.8 ± 6.3
Number Of Individuals		
% Chironomidae	18.1	22.3 ± 19.9
% Coleoptera	0.0	0.7 ± 1.9
% Diptera + Non-insects	24.4	32.8 ± 26.0
% Ephemeroptera	50.9	42.2 ± 21.6
% Ephemeroptera that are Baetidae	91.0	29.6 ± 25.6
% EPT Individuals	75.6	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	68.4	58.1 ± 13.7
% of 5 dominant taxa	94.3	82.2 ± 8.7
% of dominant taxa	46.3	39.9 ± 14.9
% Plecoptera	23.6	14.7 ± 11.2
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	19.9 ± 23.1
% Tricoptera	1.1	9.2 ± 10.9
No. EPT individuals/Chironomids+EPT Individuals	0.8	0.7 ± 0.2
Total Abundance	3500.0	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	4.0	3.6 ± 1.1
EPT Individuals (Sum)	2630.0	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	2.0	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	15.0	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 CRB-DS-AQ01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Ameletidae	29%	26%	26%	46%	0%	69%	0.41
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%	0.11
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%	0.08
Aturidae	4%	6%	0%	5%	0%	2%	0.05
Baetidae	97%	92%	79%	93%	62%	84%	0.89
Blephariceridae	1%	0%	0%	2%	0%	2%	0.02
Brachycentridae	42%	53%	5%	35%	15%	27%	0.33
Caenidae	0%	0%	0%	1%	38%	0%	0.05
Capniidae	81%	60%	37%	65%	31%	69%	0.61
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.31
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%	0.01
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%	0.27
Empididae	51%	65%	47%	62%	8%	51%	0.55
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.34
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.91
Ephemeridae	1%	0%	0%	3%	0%	0%	0.02
Feltriidae	0%	0%	0%	2%	0%	0%	0.02
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%	0.02
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.30
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%	0.94
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%	0.64
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.16
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.04
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.11
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
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%	0.46
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.43
Leptoceridae	1%	15%	0%	5%	62%	2%	0.12
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.02
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.36
Leuctridae	35%	26%	11%	39%	8%	25%	0.36
Limnephilidae	36%	24%	21%	26%	0%	39%	0.23
Limnesiidae	7%	13%	5%	9%	46%	25%	0.14
Lumbriculidae	4%	10%	0%	15%	46%	22%	0.19
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%	0.00
Muscidae	0%	2%	0%	4%	0%	6%	0.04
Naididae	26%	47%	5%	46%	85%	33%	0.51
Nemouridae	93%	73%	53%	81%	15%	73%	0.73

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	
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%	0.06
Perlidae	32%	29%	11%	32%	8%	20%	0.29
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%	0.01
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%	0.16
Planorbidae	1%	3%	0%	1%	31%	0%	0.04
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.02
Psychodidae	33%	21%	0%	22%	0%	4%	0.20
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.09
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.58
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.30
Sperchontidae	17%	34%	37%	50%	23%	45%	0.47
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.02
Stygothrombiidae	3%	0%	0%	4%	0%	2%	0.04
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.47
Tanyderidae	0%	0%	0%	3%	0%	6%	0.02
Thaumaleidae	0%	0%	0%	2%	0%	0%	0.02
Tipulidae	67%	50%	42%	68%	38%	63%	0.65
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.34
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.03
Uenoidae	9%	8%	37%	17%	0%	10%	0.15
Unionicolidae	0%	0%	0%	0%	15%	0%	0.02
Valvatidae	3%	2%	0%	3%	8%	2%	0.04

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	9.55
RIVPACS : Observed taxa P>0.50	9.00
RIVPACS : O:E (p > 0.5)	0.94
RIVPACS : Expected taxa P>0.70	5.31
RIVPACS : Observed taxa P>0.70	6.00
RIVPACS : O:E (p > 0.7)	1.13

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	0.33000	28.74839 ± 35.48825
Channel		
Depth-Avg (cm)	12.8	28.2 ± 14.0
Depth-BankfullMinusWetted (cm)	35.00	60.67 ± 44.73
Depth-Max (cm)	17.5	41.6 ± 22.3
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	4.00	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)	0	1 ± 0
Slope (m/m)	3.0000000	0.0249850 ± 0.0294369
Veg-Coniferous (Binary)	0	1 ± 0

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	0 ± 1
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.56	0.45 ± 0.19
Velocity-Max (m/s)	0.70	0.68 ± 0.25
Width-Bankfull (m)	3.4	35.9 ± 41.6
Width-Wetted (m)	2.3	17.8 ± 20.2
XSEC-VelMethod (Category(1-3))	1	3 ± 0
Climate		
Precip02_FEB (mm)	163.00000	94.95103 ± 61.64910
Temp07_JULmax (Degrees Celsius)	20.48000	17.48320 ± 2.57900
Landcover		
Natl-SnowIce (%)	0.00000	4.62982 ± 9.77010
Natl-Water (%)	0.00000	1.55060 ± 2.36345
Natl-WetlandHerb (%)	0.00000	0.18446 ± 0.50703
Substrate Data		
%Bedrock (%)	0	0 ± 1
%Boulder (%)	1	11 ± 11
%Cobble (%)	58	53 ± 11
%Gravel (%)	2	5 ± 4
%Pebble (%)	31	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	8	1 ± 3
D50 (cm)	7.10	8.04 ± 4.60
Dg (cm)	5.1	8.2 ± 3.1
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	31.09165 ± 12.51836
Water Chemistry		
General-Conductivity (µS/cm)	184.9000000	92.7298969 ± 75.6979499
General-DO (mg/L)	10.0000000	11.4180702 ± 1.2821697
General-pH (pH)	7.6	7.7 ± 0.7
General-SpCond (µS/cm)	234.9000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	13.0	12.1 ± 4.3
General-TempWater (Degrees Celsius)	13.9000000	7.6535897 ± 3.4680513

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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	45.1%	26.0%	0.1%	18.4%	8.4%	2.1%
CABIN Assessment of CRB-DS-AQ01 on Aug 01, 2018	Similar to Reference					

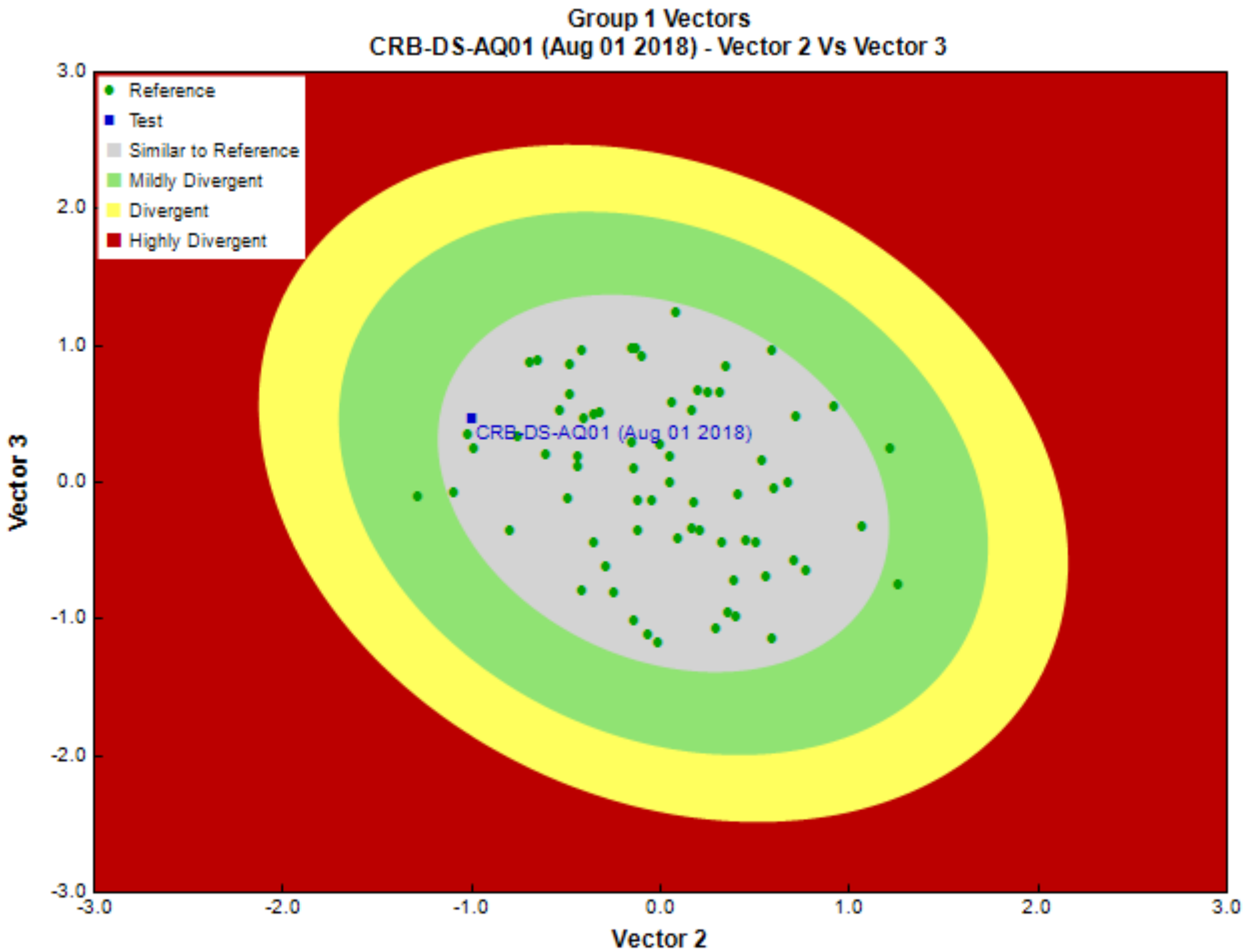


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
			Empididae	4	40.0
			Simuliidae	14	140.0
			Tipulidae	4	40.0
		Ephemeroptera	Baetidae	116	1,160.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.8	3.6 ± 0.9
Hilsenhoff Family index (North-West)	3.8	3.6 ± 0.7
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.9 ± 1.2
Tolerant individuals (%)	--	0.8 ± 0.7
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		
% Chironomidae	13.8	13.3 ± 11.8
% Coleoptera	0.0	1.6 ± 3.9
% Diptera + Non-insects	23.5	19.1 ± 14.0
% Ephemeroptera	45.5	50.6 ± 18.6
% Ephemeroptera that are Baetidae	80.0	44.8 ± 26.1
% EPT Individuals	76.5	79.0 ± 14.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	60.8	57.9 ± 12.9
% of 5 dominant taxa	86.5	83.1 ± 9.3
% of dominant taxa	36.4	38.1 ± 13.1
% Plecoptera	27.9	21.9 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	15.3 ± 22.2
% Tricoptera	3.1	6.5 ± 8.5
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
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%	0.23
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%	0.02
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%	0.40
Nemouridae	93%	73%	53%	81%	15%	73%	0.78

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	
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%	0.25
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.49
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
Stygothrombiidae	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	8.71
RIVPACS : Observed taxa P>0.50	10.00
RIVPACS : O:E (p > 0.5)	1.15
RIVPACS : Expected taxa P>0.70	5.22
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	20.7 ± 10.2
Depth-BankfullMinusWetted (cm)	37.00	38.99 ± 18.61
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	3 ± 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	0.0126213 ± 0.0108440
Veg-Coniferous (Binary)	0	1 ± 0

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
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
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 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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	45.1%	26.0%	0.1%	18.4%	8.4%	2.1%
CABIN Assessment of CRB-DS-AQ01 on Jul 25, 2017	Similar to Reference					

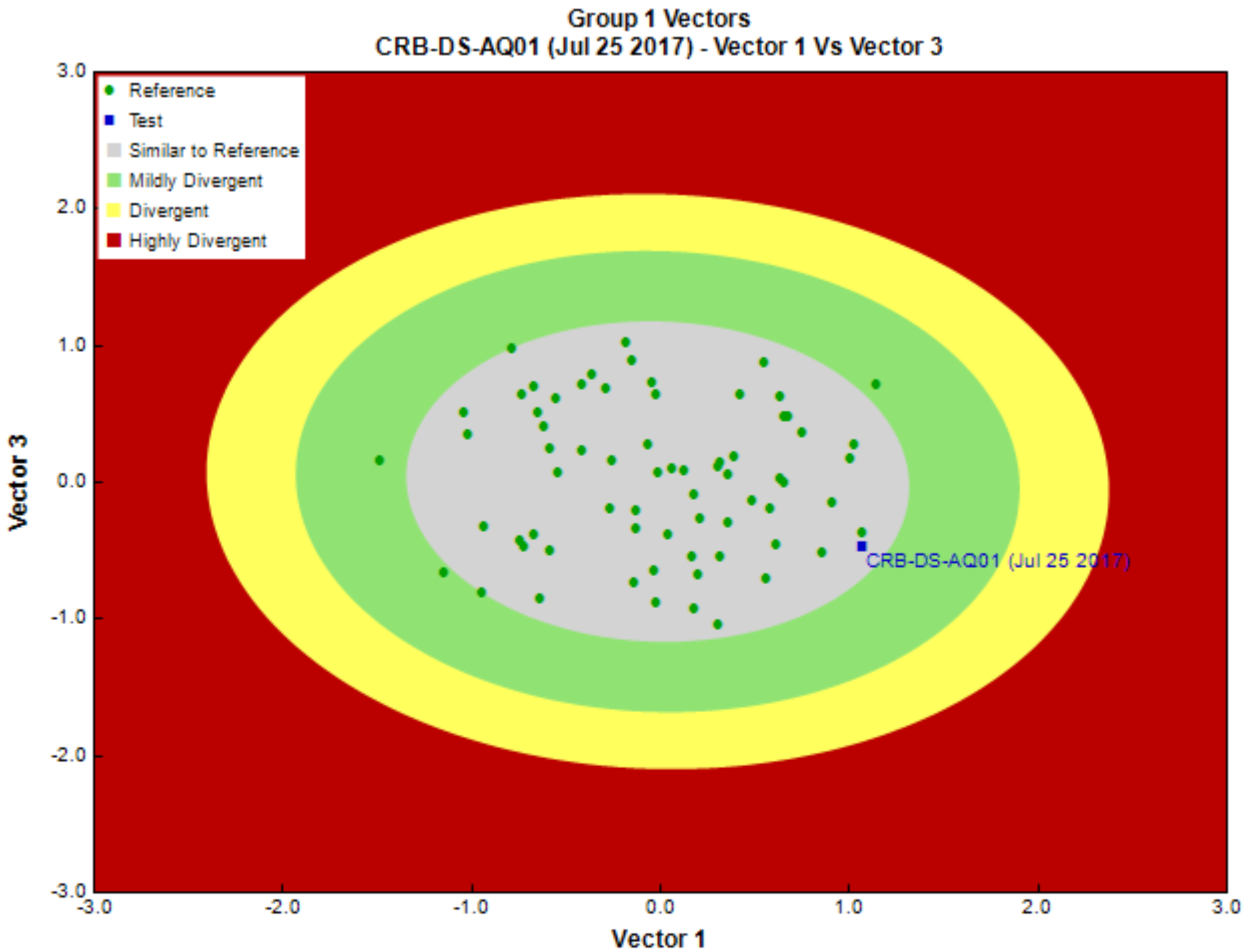


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
		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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.1	3.6 ± 0.9
Hilsenhoff Family index (North-West)	4.1	3.6 ± 0.7
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.9 ± 1.2
Tolerant individuals (%)	--	0.8 ± 0.7
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		
% Chironomidae	8.3	13.3 ± 11.8
% Coleoptera	0.0	1.6 ± 3.9
% Diptera + Non-insects	13.1	19.1 ± 14.0
% Ephemeroptera	75.7	50.6 ± 18.6
% Ephemeroptera that are Baetidae	96.8	44.8 ± 26.1
% EPT Individuals	86.9	79.0 ± 14.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	81.6	57.9 ± 12.9
% of 5 dominant taxa	94.2	83.1 ± 9.3
% of dominant taxa	73.3	38.1 ± 13.1
% Plecoptera	9.0	21.9 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	15.3 ± 22.2
% Tricoptera	2.2	6.5 ± 8.5
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

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%	0.23
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%	0.02
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%	0.40
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%	0.25
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.49
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
Stygothrombiidae	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	8.71
RIVPACS : Observed taxa P>0.50	6.00
RIVPACS : O:E (p > 0.5)	0.69
RIVPACS : Expected taxa P>0.70	5.22
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	20.7 ± 10.2
Depth-BankfullMinusWetted (cm)	30.00	38.99 ± 18.61
Depth-Max (cm)	10.0	30.4 ± 17.2
Macrophyte (PercentRange)	0	0 ± 1
Reach-%CanopyCoverage (PercentRange)	3.00	0.86 ± 1.10
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0100000	0.0126213 ± 0.0108440
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 ± 1
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

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
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
%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 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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	45.0%	25.9%	0.1%	18.4%	8.5%	2.1%
CABIN Assessment of CRB-DS-AQ01 on Aug 02, 2016	Mildly Divergent					

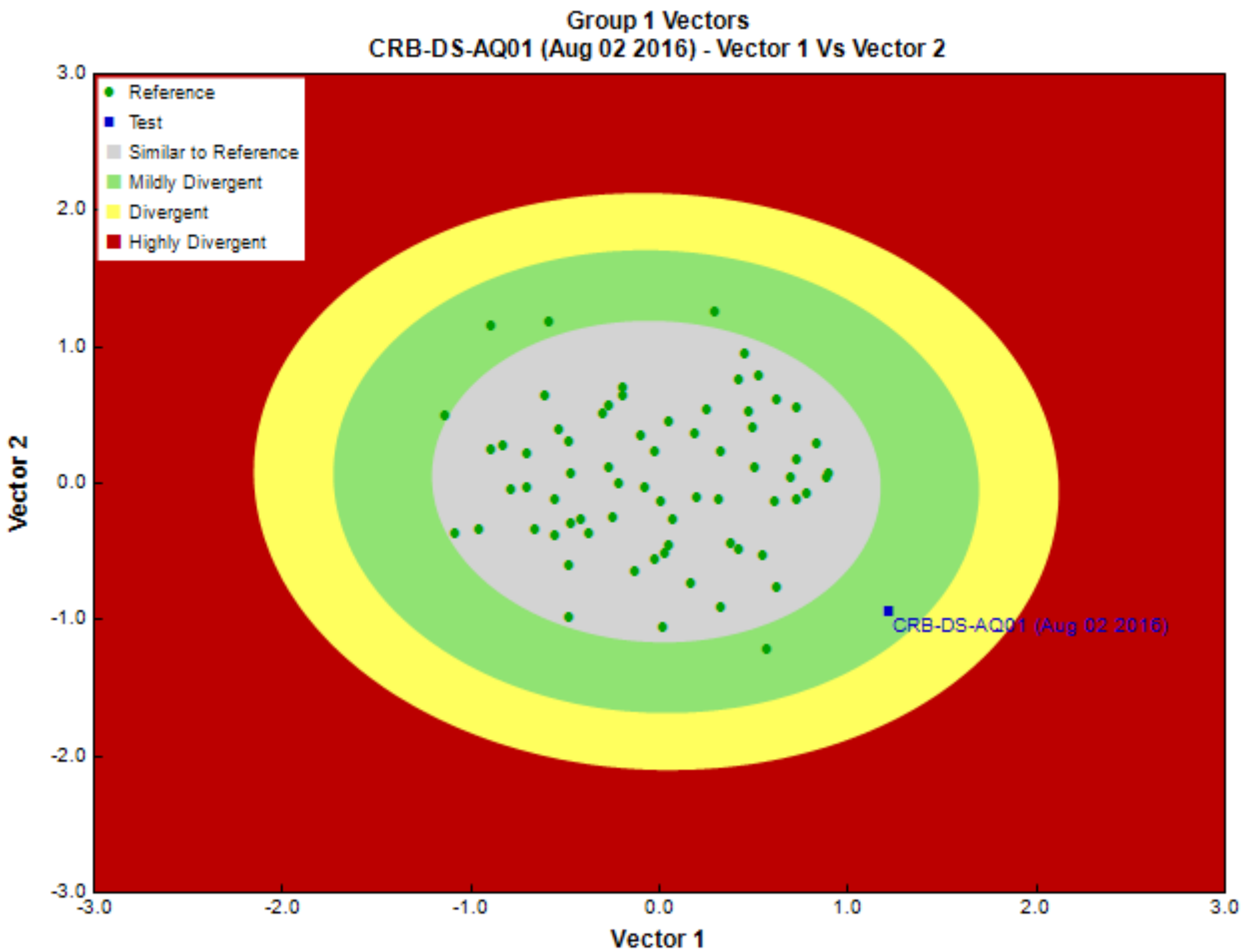


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
		Megaloptera	Sialidae	1	10.0
		Plecoptera	Chloroperlidae	55	550.0
			Leuctridae	1	10.0
			Nemouridae	159	1,590.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.6	3.6 ± 0.9
Hilsenhoff Family index (North-West)	4.6	3.6 ± 0.7
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.9 ± 1.2
Tolerant individuals (%)	--	0.8 ± 0.7
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		
% Chironomidae	5.7	13.3 ± 11.8
% Coleoptera	0.0	1.6 ± 3.9
% Diptera + Non-insects	16.4	19.1 ± 14.0
% Ephemeroptera	14.5	50.6 ± 18.6
% Ephemeroptera that are Baetidae	89.1	44.8 ± 26.1
% EPT Individuals	83.3	79.0 ± 14.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	67.5	57.9 ± 12.9
% of 5 dominant taxa	91.5	83.1 ± 9.3
% of dominant taxa	50.2	38.1 ± 13.1
% Plecoptera	68.1	21.9 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	15.3 ± 22.2
% Tricoptera	0.6	6.5 ± 8.5
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

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	
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
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%	0.23
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%	0.02
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%	0.40
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

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	
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%	0.25
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.08
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.49
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
Stygothrombiidae	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	5.22
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	20.7 ± 10.2
Depth-BankfullMinusWetted (cm)	58.00	38.99 ± 18.61
Depth-Max (cm)	12.5	30.4 ± 17.2
Macrophyte (PercentRange)	0	0 ± 1
Reach-%CanopyCoverage (PercentRange)	2.00	0.86 ± 1.10
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0100000	0.0126213 ± 0.0108440
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

Habitat Description

Variable	CRB-DS-AQ01	Predicted Group Reference Mean ±SD
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 ± 1
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 (%)	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	JOR-DS-AQ31
Sampling Date	Aug 05 2020
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	623
Local Basin Name	Jordan Creek
	Jordan Creek
Stream Order	2

Figure 1. Location Map

Across Reach

Down Stream

Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 28, 2020
Taxonomic Level	Family

Cabin Assessment Results

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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					
Probability of Group Membership	0.0%	0.0%	0.0%	99.4%	0.6%	0.0%
CABIN Assessment of JOR-DS-AQ31 on Aug 05, 2020	Mildly Divergent					

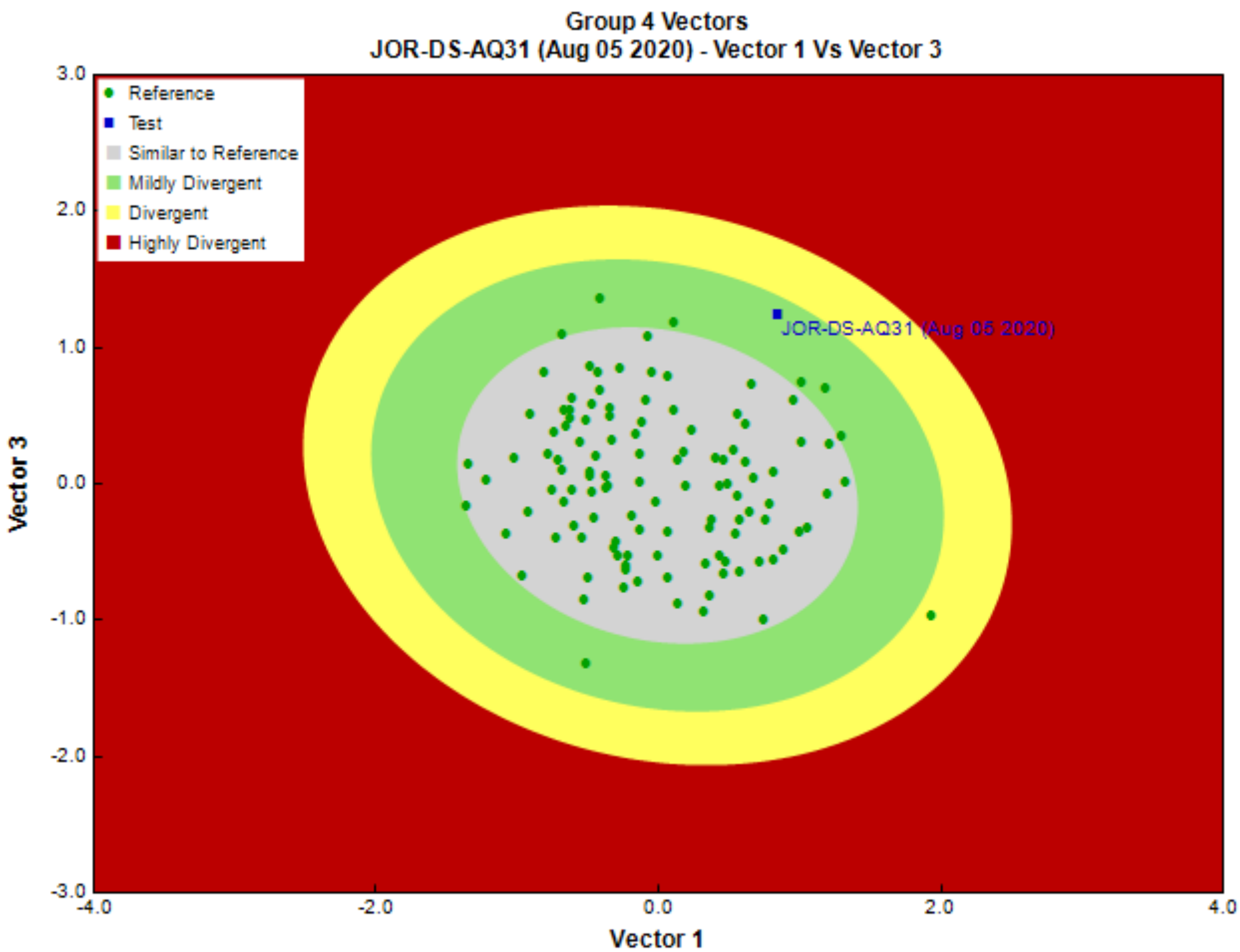


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Scott Finlayson, Cordillera Consulting
	-
Sub-Sample Proportion	16/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Sarcoptiformes		2	12.5
		Trombidiformes	Sperchontidae	1	6.3
	Collembola	Collembola		2	12.5
	Insecta	Diptera		1	6.3
			Chironomidae	96	600.2
			Simuliidae	151	943.8
			Tipulidae	2	12.5
		Ephemeroptera	Baetidae	22	137.5
			Leptophlebiidae	31	193.8
		Plecoptera	Nemouridae	7	43.8
			Perlidae	1	6.3
		Trichoptera		1	6.3
			Hydropsychidae	1	6.3
			Limnephilidae	1	6.3
Mollusca	Bivalvia	Veneroida	Pisidiidae	1	6.3
	Gastropoda	Basommatophora	Physidae	1	6.3
			Total	321	2,007.0

Metrics

Name	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.74	0.5 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	5.0	4.3 ± 1.8
Hilsenhoff Family index (North-West)	5.0	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	1.0	1.7 ± 0.9
Tolerant individuals (%)	0.3	1.3 ± 1.4
Functional Measures		
% Filterers	--	17.2 ± 42.4
% Gatherers	90.0	57.6 ± 27.3
% Predatores	77.9	31.3 ± 20.3
% Scrapers	54.8	37.4 ± 22.0
% Shredder	3.1	16.1 ± 11.0
No. Clinger Taxa	9.0	15.8 ± 6.3
Number Of Individuals		
% Chironomidae	30.5	22.3 ± 19.9
% Coleoptera	0.0	0.7 ± 1.9
% Diptera + Non-insects	80.0	32.8 ± 26.0
% Ephemeroptera	16.8	42.2 ± 21.6
% Ephemeroptera that are Baetidae	41.5	29.6 ± 25.6
% EPT Individuals	20.0	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	78.4	58.1 ± 13.7
% of 5 dominant taxa	97.5	82.2 ± 8.7
% of dominant taxa	47.9	39.9 ± 14.9
% Plecoptera	2.5	14.7 ± 11.2
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	50.0	19.9 ± 23.1
% Tricoptera	0.6	9.2 ± 10.9
No. EPT individuals/Chironomids+EPT Individuals	0.4	0.7 ± 0.2
Total Abundance	2006.3	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

Metrics

Name	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Ephemeroptera taxa	2.0	3.6 ± 1.1
EPT Individuals (Sum)	393.8	1501.0 ± 1294.6
EPT taxa (no)	6.0	10.8 ± 3.5
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.5	0.7 ± 0.1
Plecoptera taxa	2.0	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	0.2	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%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.00
Apataniidae	7%	2%	5%	11%	8%	8%	0.11
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%	0.09
Aturidae	4%	6%	0%	5%	0%	2%	0.05
Baetidae	97%	92%	79%	93%	62%	84%	0.93
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%	0.65
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.27
Chironomidae	100%	100%	89%	99%	100%	100%	0.99
Chloroperlidae	87%	61%	95%	92%	31%	76%	0.92
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%	0.28
Empididae	51%	65%	47%	62%	8%	51%	0.61
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.34
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.95
Ephemeridae	1%	0%	0%	3%	0%	0%	0.03
Feltriidae	0%	0%	0%	2%	0%	0%	0.02
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%	0.00
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.34
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%	0.99
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%	0.70
Hydroptilidae	19%	39%	5%	15%	23%	6%	0.15
Hydrozetidae	1%	3%	5%	4%	0%	2%	0.04
Hydryphantidae	10%	10%	5%	12%	0%	6%	0.12
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
Hypogastruridae	0%	0%	0%	3%	0%	12%	0.03

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	
Isotomidae	0%	2%	0%	0%	0%	0%	0.00
Lebertiidae	38%	39%	16%	45%	54%	39%	0.45
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.46
Leptoceridae	1%	15%	0%	5%	62%	2%	0.05
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.02
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.39
Leuctridae	35%	26%	11%	39%	8%	25%	0.39
Limnephilidae	36%	24%	21%	26%	0%	39%	0.25
Limnesiidae	7%	13%	5%	9%	46%	25%	0.10
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%	0.00
Muscidae	0%	2%	0%	4%	0%	6%	0.04
Naididae	26%	47%	5%	46%	85%	33%	0.46
Nemouridae	93%	73%	53%	81%	15%	73%	0.81
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%	0.07
Perlidae	32%	29%	11%	32%	8%	20%	0.31
Perlodidae	64%	60%	79%	75%	31%	76%	0.75
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%	0.03
Piscicolidae	0%	0%	0%	1%	0%	0%	0.01
Pisidiidae	16%	53%	0%	11%	54%	12%	0.11
Planorbidae	1%	3%	0%	1%	31%	0%	0.01
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.02
Psychodidae	33%	21%	0%	22%	0%	4%	0.22
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.09
Rhyacophilidae	59%	32%	47%	66%	0%	61%	0.65
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.32
Sperchontidae	17%	34%	37%	50%	23%	45%	0.50
Staphylinidae	0%	0%	0%	0%	0%	2%	0.00
Stratiomyidae	0%	0%	0%	1%	8%	2%	0.01
Stygothrombiidae	3%	0%	0%	4%	0%	2%	0.04
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%	0.02
Tipulidae	67%	50%	42%	68%	38%	63%	0.68
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.36
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.03
Uenoidae	9%	8%	37%	17%	0%	10%	0.17
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	10.64
RIVPACS : Observed taxa P>0.50	6.00
RIVPACS : O:E (p > 0.5)	0.56
RIVPACS : Expected taxa P>0.70	6.33
RIVPACS : Observed taxa P>0.70	3.00
RIVPACS : O:E (p > 0.7)	0.47

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	60.51000	28.74839 ± 35.48825
Channel		
Depth-BankfullMinusWetted (cm)	22.00	60.67 ± 44.73
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	4.00	0.92 ± 1.11
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)	5.0000000	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)	0.61	0.45 ± 0.19
Velocity-Max (m/s)	0.75	0.68 ± 0.25
Width-Bankfull (m)	5.3	35.9 ± 41.6
Width-Wetted (m)	4.8	17.8 ± 20.2
XSEC-VelMethod (Category(1-3))	1	3 ± 0
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 (%)	9	11 ± 11
%Cobble (%)	54	53 ± 11
%Gravel (%)	5	5 ± 4
%Pebble (%)	30	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	2	1 ± 3
D50 (cm)	8.85	8.04 ± 4.60
Dg (cm)	7.5	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))	3	2 ± 1
SurroundingMaterial (Category(0-9))	4	3 ± 1
Topography		
SlopeAvg (%)	40.36000	31.09165 ± 12.51836
Water Chemistry		
General-Conductivity (μS/cm)	528.0000000	92.7298969 ± 75.6979499
General-DO (mg/L)	8.1000000	11.4180702 ± 1.2821697
General-pH (pH)	7.7	7.7 ± 0.7
General-SpCond (μS/cm)	62.8000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	19.0	12.1 ± 4.3
General-TempWater (Degrees Celsius)	16.7000000	7.6535897 ± 3.4680513

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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	6.9%	6.1%	0.1%	62.9%	2.6%	21.3%
CABIN Assessment of JOR-DS-AQ31 on Jul 30, 2019	Similar to Reference					

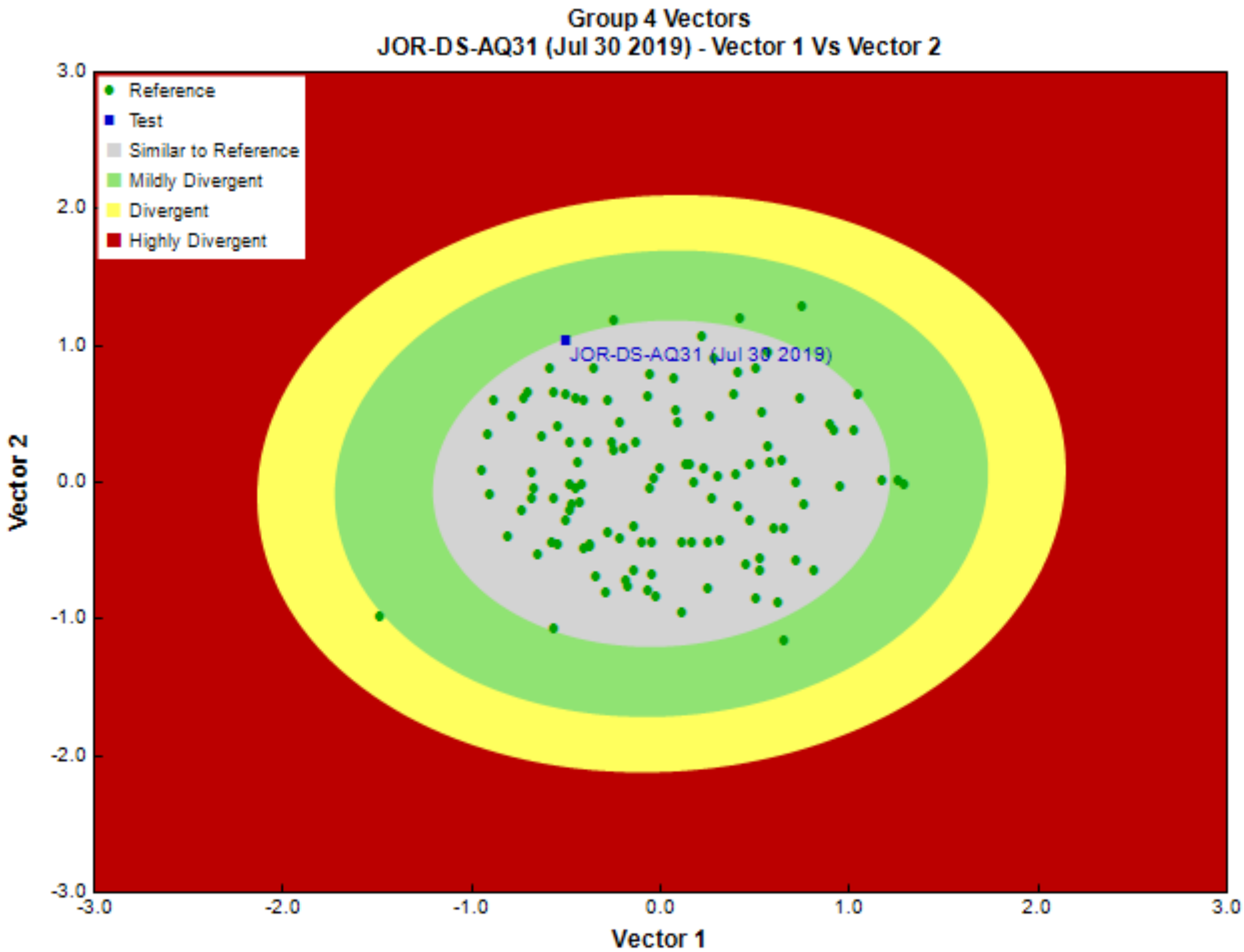


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
			Leptophlebiidae	2	5.7
		Plecoptera	Chloroperlidae	1	2.9
			Nemouridae	48	137.2
			Perlidae	3	8.6

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.2	4.3 ± 1.8
Hilsenhoff Family index (North-West)	4.2	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	2.0	1.7 ± 0.9
Tolerant individuals (%)	0.6	1.3 ± 1.4
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		
% Chironomidae	49.1	22.3 ± 19.9
% Coleoptera	0.0	0.7 ± 1.9
% Diptera + Non-insects	56.4	32.8 ± 26.0
% Ephemeroptera	25.5	42.2 ± 21.6
% Ephemeroptera that are Baetidae	89.2	29.6 ± 25.6
% EPT Individuals	43.6	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	71.8	58.1 ± 13.7
% of 5 dominant taxa	92.0	82.2 ± 8.7
% of dominant taxa	49.1	39.9 ± 14.9
% Plecoptera	16.0	14.7 ± 11.2
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	14.3	19.9 ± 23.1
% Tricoptera	2.1	9.2 ± 10.9
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%	0.34
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%	0.25
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%	0.28
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%	0.62
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

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	
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
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%	0.61
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
Stygothrombiidae	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	60.67 ± 44.73
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

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.67	0.45 ± 0.19
Velocity-Max (m/s)	0.89	0.68 ± 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 ± 0
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
%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	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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	8.9%	7.1%	0.1%	58.4%	7.5%	18.1%
CABIN Assessment of JOR-DS-AQ31 on Aug 01, 2018	Mildly Divergent					

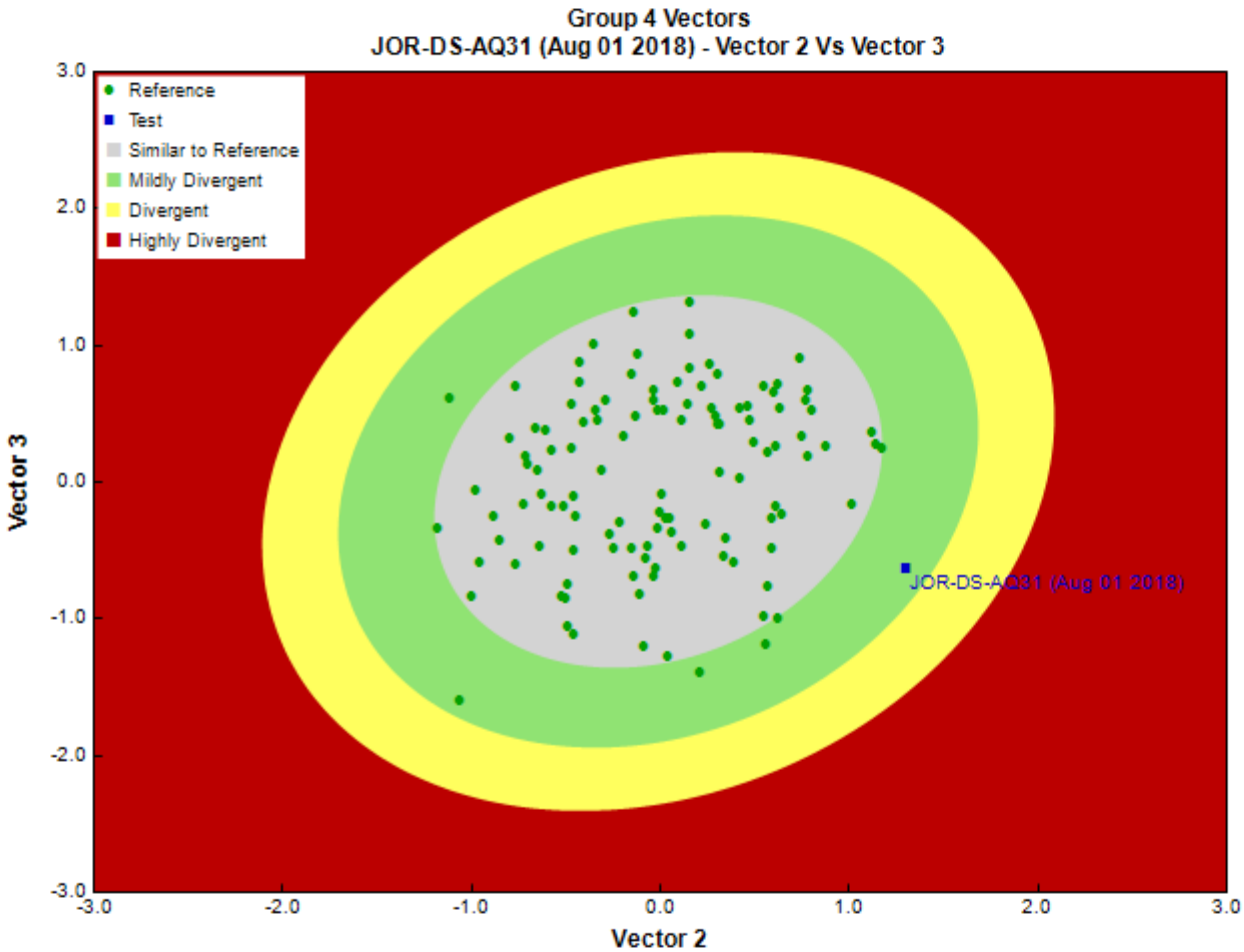


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
		Plecoptera	Chloroperlidae	1	5.9
			Nemouridae	40	235.3
			Perlidae	5	29.4
		Trichoptera	Hydropsychidae	2	11.8

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	5.5	4.3 ± 1.8
Hilsenhoff Family index (North-West)	5.5	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	2.0	1.7 ± 0.9
Tolerant individuals (%)	--	1.3 ± 1.4
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		
% Chironomidae	12.6	22.3 ± 19.9
% Coleoptera	0.0	0.7 ± 1.9
% Diptera + Non-insects	74.8	32.8 ± 26.0
% Ephemeroptera	10.4	42.2 ± 21.6
% Ephemeroptera that are Baetidae	63.2	29.6 ± 25.6
% EPT Individuals	25.2	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	73.7	58.1 ± 13.7
% of 5 dominant taxa	93.7	82.2 ± 8.7
% of dominant taxa	61.1	39.9 ± 14.9
% Plecoptera	12.6	14.7 ± 11.2
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	25.0	19.9 ± 23.1
% Tricoptera	2.2	9.2 ± 10.9
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

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	
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%	0.89
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%	0.99
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%	0.36
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

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	
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
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%	0.30
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
Stygothrombiidae	3%	0%	0%	4%	0%	2%	0.03
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.50
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	5.98
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	0.84

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	28.2 ± 14.0
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

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Velocity-Avg (m/s)	0.55	0.45 ± 0.19
Velocity-Max (m/s)	0.83	0.68 ± 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 ± 0
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 (%)	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 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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	18.6%	9.8%	0.2%	50.7%	2.1%	18.6%
CABIN Assessment of JOR-DS-AQ31 on Jul 26, 2017	Mildly Divergent					

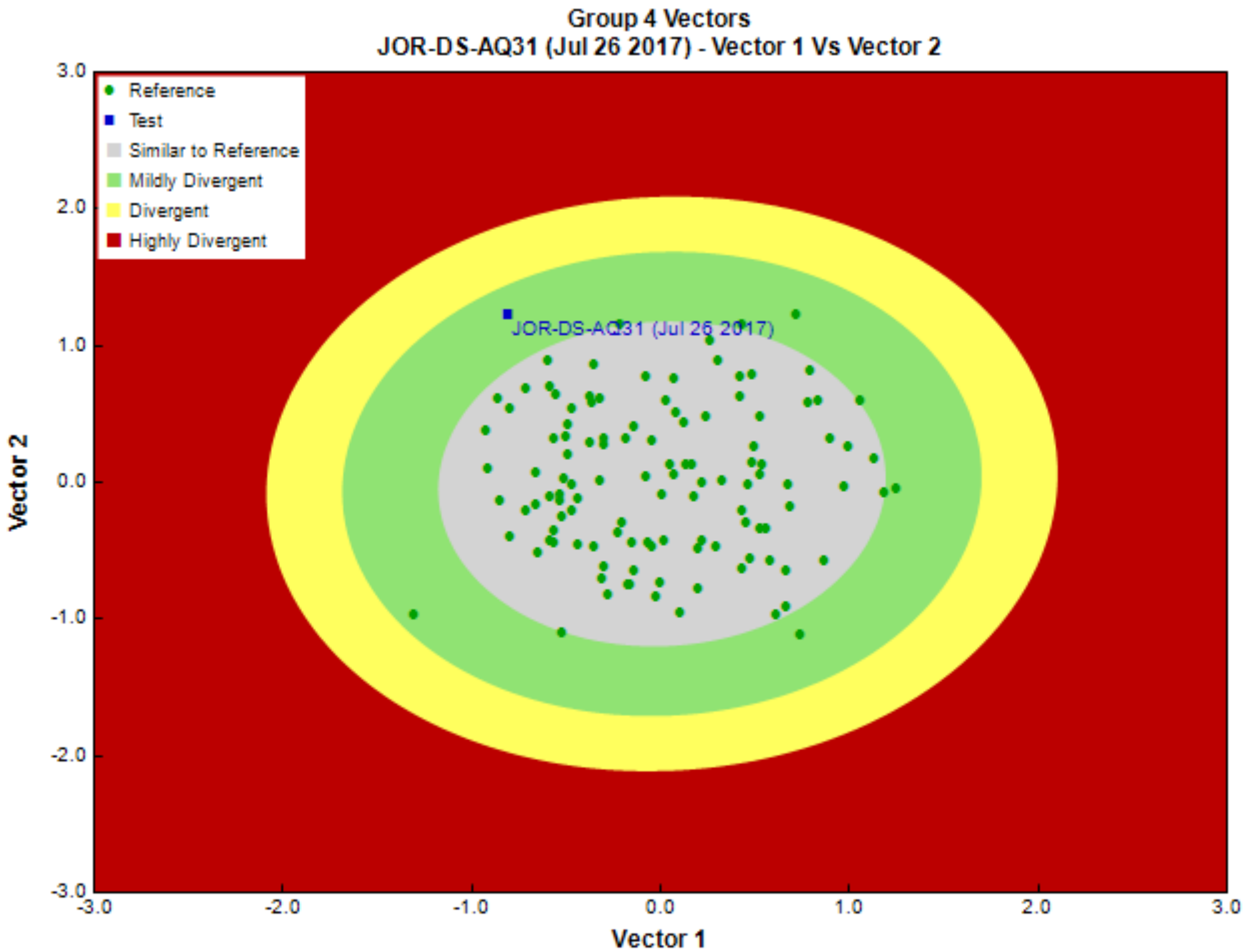


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
			Leptophlebiidae	3	21.4
		Plecoptera	Chloroperlidae	1	7.1
			Leuctridae	1	7.1
			Nemouridae	20	142.9

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	5.6	4.3 ± 1.8
Hilsenhoff Family index (North-West)	5.6	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	1.0	1.7 ± 0.9
Tolerant individuals (%)	--	1.3 ± 1.4
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		
% Chironomidae	13.6	22.3 ± 19.9
% Coleoptera	0.0	0.7 ± 1.9
% Diptera + Non-insects	80.2	32.8 ± 26.0
% Ephemeroptera	13.1	42.2 ± 21.6
% Ephemeroptera that are Baetidae	87.2	29.6 ± 25.6
% EPT Individuals	19.8	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	78.6	58.1 ± 13.7
% of 5 dominant taxa	96.7	82.2 ± 8.7
% of dominant taxa	64.9	39.9 ± 14.9
% Plecoptera	6.4	14.7 ± 11.2
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	19.9 ± 23.1
% Tricoptera	0.3	9.2 ± 10.9
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

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	
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
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%	0.60
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%	0.04

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	
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
Sialidae	0%	2%	0%	0%	0%	0%	0.00
Simuliidae	52%	29%	16%	32%	8%	24%	0.34
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
Stygothrombiidae	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	9.69
RIVPACS : Observed taxa P>0.50	8.00
RIVPACS : O:E (p > 0.5)	0.83
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	28.2 ± 14.0
Depth-BankfullMinusWetted (cm)	45.00	60.67 ± 44.73
Depth-Max (cm)	30.0	41.6 ± 22.3
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 ± 0.19
Velocity-Max (m/s)	1.69	0.68 ± 0.25

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Width-Bankfull (m)	5.7	35.9 ± 41.6
Width-Wetted (m)	3.4	17.8 ± 20.2
XSEC-VelInstrumentDirect (Category(1-3))	1	1 ± 0
XSEC-VelMethod (Category(1-3))	3	3 ± 0
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 (%)	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 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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	13.5%	8.4%	0.2%	55.1%	2.4%	20.5%
CABIN Assessment of JOR-DS-AQ31 on Aug 03, 2016	Mildly Divergent					

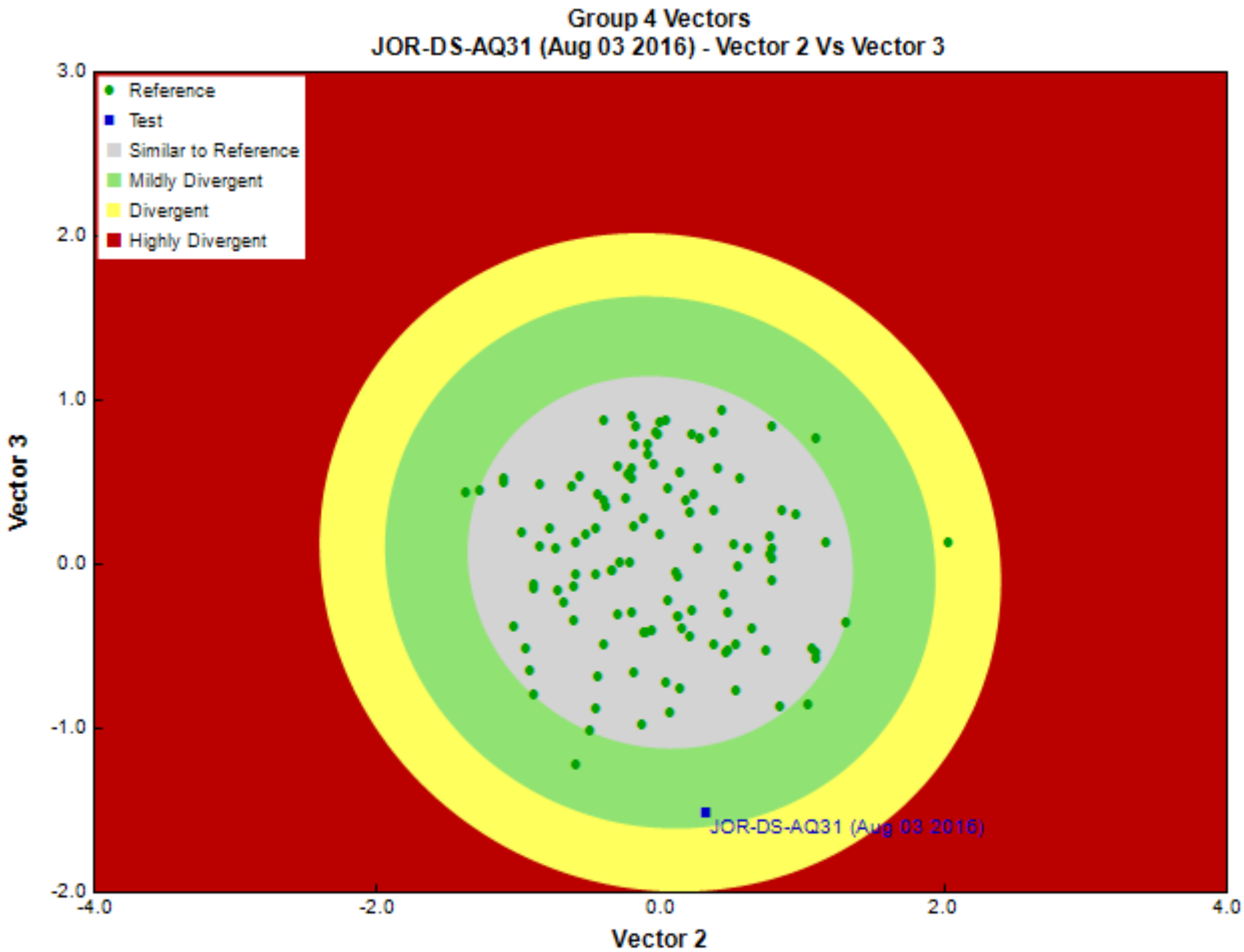


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
			Nemouridae	145	906.3
			Perlidae	5	31.3
		Trichoptera	Hydropsychidae	5	31.3
			Rhyacophilidae	1	6.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Total	335	2,094.2

Metrics

Name	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.78	0.5 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	5.6	4.3 ± 1.8
Hilsenhoff Family index (North-West)	5.6	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	1.0	1.7 ± 0.9
Tolerant individuals (%)	--	1.3 ± 1.4
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		
% Chironomidae	12.8	22.3 ± 19.9
% Coleoptera	0.0	0.7 ± 1.9
% Diptera + Non-insects	49.6	32.8 ± 26.0
% Ephemeroptera	3.6	42.2 ± 21.6
% Ephemeroptera that are Baetidae	75.0	29.6 ± 25.6
% EPT Individuals	50.4	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	77.9	58.1 ± 13.7
% of 5 dominant taxa	94.9	82.2 ± 8.7
% of dominant taxa	43.3	39.9 ± 14.9
% Plecoptera	45.1	14.7 ± 11.2
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	83.3	19.9 ± 23.1
% Tricoptera	1.8	9.2 ± 10.9
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

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	
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
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%	0.94
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

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	
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
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
Stygothrombiidae	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	9.70
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)	18.5	28.2 ± 14.0
Depth-BankfullMinusWetted (cm)	74.00	60.67 ± 44.73
Depth-Max (cm)	24.0	41.6 ± 22.3
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 ± 0.19
Velocity-Max (m/s)	0.77	0.68 ± 0.25
Width-Bankfull (m)	7.1	35.9 ± 41.6

Habitat Description

Variable	JOR-DS-AQ31	Predicted Group Reference Mean ±SD
Width-Wetted (m)	4.2	17.8 ± 20.2
XSEC-VelInstrumentDirect (Category(1-3))	1	1 ± 0
XSEC-VelMethod (Category(1-3))	3	3 ± 0
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
%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

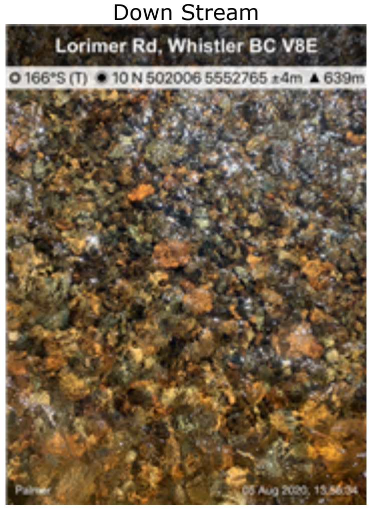
Site Description

Study Name	BC-Resort Municipality of Whistler-Ecosystem Monitoring
Site	RGD-AQ11
Sampling Date	Aug 05 2020
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	651
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach

Down Stream



Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 28, 2020
Taxonomic Level	Family

Cabin Assessment Results

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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					
Probability of Group Membership	0.0%	0.0%	0.0%	61.3%	32.9%	5.8%
CABIN Assessment of RGD-AQ11 on Aug 05, 2020	Similar to Reference					

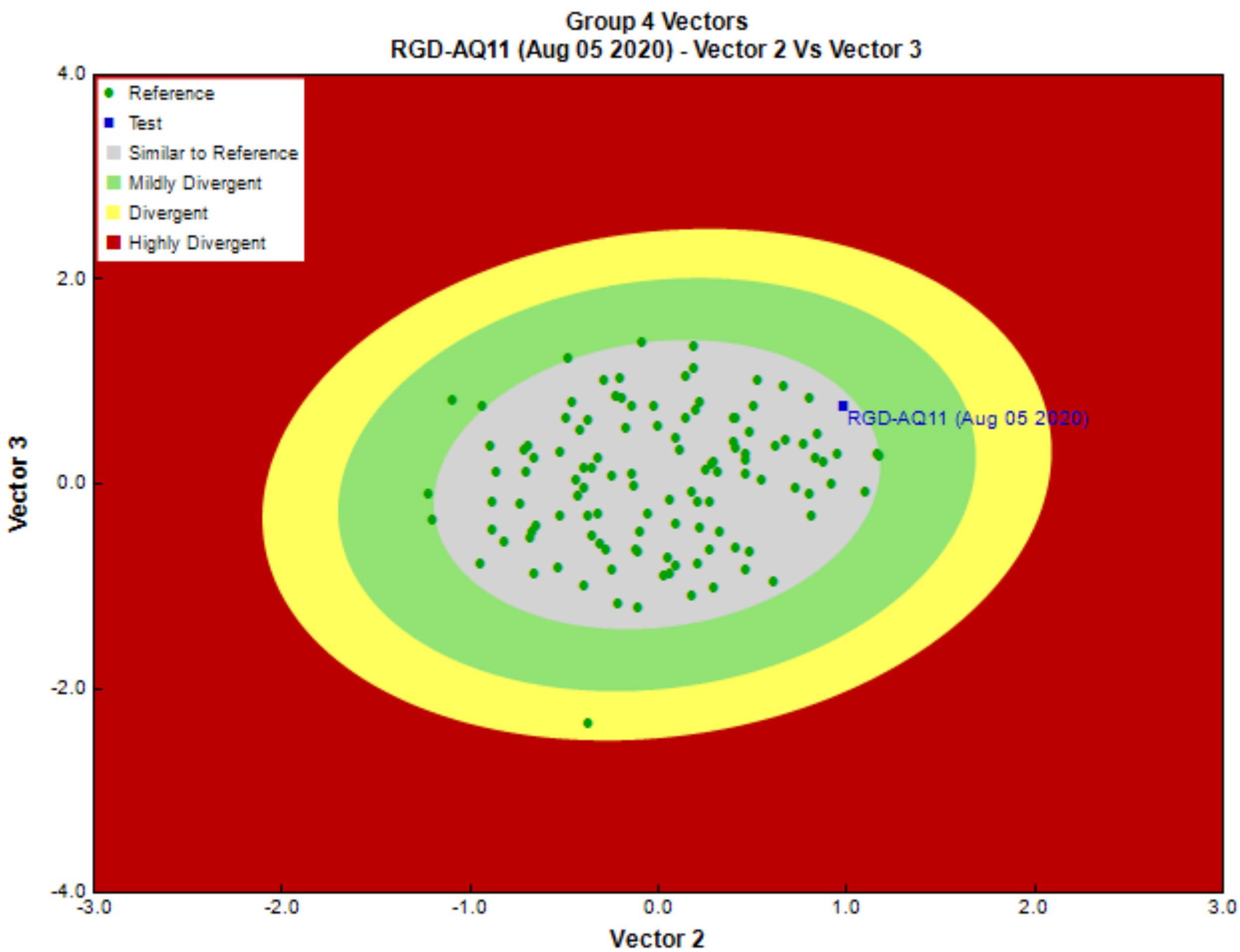


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Scott Finlayson, Cordillera Consulting
	-
Sub-Sample Proportion	100/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	2	2.0
		Tubificida	Naididae	7	7.0
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	16	16.0
			Mideopsidae	1	1.0
			Sperchontidae	10	10.0
			Torrenticolidae	1	1.0
	Insecta	Diptera	Ceratopogonidae	1	1.0
			Chironomidae	45	45.0
			Empididae	2	2.0
			Simuliidae	94	94.0
			Tipulidae	1	1.0
		Ephemeroptera	Ameletidae	23	23.0
			Baetidae	168	168.0
			Ephemerellidae	6	6.0
			Heptageniidae	119	119.0
			Leptophlebiidae	6	6.0
		Plecoptera	Capniidae	13	13.0
			Chloroperlidae	29	29.0
			Leuctridae	1	1.0
			Nemouridae	7	7.0
			Perlidae	14	14.0
			Perlodidae	9	9.0
		Trichoptera	Hydropsychidae	1	1.0
			Rhyacophilidae	6	6.0
Mollusca	Bivalvia	Veneroida	Pisidiidae	1	1.0
			Total	583	583.0

Metrics

Name	RGD-AQ11	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.48	0.5 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.4	4.3 ± 1.8
Hilsenhoff Family index (North-West)	4.4	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	1.0	1.7 ± 0.9
Tolerant individuals (%)	--	1.3 ± 1.4
Functional Measures		
% Filterers	--	17.2 ± 42.4
% Gatherers	34.3	57.6 ± 27.3
% Predatores	34.1	31.3 ± 20.3
% Scrapers	65.5	37.4 ± 22.0
% Shredder	3.8	16.1 ± 11.0
No. Clinger Taxa	27.0	15.8 ± 6.3
Number Of Individuals		
% Chironomidae	7.7	22.3 ± 19.9
% Coleoptera	0.0	0.7 ± 1.9
% Diptera + Non-insects	31.0	32.8 ± 26.0
% Ephemeroptera	55.2	42.2 ± 21.6
% Ephemeroptera that are Baetidae	52.2	29.6 ± 25.6
% EPT Individuals	69.0	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	49.2	58.1 ± 13.7
% of 5 dominant taxa	78.0	82.2 ± 8.7
% of dominant taxa	28.8	39.9 ± 14.9
% Plecoptera	12.5	14.7 ± 11.2

Metrics

Name	RGD-AQ11	Predicted Group Reference Mean ±SD
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	14.3	19.9 ± 23.1
% Tricoptera	1.2	9.2 ± 10.9
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.7 ± 0.2
Total Abundance	583.0	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	5.0	3.2 ± 1.3
Ephemeroptera taxa	5.0	3.6 ± 1.1
EPT Individuals (Sum)	402.0	1501.0 ± 1294.6
EPT taxa (no)	13.0	10.8 ± 3.5
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	6.0	4.1 ± 1.8
Shannon-Wiener Diversity	2.2	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	25.0	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 RGD-AQ11
	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%	0.00
Anisitsiellidae	0%	10%	0%	0%	0%	4%	0.00
Apataniidae	7%	2%	5%	11%	8%	8%	0.10
Arrenuridae	0%	2%	0%	0%	15%	0%	0.05
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%	0.03
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%	0.28
Caenidae	0%	0%	0%	1%	38%	0%	0.13
Capniidae	81%	60%	37%	65%	31%	69%	0.54
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%	0.71
Crangonyctidae	1%	2%	0%	0%	8%	0%	0.03
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%	0.23
Empididae	51%	65%	47%	62%	8%	51%	0.43
Enchytraeidae	22%	26%	5%	34%	31%	39%	0.33
Ephemerellidae	88%	79%	84%	95%	62%	84%	0.83
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%	0.00
Gerridae	0%	0%	0%	0%	0%	2%	0.00
Glossiphoniidae	0%	0%	0%	0%	15%	0%	0.05
Glossosomatidae	32%	21%	16%	34%	0%	12%	0.22
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%	0.84

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	
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%	0.53
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%	0.08
Hygrobatidae	6%	5%	5%	8%	8%	12%	0.08
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%	0.48
Lepidostomatidae	39%	52%	5%	46%	23%	18%	0.37
Leptoceridae	1%	15%	0%	5%	62%	2%	0.23
Leptohyphidae	0%	3%	0%	2%	0%	0%	0.01
Leptophlebiidae	54%	71%	5%	39%	15%	14%	0.30
Leuctridae	35%	26%	11%	39%	8%	25%	0.28
Limnephilidae	36%	24%	21%	26%	0%	39%	0.18
Limnesiidae	7%	13%	5%	9%	46%	25%	0.22
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%	0.00
Muscidae	0%	2%	0%	4%	0%	6%	0.03
Naididae	26%	47%	5%	46%	85%	33%	0.58
Nemouridae	93%	73%	53%	81%	15%	73%	0.59
Oxidae	0%	2%	0%	1%	15%	0%	0.06
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%	0.23
Perlodidae	64%	60%	79%	75%	31%	76%	0.61
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%	0.25
Planorbidae	1%	3%	0%	1%	31%	0%	0.11
Poduridae	0%	3%	0%	0%	0%	2%	0.00
Polycentropodidae	0%	0%	0%	2%	0%	0%	0.01
Psychodidae	33%	21%	0%	22%	0%	4%	0.14
Pteronarcyidae	7%	8%	0%	9%	15%	6%	0.11
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%	0.24
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%	0.03
Stygothrombiidae	3%	0%	0%	4%	0%	2%	0.03
Tabanidae	0%	0%	0%	1%	0%	4%	0.01
Taeniopterygidae	59%	16%	100%	51%	15%	71%	0.41
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%	0.58
Torrenticolidae	32%	58%	0%	36%	23%	6%	0.30
Trhypochthoniidae	1%	5%	0%	3%	0%	0%	0.02
Uenoidae	9%	8%	37%	17%	0%	10%	0.11
Unionicolidae	0%	0%	0%	0%	15%	0%	0.05
Valvatidae	3%	2%	0%	3%	8%	2%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	7.63
RIVPACS : Observed taxa P>0.50	11.00
RIVPACS : O:E (p > 0.5)	1.44
RIVPACS : Expected taxa P>0.70	4.20
RIVPACS : Observed taxa P>0.70	5.00
RIVPACS : O:E (p > 0.7)	1.19

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
Bedrock Geology		
Sedimentary (%)	2.56000	28.74839 ± 35.48825
Channel		
Depth-BankfullMinusWetted (cm)	30.00	60.67 ± 44.73
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	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)	0	1 ± 0
Slope (m/m)	1.0000000	0.0249850 ± 0.0294369
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	0	0 ± 1
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.55	0.45 ± 0.19
Velocity-Max (m/s)	0.89	0.68 ± 0.25
Width-Bankfull (m)	18.5	35.9 ± 41.6
Width-Wetted (m)	8.8	17.8 ± 20.2
XSEC-VelMethod (Category(1-3))	1	3 ± 0
Climate		
Precip02_FEB (mm)	155.11000	94.95103 ± 61.64910
Temp07_JULmax (Degrees Celsius)	18.25000	17.48320 ± 2.57900
Landcover		
Natl-SnowIce (%)	26.42000	4.62982 ± 9.77010
Natl-Water (%)	2.82000	1.55060 ± 2.36345
Natl-WetlandHerb (%)	0.00000	0.18446 ± 0.50703
Substrate Data		
%Bedrock (%)	0	0 ± 1
%Boulder (%)	1	11 ± 11
%Cobble (%)	20	53 ± 11
%Gravel (%)	6	5 ± 4
%Pebble (%)	73	30 ± 12
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	1 ± 3
D50 (cm)	4.05	8.04 ± 4.60
Dg (cm)	3.9	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))	1	2 ± 1
SurroundingMaterial (Category(0-9))	4	3 ± 1
Topography		
SlopeAvg (%)	39.43000	31.09165 ± 12.51836
Water Chemistry		
General-Conductivity (µS/cm)	32.3000000	92.7298969 ± 75.6979499
General-DO (mg/L)	8.2200000	11.4180702 ± 1.2821697
General-pH (pH)	7.7	7.7 ± 0.7
General-SpCond (µS/cm)	41.7000000	105.8321429 ± 89.5097928
General-TempAir (Degrees Celsius)	26.0	12.1 ± 4.3
General-TempWater (Degrees Celsius)	13.6000000	7.6535897 ± 3.4680513

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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	8.9%	4.6%	38.6%	21.4%	16.7%	9.8%
CABIN Assessment of RGD-AQ11 on Jul 30, 2019	Mildly Divergent					

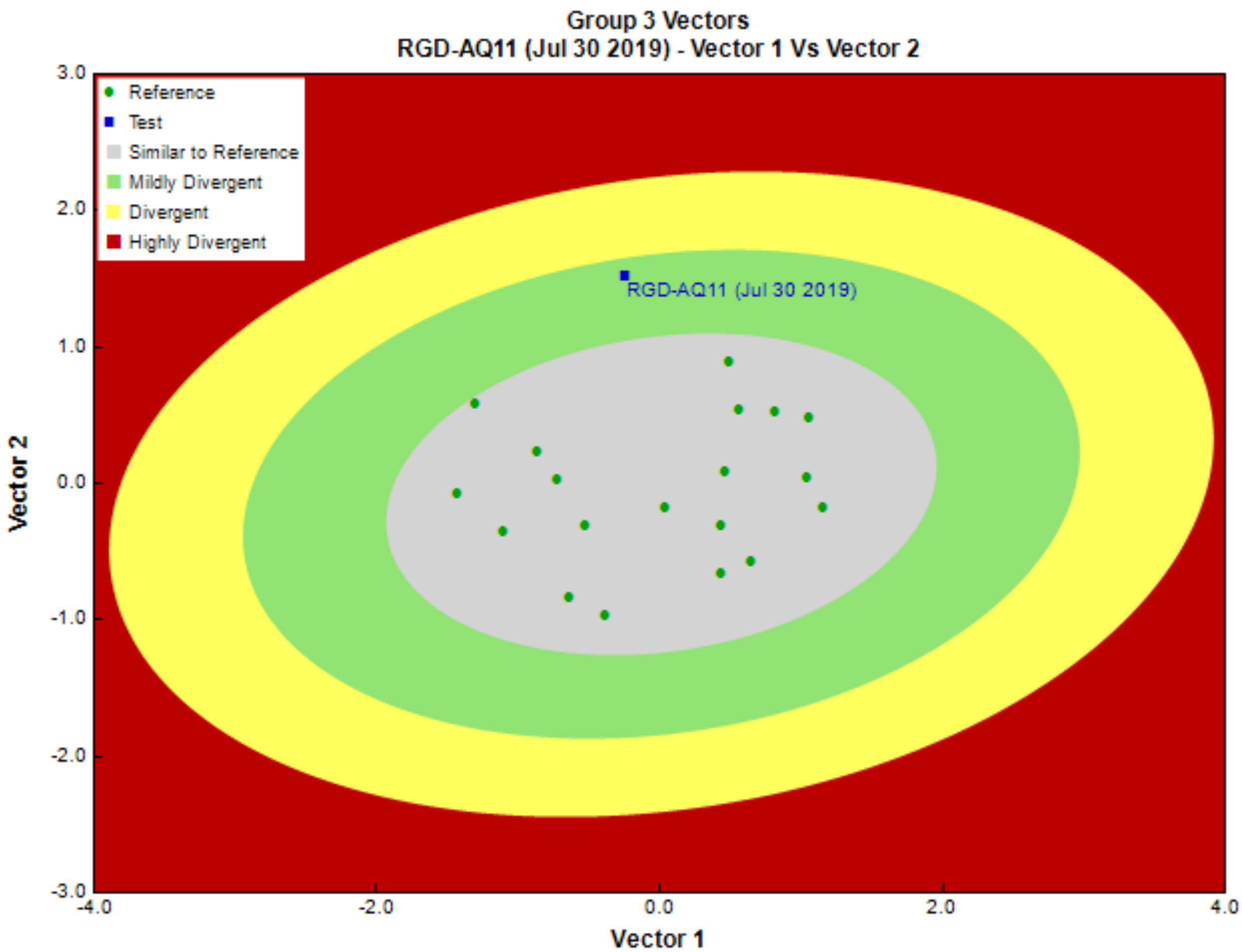


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
			Baetidae	97	359.3
			Ephemerellidae	2	7.4
			Heptageniidae	69	255.5
			Leptophlebiidae	2	7.4

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.4	3.5 ± 1.1
Hilsenhoff Family index (North-West)	4.4	3.4 ± 0.9
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	4.0	1.5 ± 0.6
Tolerant individuals (%)	0.6	1.2 ± 1.0
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		
% Chironomidae	5.3	15.2 ± 13.8
% Coleoptera	0.6	0.9 ± 3.1
% Diptera + Non-insects	27.2	20.6 ± 17.1
% Ephemeroptera	57.5	42.0 ± 19.3
% Ephemeroptera that are Baetidae	52.7	33.7 ± 27.0
% EPT Individuals	72.2	78.2 ± 17.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	51.9	61.7 ± 12.7
% of 5 dominant taxa	82.8	86.1 ± 8.2
% of dominant taxa	30.3	42.0 ± 14.3
% Plecoptera	14.4	30.6 ± 25.8
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	14.8 ± 22.6
% Tricoptera	0.3	5.6 ± 7.7
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
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

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	
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
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
Stygothrombiidae	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	6.73
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	28.3 ± 10.9
Depth-BankfullMinusWetted (cm)	33.00	163.00
Depth-Max (cm)	31.0	43.6 ± 19.2
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
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)	0	0 ± 1
Slope (m/m)	0.0100000	0.0259896 ± 0.0313728
Veg-Coniferous (Binary)	1	1 ± 0

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
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	0.68 ± 0.20
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 ± 0
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 (%)	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

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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	8.9%	4.2%	26.6%	15.5%	38.3%	6.5%
CABIN Assessment of RGD-AQ11 on Jul 31, 2018	Divergent					

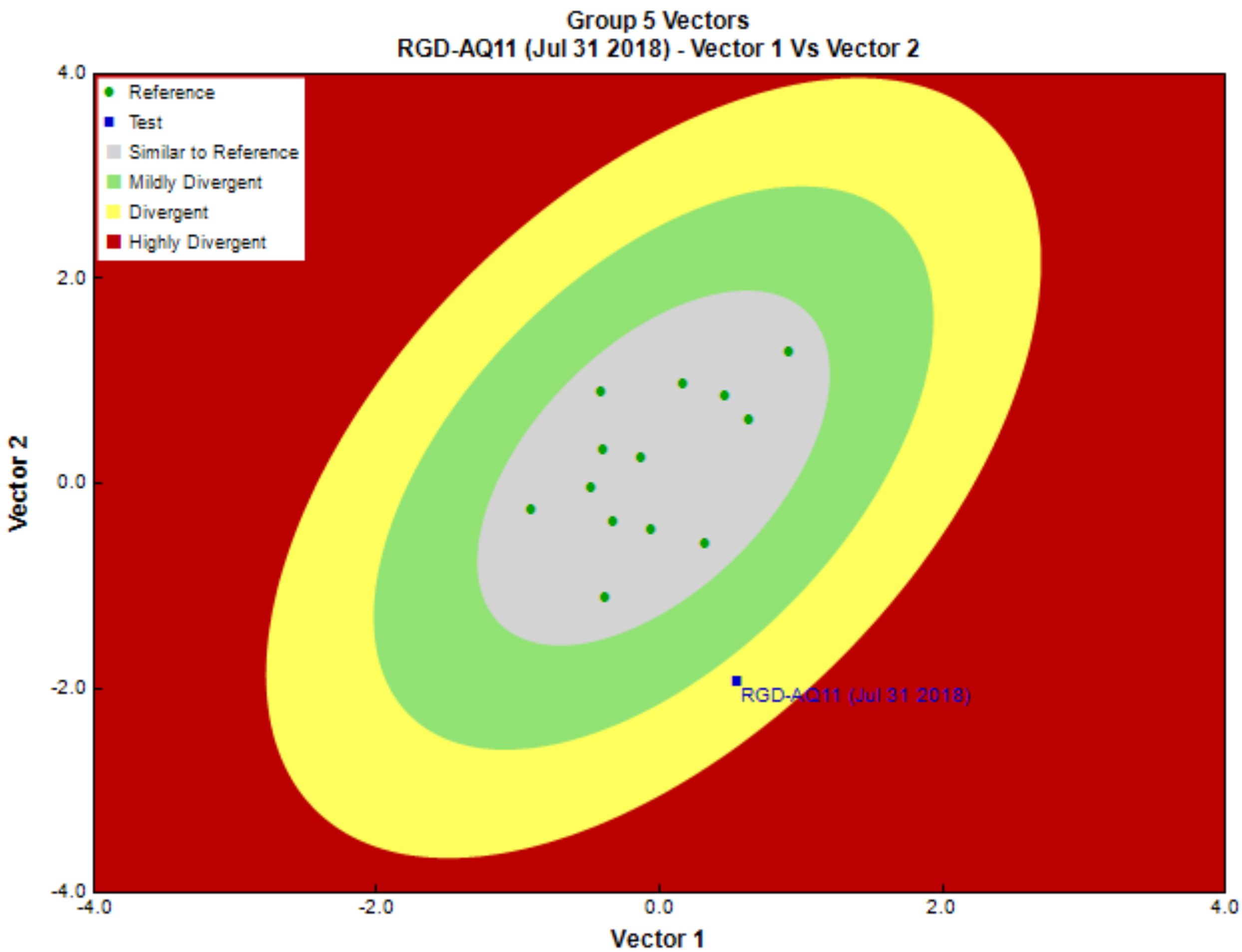


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
	Collembola	Collembola	Sminthuridae	2	2.0
	Insecta	Diptera	Chironomidae	27	27.0
			Simuliidae	282	282.0
			Tipulidae	1	1.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.6	4.7 ± 2.2
Hilsenhoff Family index (North-West)	4.6	4.8 ± 1.3
Intolerant taxa	--	
Long-lived taxa	3.0	1.8 ± 0.9
Tolerant individuals (%)	0.1	1.1 ± 1.4
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		
% Chironomidae	3.2	34.9 ± 20.4
% Coleoptera	0.0	2.6 ± 5.0
% Diptera + Non-insects	40.2	47.4 ± 26.3
% Ephemeroptera	40.4	34.2 ± 22.7
% Ephemeroptera that are Baetidae	48.2	38.4 ± 28.2
% EPT Individuals	59.6	49.6 ± 26.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	53.0	64.4 ± 13.7
% of 5 dominant taxa	82.8	86.1 ± 8.4
% of dominant taxa	33.5	44.7 ± 15.5
% Plecoptera	18.3	9.7 ± 9.0
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	17.3 ± 27.0
% Tricoptera	0.8	5.7 ± 7.1
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

Metrics

Name	RGD-AQ11	Predicted Group Reference Mean ±SD
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
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%	0.20
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%	0.35
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

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	
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%	0.48
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%	0.16
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
Stygothrombiidae	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

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
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
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 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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	8.4%	4.4%	40.7%	20.4%	16.4%	9.7%
CABIN Assessment of RGD-AQ11 on Jul 25, 2017	Mildly Divergent					

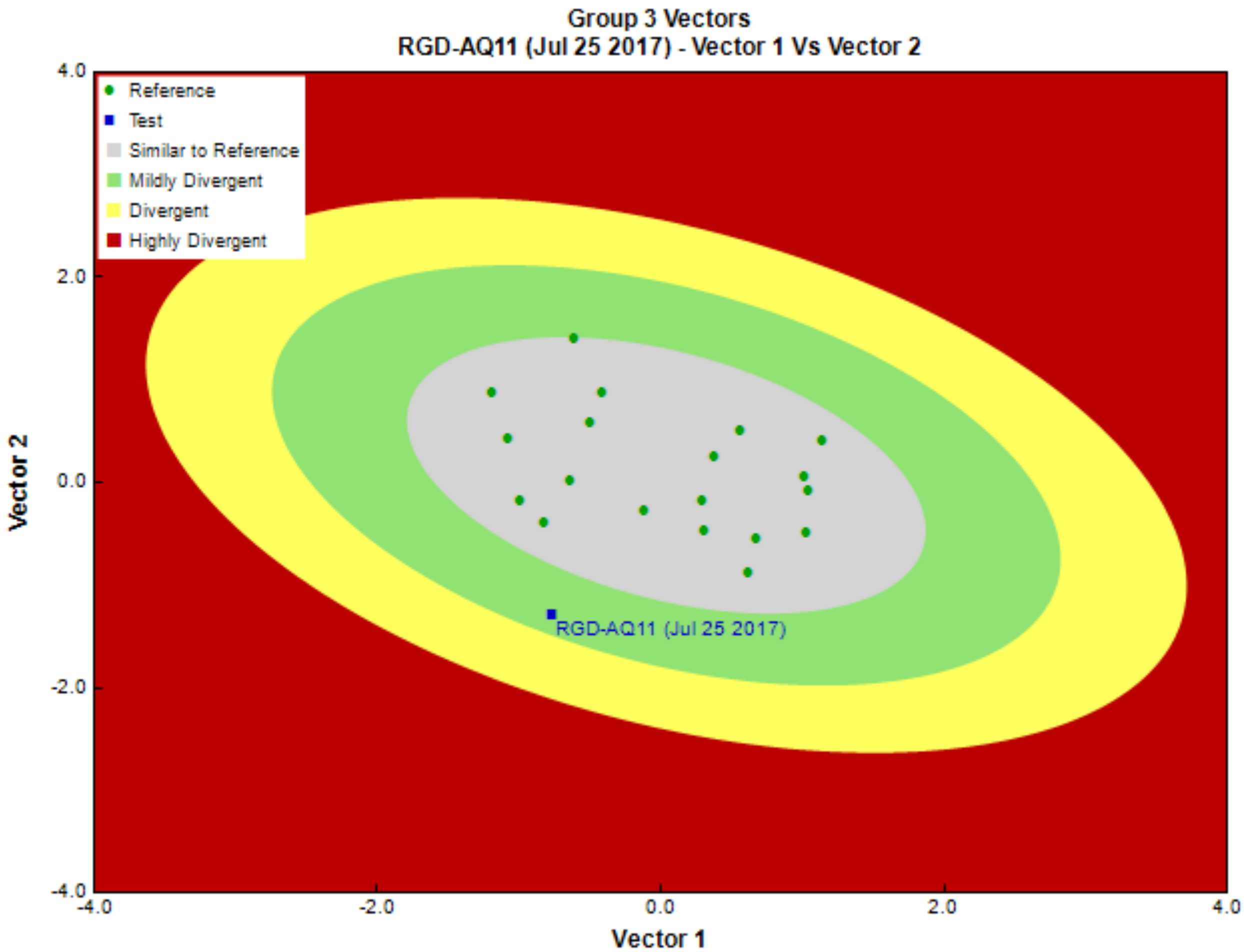


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
		Plecoptera	Chloroperlidae	23	74.2
			Nemouridae	2	6.4
			Perlidae	2	6.4
			Perlodidae	1	3.2

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.3	3.5 ± 1.1
Hilsenhoff Family index (North-West)	4.3	3.4 ± 0.9
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	1.0	1.5 ± 0.6
Tolerant individuals (%)	--	1.2 ± 1.0
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		
% Chironomidae	5.2	15.2 ± 13.8
% Coleoptera	0.0	0.9 ± 3.1
% Diptera + Non-insects	20.6	20.6 ± 17.1
% Ephemeroptera	70.1	42.0 ± 19.3
% Ephemeroptera that are Baetidae	14.5	33.7 ± 27.0
% EPT Individuals	79.4	78.2 ± 17.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	72.8	61.7 ± 12.7
% of 5 dominant taxa	94.8	86.1 ± 8.2
% of dominant taxa	59.4	42.0 ± 14.3
% Plecoptera	8.1	30.6 ± 25.8
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	14.8 ± 22.6
% Tricoptera	1.2	5.6 ± 7.7
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

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	
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
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

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	
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
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
Stygothrombiidae	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	28.3 ± 10.9
Depth-BankfullMinusWetted (cm)	40.00	163.00
Depth-Max (cm)	0.5	43.6 ± 19.2
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
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	0.68 ± 0.20
Width-Bankfull (m)	19.4	85.0 ± 66.5

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
Width-Wetted (m)	9.2	23.1 ± 31.8
XSEC-VelInstrumentDirect (Category(1-3))	1	1 ± 1
XSEC-VelMethod (Category(1-3))	3	3 ± 0
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 (%)	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	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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	9.1%	4.7%	37.9%	21.7%	16.8%	9.8%
CABIN Assessment of RGD-AQ11 on Aug 03, 2016	Mildly Divergent					

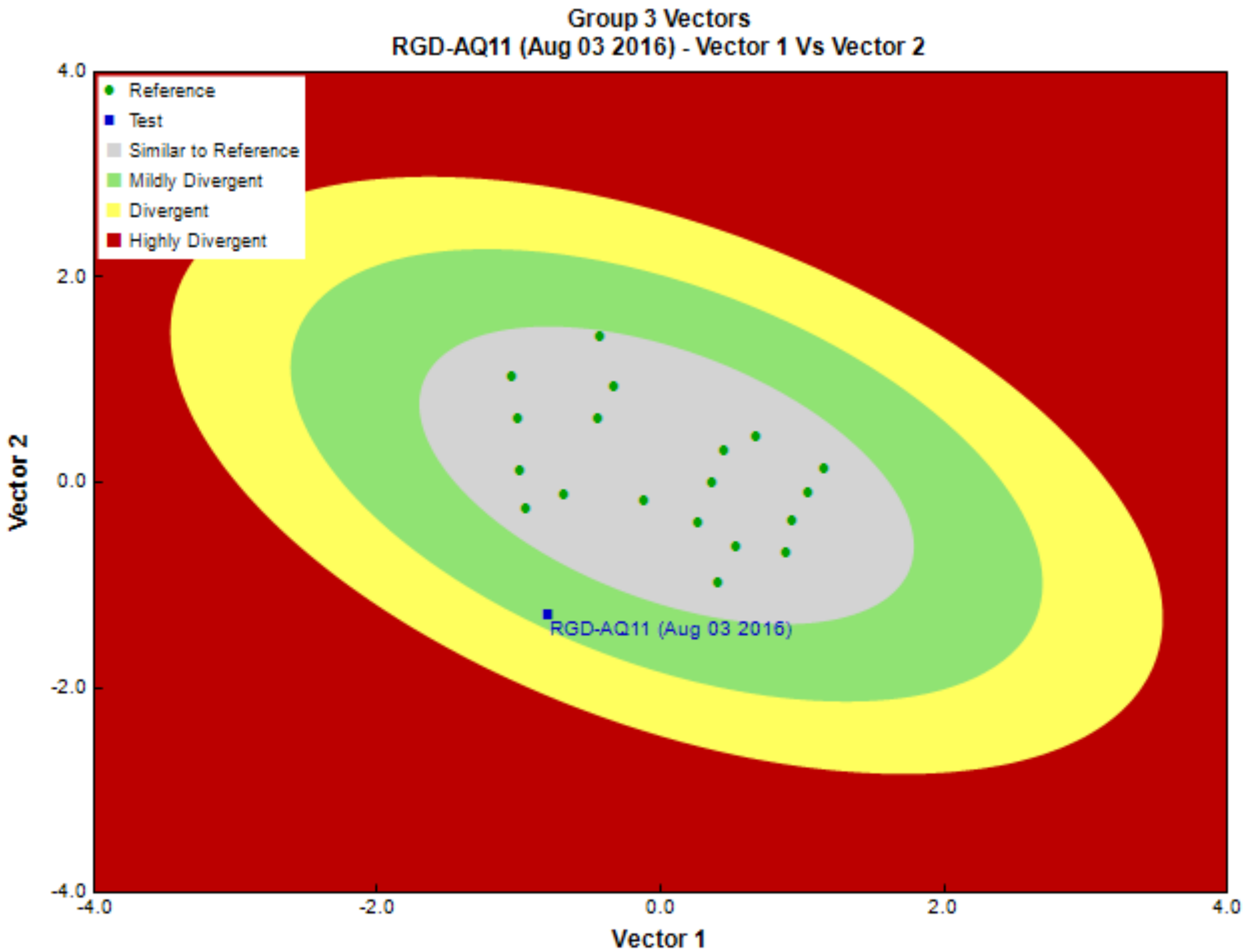


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
		Plecoptera	Chloroperlidae	34	130.8
			Nemouridae	26	100.0
			Perlodidae	5	19.2
		Trichoptera	Rhyacophilidae	1	3.8

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Total	302	1,161.5

Metrics

Name	RGD-AQ11	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.7	0.4 ± 0.2
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.3	3.5 ± 1.1
Hilsenhoff Family index (North-West)	4.3	3.4 ± 0.9
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.5 ± 0.6
Tolerant individuals (%)	--	1.2 ± 1.0
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		
% Chironomidae	2.6	15.2 ± 13.8
% Coleoptera	0.0	0.9 ± 3.1
% Diptera + Non-insects	18.5	20.6 ± 17.1
% Ephemeroptera	59.6	42.0 ± 19.3
% Ephemeroptera that are Baetidae	56.7	33.7 ± 27.0
% EPT Individuals	81.5	78.2 ± 17.8
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	57.3	61.7 ± 12.7
% of 5 dominant taxa	87.1	86.1 ± 8.2
% of dominant taxa	33.8	42.0 ± 14.3
% Plecoptera	21.5	30.6 ± 25.8
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	14.8 ± 22.6
% Tricoptera	0.3	5.6 ± 7.7
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

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	
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%	0.22
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%	0.20
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

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	
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
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
Stygothrombiidae	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	7.23
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	28.3 ± 10.9
Depth-BankfullMinusWetted (cm)	37.00	163.00
Depth-Max (cm)	28.0	43.6 ± 19.2
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.16 ± 0.37
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
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	0.68 ± 0.20
Width-Bankfull (m)	16.5	85.0 ± 66.5
Width-Wetted (m)	6.8	23.1 ± 31.8
XSEC-VelInstrumentDirect (Category(1-3))	1	1 ± 1

Habitat Description

Variable	RGD-AQ11	Predicted Group Reference Mean ±SD
XSEC-VelMethod (Category(1-3))	3	3 ± 0
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
%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-DS-AQ12
Sampling Date	Aug 05 2020
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	632
Local Basin Name	River of Golden Dreams
	River of Golden Dreams
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)

Down Stream

Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					
Probability of Group Membership	18.3%	7.2%	9.7%	15.9%	43.7%	5.2%
CABIN Assessment of RGD-DS-AQ12 on Aug 05, 2020	Similar to Reference					

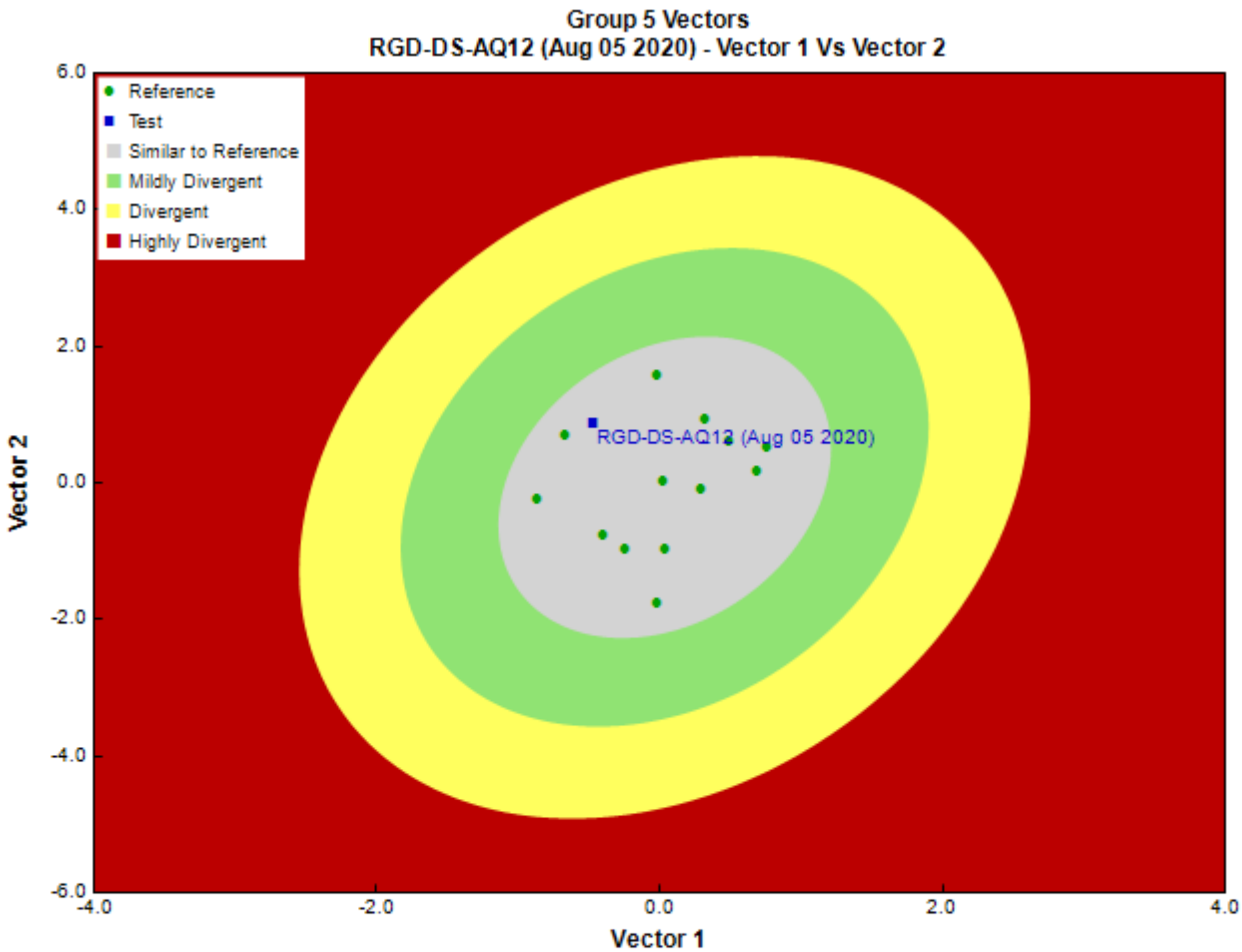


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Scott Finlayson, Cordillera Consulting
	-
Sub-Sample Proportion	30/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	11	36.7
		Tubificida	Naididae	50	166.6
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	12	40.0
			Lebertiidae	4	13.3
			Sperchontidae	1	3.3
	Insecta	Coleoptera	Dytiscidae	16	53.3
		Diptera	Ceratopogonidae	1	3.3
			Chironomidae	70	233.3
			Empididae	4	13.4
			Simuliidae	15	50.0
			Tabanidae	1	3.3
			Tipulidae	1	3.3
		Ephemeroptera	Ameletidae	6	20.0
			Baetidae	59	196.7
			Ephemerellidae	25	83.3
			Heptageniidae	6	20.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera		1	3.3
			Capniidae	1	3.3
			Chloroperlidae	1	3.3
			Nemouridae	8	26.7
			Perlidae	1	3.3
			Perlodidae	2	6.6
		Trichoptera	Brachycentridae	1	3.3
			Rhyacophilidae	2	6.7
Mollusca	Bivalvia	Veneroida	Pisidiidae	5	16.6
			Total	304	1,012.9

Metrics

Name	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.58	0.6 ± 0.2
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	7.3	4.7 ± 2.2
Hilsenhoff Family index (North-West)	7.3	4.8 ± 1.3
Intolerant taxa	--	
Long-lived taxa	3.0	1.8 ± 0.9
Tolerant individuals (%)	5.6	1.1 ± 1.4
Functional Measures		
% Filterers	--	11.5 ± 10.5
% Gatherers	79.6	67.6 ± 30.3
% Predatores	42.4	41.1 ± 20.2
% Scrapers	26.3	34.3 ± 21.0
% Shredder	3.6	13.7 ± 9.2
No. Clinger Taxa	17.0	13.0 ± 5.7
Number Of Individuals		
% Chironomidae	23.1	34.9 ± 20.4
% Coleoptera	5.3	2.6 ± 5.0
% Diptera + Non-insects	57.8	47.4 ± 26.3
% Ephemeroptera	31.7	34.2 ± 22.7
% Ephemeroptera that are Baetidae	61.5	38.4 ± 28.2
% EPT Individuals	37.0	49.6 ± 26.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	42.6	64.4 ± 13.7
% of 5 dominant taxa	72.6	86.1 ± 8.4
% of dominant taxa	23.1	44.7 ± 15.5
% Plecoptera	4.3	9.7 ± 9.0
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	17.3 ± 27.0
% Tricoptera	1.0	5.7 ± 7.1
No. EPT individuals/Chironomids+EPT Individuals	0.6	0.6 ± 0.2
Total Abundance	1013.3	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	6.0	2.6 ± 1.2
Ephemeroptera taxa	4.0	3.4 ± 1.2
EPT Individuals (Sum)	373.3	7446.2 ± 6472.9
EPT taxa (no)	11.0	9.3 ± 3.6
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.6 ± 0.1
Plecoptera taxa	5.0	3.4 ± 1.8
Shannon-Wiener Diversity	2.4	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	24.0	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
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%	0.27
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%	0.17
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%	0.51

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	
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
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
Stygothrombiidae	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	6.52
RIVPACS : Observed taxa P>0.50	10.00
RIVPACS : O:E (p > 0.5)	1.53
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-BankfullMinusWetted (cm)	31.00	188.00
Macrophyte (PercentRange)	1	1 ± 2
Reach-%CanopyCoverage (PercentRange)	1.00	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)	0.0000000	0.0047331 ± 0.0082050
Veg-Coniferous (Binary)	0	0 ± 1
Veg-Deciduous (Binary)	1	0 ± 1
Veg-GrassesFerns (Binary)	1	1 ± 0

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.37	0.23 ± 0.24
Velocity-Max (m/s)	0.44	0.31 ± 0.35
Width-Bankfull (m)	15.2	75.1 ± 72.8
Width-Wetted (m)	14.7	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 (%)	0	58
%Gravel (%)	21	1
%Pebble (%)	69	41
%Sand (%)	0	0
%Silt+Clay (%)	10	0
D50 (cm)	2.35	3.30
Dg (cm)	1.6	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))	2	3
SurroundingMaterial (Category(0-9))	2	2 ± 1
Topography		
SlopeAvg (%)	36.72000	30.12236 ± 18.75100
Water Chemistry		
General-Conductivity (µS/cm)	59.4000000	79.0846153 ± 50.3407694
General-DO (mg/L)	9.0600000	9.3400000 ± 2.0171679
General-pH (pH)	7.4	6.8 ± 1.0
General-SpCond (µS/cm)	71.1000000	176.1000000
General-TempAir (Degrees Celsius)	27.0	0.0 ± 0.0
General-TempWater (Degrees Celsius)	16.3000000	13.2730769 ± 4.7663725

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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	18.2%	7.2%	9.9%	15.8%	43.7%	5.2%
CABIN Assessment of RGD-DS-AQ12 on Jul 31, 2019	Similar to Reference					

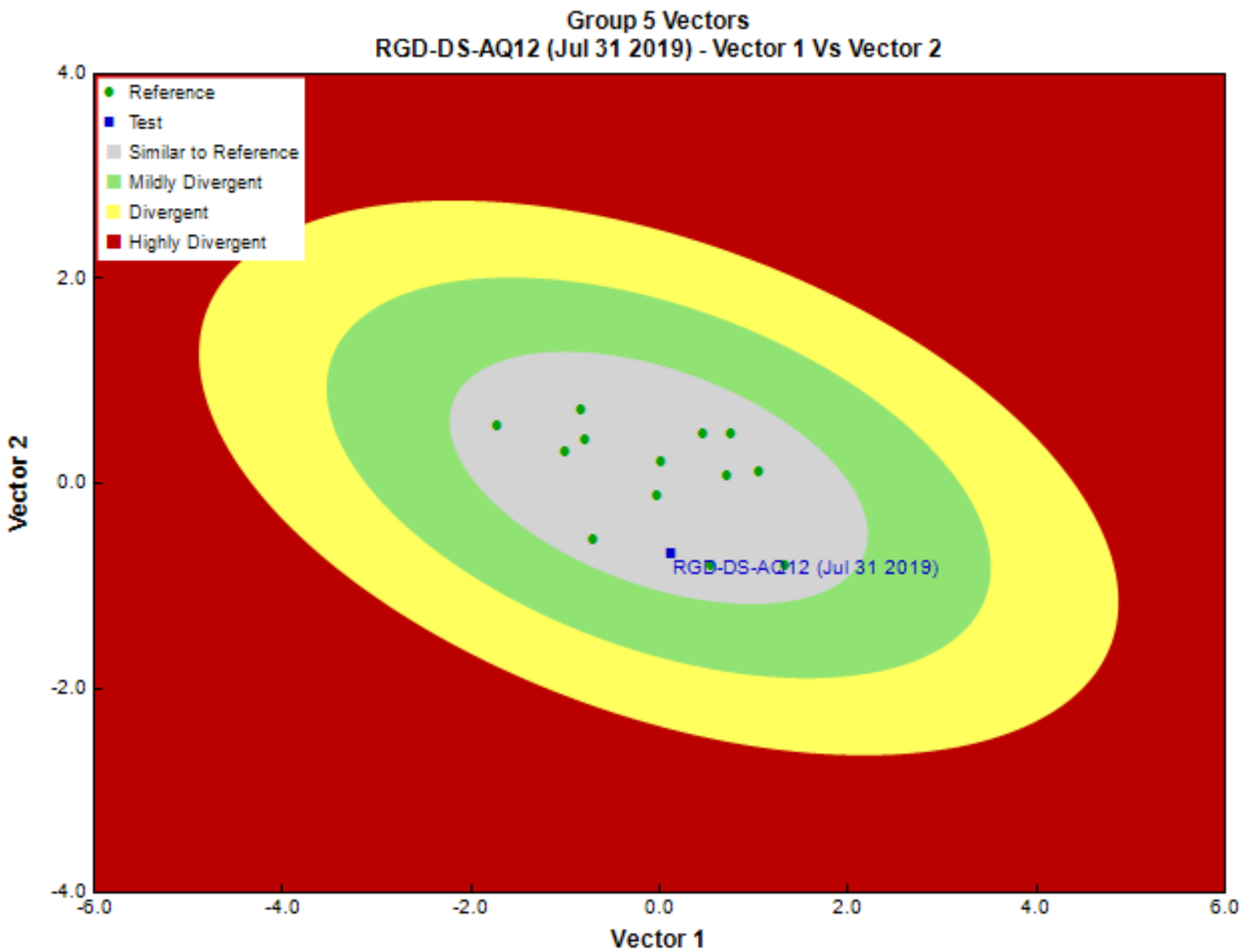


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
			Tipulidae	1	4.3
		Ephemeroptera	Ameletidae	1	4.3
			Baetidae	25	108.7
			Ephemerellidae	55	239.1

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	8.3	4.7 ± 2.2
Hilsenhoff Family index (North-West)	8.3	4.8 ± 1.3
Intolerant taxa	--	
Long-lived taxa	2.0	1.8 ± 0.9
Tolerant individuals (%)	11.8	1.1 ± 1.4
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		
% Chironomidae	25.7	34.9 ± 20.4
% Coleoptera	11.9	2.6 ± 5.0
% Diptera + Non-insects	57.2	47.4 ± 26.3
% Ephemeroptera	27.7	34.2 ± 22.7
% Ephemeroptera that are Baetidae	29.1	38.4 ± 28.2
% EPT Individuals	30.9	49.6 ± 26.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	51.4	64.4 ± 13.7
% of 5 dominant taxa	89.1	86.1 ± 8.4
% of dominant taxa	25.7	44.7 ± 15.5
% Plecoptera	2.3	9.7 ± 9.0
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	17.3 ± 27.0
% Tricoptera	1.0	5.7 ± 7.1
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
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%	0.27
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%	0.17
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%	0.51

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	
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
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
Stygothrombiidae	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	6.02
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

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
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		
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-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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	12.3%	4.4%	4.7%	7.8%	68.4%	2.4%
CABIN Assessment of RGD-DS-AQ12 on Aug 01, 2018	Similar to Reference					

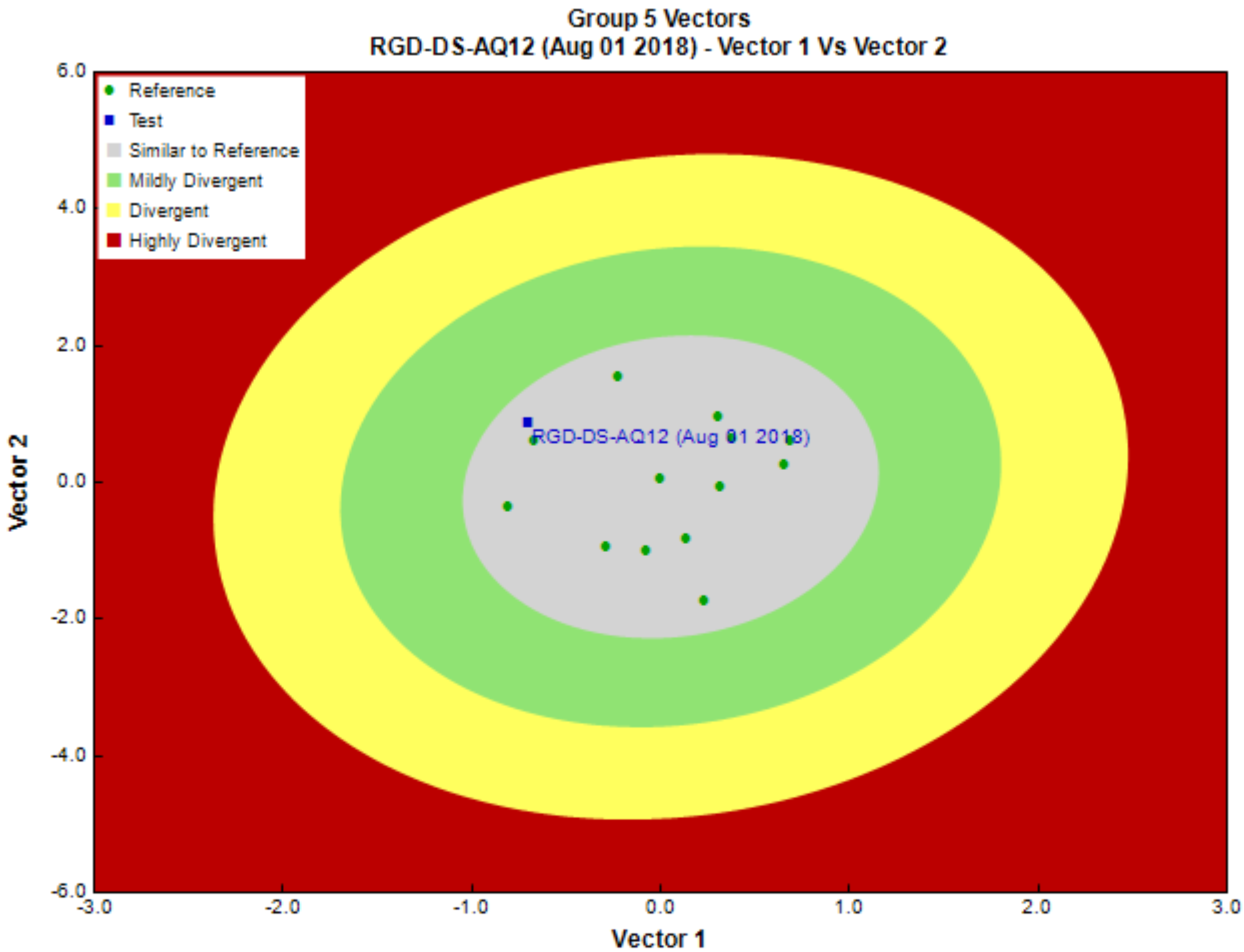


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
	-
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
			Chironomidae	188	188.7
			Empididae	2	2.3
			Simuliidae	15	14.6
			Tipulidae	4	4.6

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	7.6	4.7 ± 2.2
Hilsenhoff Family index (North-West)	7.6	4.8 ± 1.3
Intolerant taxa	--	
Long-lived taxa	2.0	1.8 ± 0.9
Tolerant individuals (%)	9.6	1.1 ± 1.4
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		
% Chironomidae	23.6	34.9 ± 20.4
% Coleoptera	9.6	2.6 ± 5.0
% Diptera + Non-insects	53.5	47.4 ± 26.3
% Ephemeroptera	28.4	34.2 ± 22.7
% Ephemeroptera that are Baetidae	37.0	38.4 ± 28.2
% EPT Individuals	36.6	49.6 ± 26.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	43.7	64.4 ± 13.7
% of 5 dominant taxa	75.8	86.1 ± 8.4
% of dominant taxa	23.6	44.7 ± 15.5
% Plecoptera	6.8	9.7 ± 9.0
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	17.3 ± 27.0
% Tricoptera	1.4	5.7 ± 7.1
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

Metrics

Name	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
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
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

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	
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
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
Stygothrombiidae	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

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
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
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 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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	15.7%	6.7%	9.6%	16.7%	45.9%	5.4%
CABIN Assessment of RGD-DS-AQ12 on Jul 25, 2017	Similar to Reference					

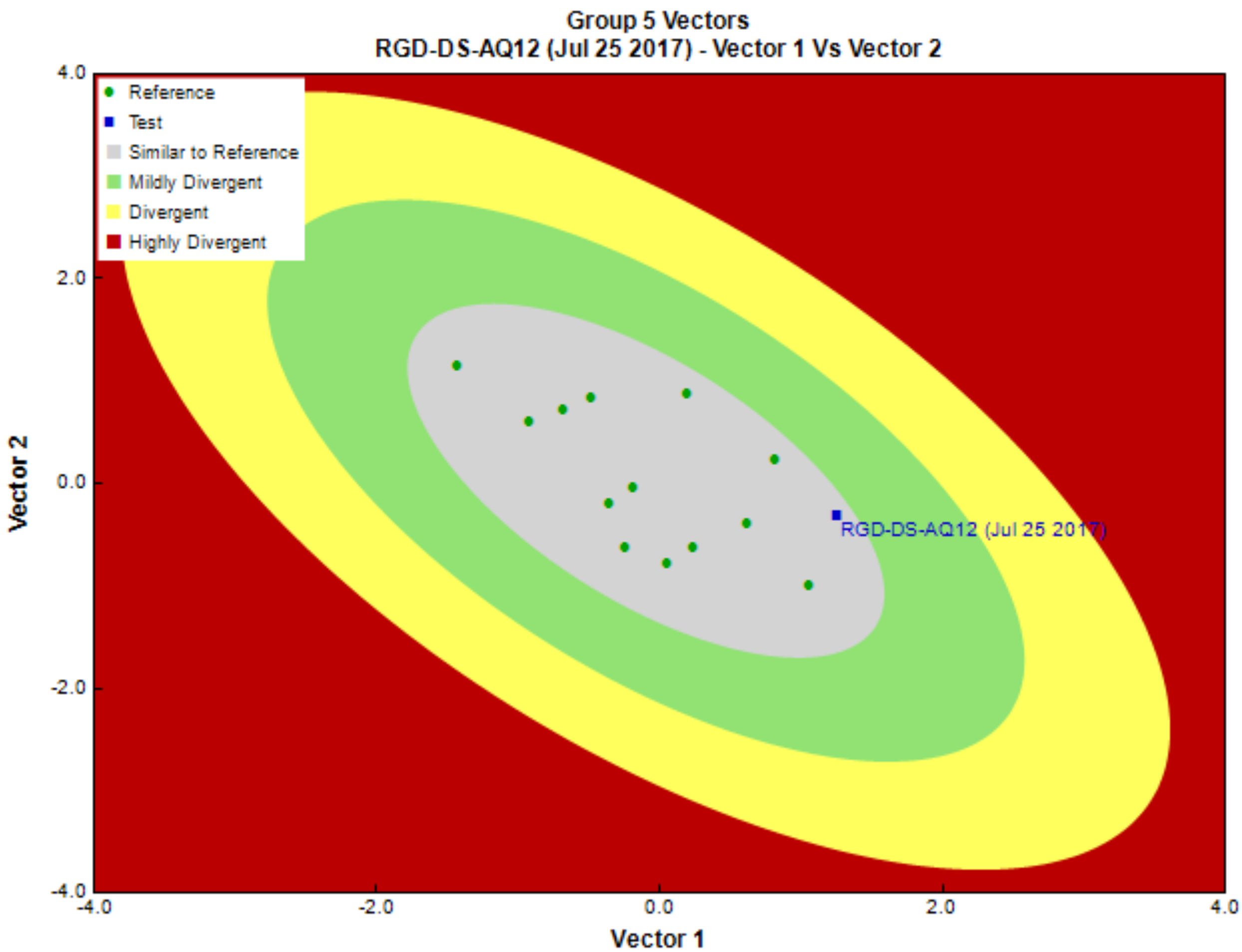


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
			Heptageniidae	93	265.7
		Plecoptera	Chloroperlidae	5	14.3
		Trichoptera	Limnephilidae	1	2.9
			Rhyacophilidae	7	20.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Total	350	1,000.0

Metrics

Name	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.72	0.6 ± 0.2
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.3	4.7 ± 2.2
Hilsenhoff Family index (North-West)	4.3	4.8 ± 1.3
Intolerant taxa	--	
Long-lived taxa	1.0	1.8 ± 0.9
Tolerant individuals (%)	0.6	1.1 ± 1.4
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		
% Chironomidae	26.0	34.9 ± 20.4
% Coleoptera	0.6	2.6 ± 5.0
% Diptera + Non-insects	36.0	47.4 ± 26.3
% Ephemeroptera	59.7	34.2 ± 22.7
% Ephemeroptera that are Baetidae	41.1	38.4 ± 28.2
% EPT Individuals	63.4	49.6 ± 26.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	52.6	64.4 ± 13.7
% of 5 dominant taxa	92.0	86.1 ± 8.4
% of dominant taxa	26.6	44.7 ± 15.5
% Plecoptera	1.4	9.7 ± 9.0
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	17.3 ± 27.0
% Tricoptera	2.3	5.7 ± 7.1
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

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%	0.05
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%	0.25
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
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

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%	0.01
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
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
Stygothrombiidae	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

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
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
%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 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)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Fraser River 2014
Analysis Date	December 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	46.4%	41.9%	26.3%	45.3%	38.5%	54.9%
Overall Model Error Rate	45.0%					

Probability of Group Membership	17.7%	8.4%	15.9%	26.1%	22.7%	9.2%
CABIN Assessment of RGD-DS-AQ12 on Aug 05, 2016	Similar to Reference					

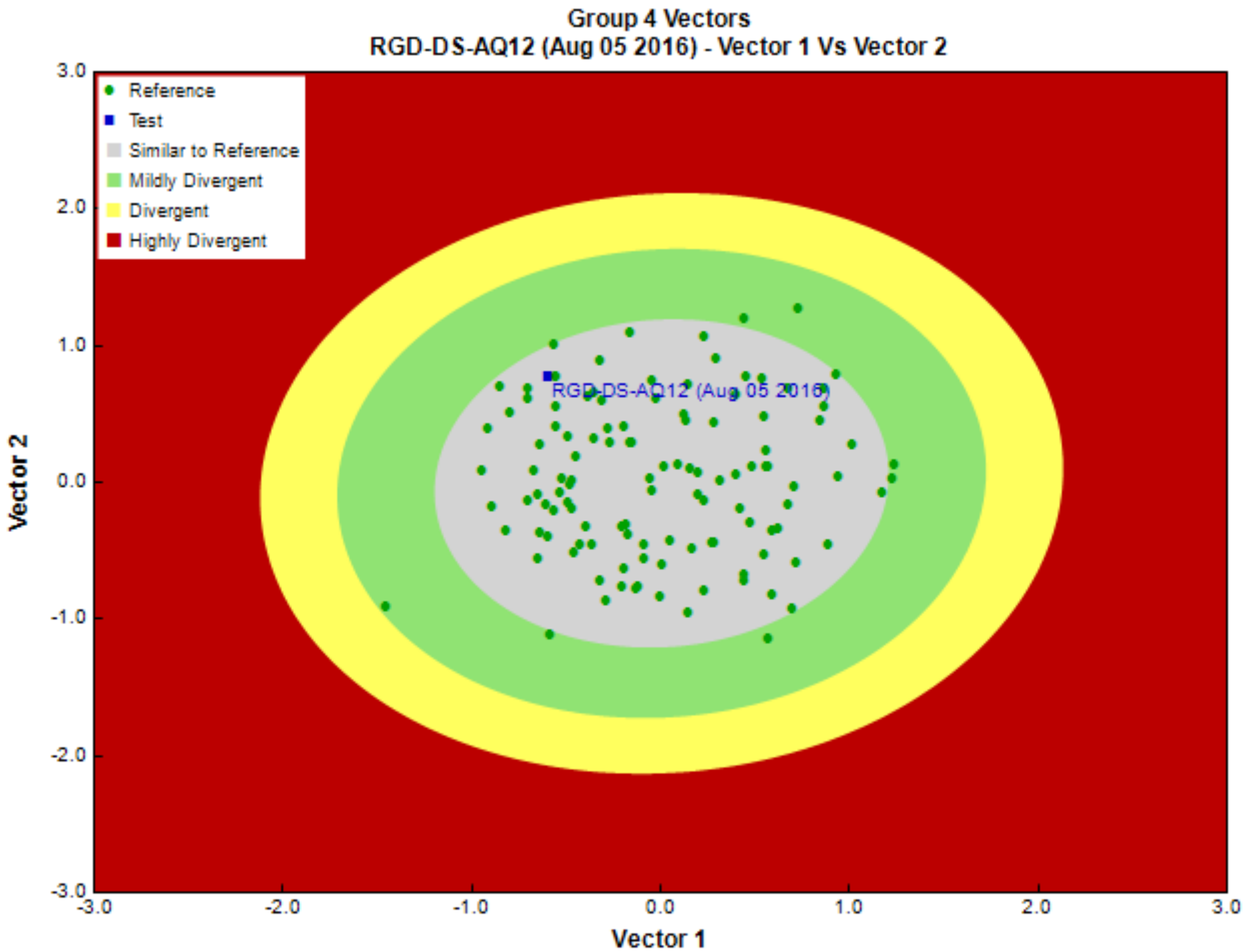


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Karen Needham, Spencer Entomological Collecti
	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
			Heptageniidae	2	10.5
		Plecoptera	Chloroperlidae	1	5.3
			Leuctridae	5	26.3
			Nemouridae	73	384.2

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			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
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.9	4.3 ± 1.8
Hilsenhoff Family index (North-West)	3.9	4.0 ± 1.3
Intolerant taxa	--	1.1 ± 0.4
Long-lived taxa	1.0	1.7 ± 0.9
Tolerant individuals (%)	0.6	1.3 ± 1.4
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		
% Chironomidae	14.4	22.3 ± 19.9
% Coleoptera	0.6	0.7 ± 1.9
% Diptera + Non-insects	22.4	32.8 ± 26.0
% Ephemeroptera	49.0	42.2 ± 21.6
% Ephemeroptera that are Baetidae	52.3	29.6 ± 25.6
% EPT Individuals	76.9	66.1 ± 26.2
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	49.0	58.1 ± 13.7
% of 5 dominant taxa	91.3	82.2 ± 8.7
% of dominant taxa	25.6	39.9 ± 14.9
% Plecoptera	25.6	14.7 ± 11.2
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	71.4	19.9 ± 23.1
% Tricoptera	2.2	9.2 ± 10.9
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

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	
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%	0.84
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%	0.56
Ceratopogonidae	23%	23%	5%	27%	54%	14%	0.27
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

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	
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%	0.62
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%	0.24
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
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%	0.27
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
Stygothrombiidae	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	28.2 ± 14.0
Depth-BankfullMinusWetted (cm)	62.00	60.67 ± 44.73
Depth-Max (cm)	16.0	41.6 ± 22.3
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

Habitat Description

Variable	RGD-DS-AQ12	Predicted Group Reference Mean ±SD
Velocity-Avg (m/s)	0.27	0.45 ± 0.19
Velocity-Max (m/s)	0.31	0.68 ± 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	1 ± 0
XSEC-VelMethod (Category(1-3))	3	3 ± 0
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
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

Methods and QC Report 2020

Project ID: Whistler 160255

Client: Palmer Environmental

Prepared by:
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Sample Reception

On September 10, 2020, Cordillera Consulting received 7 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

Site Code	CC#	Date	Size	# of Jars
CRB-DS-AQ01	CC210541	8/4/2020	400µM	2
CRB-DS-AQ01 QA/QC	CC210542	8/4/2020	400µM	3
21M-DS-AQ21	CC210543	8/4/2020	400µM	1
21M-DS-AQ21 QA/QC	CC210544	8/4/2020	400µM	1
RGD-DS-AQ12	CC210545	8/5/2020	400µM	1
RGD-AQ11	CC210546	8/5/2020	400µM	1
JOR-DS-AQ31	CC210547	8/5/2020	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
CRB-DS-AQ01	04-Aug-20	CC210541	14%	308
CRB-DS-AQ01 QA/QC	04-Aug-20	CC210542	100%	0
21M-DS-AQ21	04-Aug-20	CC210543	34%	308
21M-DS-AQ21 QA/QC	04-Aug-20	CC210544	100%	0
RGD-DS-AQ12	05-Aug-20	CC210545	30%	304
RGD-AQ11	05-Aug-20	CC210546	100%	583
JOR-DS-AQ31	05-Aug-20	CC210547	16%	321

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# - CC210545, Percent sampled = 30%, Sieve size = 400			
Oligochaeta	3		
Total:	**3**	**304**	**99%**

Site - QC, Sample - QC2, CC# - CC210547, Percent sampled = 16%, Sieve size = 400			
Baetidae	2		
Total:	**2**	**321**	**99%**

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 - 2020, Sample - CRB-DS-AQ01, CC# - CC210541, Percent sampled = 14%, Sieve size = 400	305	0.00	0.48939641	1.94805195	0.01468189

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 - 2020, Sample - CRB-DS-AQ01, CC# - CC210541, Percent sampled = 14%, Sieve size = 400	Laboratory Count	QC Audit Count	Agreement	Misidentification	Questionable Taxonomic Resolution	Enumeration	Insufficient Taxonomic Resolution	Comments
Aturus	1	1						
Baetidae	7	10	No			X		
Baetis	80	76	No			X		
Baetis rhodani group	1	1						
Brillia	3	3						
Cardiocladius	1	1						
Chloroperlidae	4	4						
Corynoneura	3	3						
Diptera	2	2						
Drunella spinifera	1	1						
Eloeophila	3	3						
Empididae	1	1						
Eukiefferiella	5	5						
Heptageniidae	4	4						
Hexatoma	2	2						
Hygrobates	5	4	No			X		
Krenosmittia	1	1						
Lebertia	2	2						
Leptophlebiidae	22	22						
Ljania	1	1						
Lumbriculidae	3	3						
Micrasema	1	1						
Micropsectra	19	19						
Naididae	1	1						
Nemouridae	12	12						
Onocosmoecus	1	1						
Orthocladiinae	5	5						
Orthocladius complex	1	1						
Pisidiidae	3	3						
Plecoptera	7	7						
Procladius	1	1						
Saetheria	1	1						
Simulium	12	12						
Sweltsa	33	33						
Taeniopterygidae	3	3						
Tanytarsini	11	11						
Tipulidae	2	2						

Tvetenia	2	2							
Zapada cinctipes	41	40	No			X			
Total:	**308**	**305**							
					0	**4**	**0**		
% Total Misidentification Rate =	misidentifications	x100 =	0.00	**Pass**					
	total number								

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[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

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Cordillera Consulting

Project: Whistler 160255 2019

Palmer Environmental Group, Alyssa Murdoch, May Mason Irene Mencke,

Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	2019	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	RGD-AQ11QA/QC	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200371	CC200372	CC200373	CC200374	CC200375
Phylum: Arthropoda	0	0	0	0	0	0
| Order: Collembola	0	0	10	0	3	6
Subphylum: Hexapoda	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0
Ameletus	52	0	0	4	0	89
| Family: Baetidae	63	0	530	26	34	111
Baetis	78	1	1040	35	154	139
Baetis rhodani group	219	2	40	9	20	178
Baetis bicaudatus	0	0	0	13	0	28
Centroptilum	0	0	0	0	0	0
Anafroptilum	0	0	0	26	0	0
Diphetor hageni	0	0	0	0	3	0
| Family: Ephemerellidae	0	0	0	100	11	17
Drunella	0	0	0	0	0	0
Drunella grandis group	4	0	10	109	6	0
Drunella coloradensis	0	0	0	0	0	6
Drunella doddsii	0	0	0	0	0	22
Drunella spinifera	4	0	0	4	0	17
Ephemerella	0	0	0	17	0	0
Serratella	0	0	0	9	3	0
| Family: Heptageniidae	48	0	10	4	0	67
Cinygmula	74	0	0	0	0	139
Epeorus	107	0	0	0	0	283
Rhithrogena	26	0	0	0	0	6
| Family: Leptophlebiidae	7	0	140	17	6	11
| Order: Plecoptera	0	0	0	0	0	0
| Family: Capniidae	19	0	0	0	0	11
| Family: Chloroperlidae	22	0	20	0	0	22
Sweltsa	81	0	30	13	3	56
| Family: Nemouridae	0	0	90	0	3	0
Malenka	4	0	10	4	0	6
Zapada	11	0	440	4	80	33

Site:	2019	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	RGD-AQ11QA/QC	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200371	CC200372	CC200373	CC200374	CC200375
Zapada oregonensis group	0	0	50	0	0	0
Zapada cinctipes	0	0	180	9	54	6
Zapada columbiana	4	0	0	0	0	0
| Family: Perlidae	11	0	0	0	6	17
Calineuria californica	4	0	0	0	0	0
Doroneuria	4	0	0	0	0	11
Hesperoperla	0	0	0	0	3	0
| Family: Perlodidae	7	0	0	0	0	17
Megarcys	4	0	0	0	0	17
| Order: Trichoptera	0	0	10	0	0	0
| Family: Glossosomatidae	0	0	0	0	0	0
Glossosoma	0	0	0	0	3	0
| Family: Hydropsychidae	0	0	0	0	3	6
| Family: Lepidostomatidae	0	0	0	0	0	0
Lepidostoma	0	0	0	0	11	0
| Family: Limnephilidae	0	0	0	0	0	11
Onocosmoecus	0	0	0	4	0	0
Psychoglypha	0	0	0	4	0	0
| Family: Philopotamidae	0	0	0	0	0	0
Wormaldia	0	0	0	0	3	0
| Family: Rhyacophilidae	0	0	0	0	0	0
Rhyacophila	0	0	20	4	0	6
Rhyacophila angelita group	4	0	0	0	0	0
Rhyacophila brunnea/vemna grou	0	0	0	0	0	11
Rhyacophila arnaudi	0	0	20	0	0	0
| Order: Coleoptera	0	0	0	0	0	0
| Family: Dytiscidae	0	0	0	0	0	0
Oreodytes	7	0	0	83	0	0
| Subfamily: Hydroporinae	0	0	0	78	0	0
| Order: Diptera	0	0	0	0	0	0
| Family: Ceratopogonidae	0	0	0	0	0	0
Bezzia/ Palpomyia	0	0	0	0	0	11
| Family: Chironomidae	4	0	30	135	11	28
| Subfamily: Chironominae	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0
Microtendipes	4	0	10	0	0	6
Paracladopelma	0	0	0	4	0	0
Polypedilum	4	0	0	9	0	33
| Tribe: Tanytarsini	0	0	10	0	0	0
Micropsectra	22	0	80	22	40	6
Stempellinella	0	0	0	0	3	6
Tanytarsus	4	0	0	30	3	0
| Subfamily: Diamesinae	0	0	0	0	0	0

Site:	2019	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	RGD-AQ11QA/QC	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200371	CC200372	CC200373	CC200374	CC200375
| Tribe: Diamesini	0	0	0	0	0	0
Diamesa	0	0	0	0	0	6
| Subfamily: Orthocladiinae	0	0	40	4	80	6
Brillia	0	0	70	4	80	6
Corynoneura	0	0	20	0	0	0
Eukiefferiella	15	0	150	4	23	11
Heterotanytarsus	0	0	0	4	0	0
Heterotrissocladius	0	0	0	17	0	0
Orthocladius complex	0	0	30	30	3	6
Parakiefferiella	0	0	0	17	3	0
Parametriocnemus	0	0	20	0	0	0
Rheocricotopus	0	0	20	4	0	0
Synorthocladius	0	0	0	0	6	0
Thienemanniella	0	0	0	13	0	0
Tvetenia	4	0	150	0	200	0
| Subfamily: Tanypodinae	4	0	0	0	0	0
Nilotanypus	0	0	0	0	3	0
| Tribe: Pentaneurini	0	0	0	0	0	0
Thienemannimyia group	4	0	0	48	3	6
| Family: Empididae	0	0	0	0	0	6
Neoplasta	0	0	10	0	0	0
Oreogeton	0	0	0	0	0	6
| Family: Simuliidae	4	0	10	0	0	6
Helodon	4	0	0	0	0	6
Simulium	193	1	120	4	29	217
| Family: Tipulidae	0	0	0	0	0	0
Dicranota	4	0	10	4	3	0
Hexatoma	0	0	0	0	0	6
Subphylum: Chelicerata	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0
| Family: Hydryphantidae	0	0	0	0	0	0
Protzia	0	0	0	0	0	6
| Family: Hygrobatidae	0	0	0	0	0	0
Atractides	11	1	0	4	3	11
Hygrobates	0	0	30	30	0	0
| Family: Lebertiidae	0	0	0	0	0	0
Lebertia	0	0	0	4	0	11
| Family: Sperchontidae	0	0	0	0	0	0
Sperchon	22	0	20	9	0	6
| Family: Torrenticolidae	0	0	0	0	0	0
Testudacarus	0	0	0	0	0	6
Suborder: Prostigmata	0	0	0	0	0	0
| Family: Stygothrombidiidae	0	0	0	0	0	0

Site:	2019	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	RGD-AQ11QA/QC	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200371	CC200372	CC200373	CC200374	CC200375
Stygothrombium	0	0	10	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0
| Order: Oribatida	0	0	0	0	0	6
| Class: Malacostraca	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	9	0	0
| Family: Crangonyctidae	0	0	0	0	0	0
Crangonyx	15	0	0	4	0	0
Phylum: Mollusca	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0
| Family: Pisidiidae	0	0	10	0	14	0
Pisidium	0	0	0	4	9	0
| Class: Gastropoda	0	0	0	0	0	0
| Order: Basommatophora	0	0	0	0	0	0
| Family: Physidae	0	0	0	0	6	0
Phylum: Annelida	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0
| Family: Lumbriculidae	0	0	0	0	0	0
Lumbriculus	0	0	0	13	0	0
| Order: Tubificida	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	0
| Subfamily: Tubificinae with ha	4	0	0	335	3	0
| Subfamily: Tubificinae withou	4	1	0	13	3	33
Phylum: Cnidaria	0	0	0	0	0	0
| Class: Hydrozoa	0	0	0	0	0	0
| Order: Anthoathecatae	0	0	0	0	0	0
| Family: Hydridae	0	0	0	0	0	0
Hydra	0	0	0	0	3	0
Totals:	**1190**	**6**	**3500**	**1354**	**940**	**1806**

Taxa present but not included:

Terrestrials	0	0	0	0	6	0
Phylum: Arthropoda	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0

Site:	2019	2019	2019	2019	2019	2019
Sample:	RGD-AQ11	RGD-AQ11QA/QC	CRB-DS-AQ01	RGD-DS-AQ12	JOR-DS-AQ31	21M-DS-AQ21
Sample Collection Date:	30-Jul-19	30-Jul-19	30-Jul-19	31-Jul-19	31-Jul-19	30-Jul-19
CC#:	CC200370	CC200371	CC200372	CC200373	CC200374	CC200375
| Order: Diptera	0	0	0	0	0	0
| Family: Cecidomyiidae	0	0	10	0	0	0
| Order: Psocodea	4	0	0	0	0	0
| Class: Maxillipoda	0	0	0	0	0	0
| Class: Copepoda	0	0	0	4	3	0
Totals:	**4**	**0**	**10**	**4**	**9**	**0**

Project: Whistler 160255 2020
Palmer Environmental Group
Taxonomist: Scott Finlayson
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Site:	2020	2020	2020	2020	2020	2020	2020
Sample:	CRB-DS-AQ01	CRB-DS-AQ01 QA/QC	21M-DS-AQ21	21M-DS-AQ21 QA/QC	RGD-DS-AQ12	RGD-AQ11	JOR-DS-AQ31
Sample Collection Date:	04-Aug-20	04-Aug-20	04-Aug-20	04-Aug-20	05-Aug-20	05-Aug-20	05-Aug-20
CC#:	CC210541	CC210542	CC210543	CC210544	CC210545	CC210546	CC210547
Phylum: Arthropoda	0	0	0	0	0	0	0
| Order: Collembola	0	0	0	0	0	0	12
Subphylum: Hexapoda	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0
Ameletus	0	0	29	0	20	23	0
| Family: Baetidae	50	0	29	0	10	15	0
Baetis	571	0	215	0	177	141	112
Baetis rhodani group	7	0	6	0	10	12	25
| Family: Ephemerellidae	0	0	24	0	40	4	0
Drunella	0	0	0	0	40	1	0
Drunella spinifera	7	0	3	0	3	0	0
Ephemerella	0	0	0	0	0	1	0
| Family: Heptageniidae	29	0	153	0	7	63	0
Cinygmula	0	0	21	0	13	17	0
Epeorus	0	0	44	0	0	34	0
Rhithrogena	0	0	0	0	0	5	0
| Family: Leptophlebiidae	157	0	0	0	0	6	188
Neoleptophlebia	0	0	0	0	0	0	6
| Order: Plecoptera	50	0	9	0	3	0	0
| Family: Capniidae	0	0	9	0	3	13	0
| Family: Chloroperlidae	29	0	29	0	0	23	0
Haploperla	0	0	0	0	0	1	0
Paraperla	0	0	0	0	0	1	0
Suwallia	0	0	3	0	0	0	0
Sweltsa	236	0	0	0	3	4	0
| Family: Leuctridae	0	0	0	0	0	1	0
| Family: Nemouridae	86	0	3	0	0	3	6
Zapada	0	0	12	0	0	3	0
Zapada cinctipes	293	0	0	0	27	1	38
Zapada columbiana	0	0	6	0	0	0	0
| Family: Perlidae	0	0	38	0	3	14	6
Calineuria californica	0	0	21	0	0	0	0
| Family: Perlodidae	0	0	3	0	3	7	0
Kogotus	0	0	6	0	0	1	0
Megarcys	0	0	0	0	3	1	0
| Family: Taeniopterygidae	21	0	0	0	0	0	0
| Order: Trichoptera	0	0	6	0	0	0	6
| Family: Brachycentridae	0	0	0	0	0	0	0
Micrasema	7	0	0	0	3	0	0

Site:	2020	2020	2020	2020	2020	2020	2020
Sample:	CRB-DS-AQ01	CRB-DS-AQ01 QA/QC	21M-DS-AQ21	21M-DS-AQ21 QA/QC	RGD-DS-AQ12	RGD-AQ11	JOR-DS-AQ31
Sample Collection Date:	04-Aug-20	04-Aug-20	04-Aug-20	04-Aug-20	05-Aug-20	05-Aug-20	05-Aug-20
CC#:	CC210541	CC210542	CC210543	CC210544	CC210545	CC210546	CC210547
| Family: Glossosomatidae	0	0	0	0	0	0	0
Glossosoma	0	0	3	0	0	0	0
| Family: Hydropsychidae	0	0	0	0	0	1	6
Parapsyche	0	0	3	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	0	0
Clostoeca disjuncta	0	0	0	0	0	0	6
Ecclisomyia	0	0	3	0	0	0	0
Onocosmoecus	7	0	0	0	0	0	0
| Family: Rhyacophilidae	0	0	0	0	0	0	0
Rhyacophila	0	0	12	0	7	3	0
Rhyacophila betteni group	0	0	0	0	0	3	0
Rhyacophila brunnea/vemna group	0	0	6	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0
| Family: Dytiscidae	0	0	0	0	10	0	0
Oreodytes	0	0	0	0	44	0	0
| Order: Diptera	14	0	6	0	0	0	6
| Family: Ceratopogonidae	0	0	0	0	0	0	0
Mallochohelea	0	0	3	0	3	1	0
| Family: Chironomidae	0	0	12	0	67	4	19
| Subfamily: Chironominae	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0
Polypedilum	0	0	3	0	0	2	0
Saetheria	7	0	0	0	0	0	0
| Tribe: Tanytarsini	79	0	0	0	0	2	0
Micropsectra	136	0	26	0	23	10	156
Paratanytarsus	0	0	0	0	0	1	0
Stempellinella	0	0	3	0	0	1	0
| Subfamily: Orthocladiinae	36	0	0	0	0	0	0
Brillia	21	0	6	0	3	1	50
Cardiocladius	7	0	0	0	0	0	0
Corynoneura	21	0	0	0	0	0	6
Eukiefferiella	36	0	15	0	20	14	131
Krenosmittia	7	0	0	0	0	0	0
Orthocladius complex	7	0	0	0	10	0	25
Parorthocladius	0	0	3	0	3	0	0
Thienemanniella	0	0	3	0	0	0	0
Tvetenia	14	0	15	0	87	7	212
| Subfamily: Tanypodinae	0	0	0	0	0	0	0
| Tribe: Pentaneurini	0	0	0	0	0	0	0
Thienemannimyia group	0	0	3	0	20	3	0
| Tribe: Procladiini	0	0	0	0	0	0	0
Procladius	7	0	0	0	0	0	0
| Family: Empididae	7	0	9	0	6	2	0
Hemerodromia	0	0	0	0	7	0	0
Oreogeton	0	0	3	0	0	0	0
| Family: Simuliidae	0	0	3	0	7	11	119
Simulium	86	0	53	0	43	83	825
| Family: Tabanidae	0	0	0	0	0	0	0
Tabanus	0	0	0	0	3	0	0
| Family: Tipulidae	14	0	0	0	3	1	0
Dicranota	0	0	3	0	0	0	12
| Family: Limoniidae	0	0	0	0	0	0	0
Eloeophila	21	0	0	0	0	0	0
Hexatoma	14	0	3	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0

Site:	2020	2020	2020	2020	2020	2020	2020
Sample:	CRB-DS-AQ01	CRB-DS-AQ01 QA/QC	21M-DS-AQ21	21M-DS-AQ21 QA/QC	RGD-DS-AQ12	RGD-AQ11	JOR-DS-AQ31
Sample Collection Date:	04-Aug-20	04-Aug-20	04-Aug-20	04-Aug-20	05-Aug-20	05-Aug-20	05-Aug-20
CC#:	CC210541	CC210542	CC210543	CC210544	CC210545	CC210546	CC210547
| Class: Arachnida	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0	0
| Family: Aturidae	0	0	0	0	0	0	0
Aturus	7	0	0	0	0	0	0
Ljania	7	0	0	0	0	0	0
| Family: Hygrobatidae	0	0	0	0	0	0	0
Atractides	0	0	18	0	17	16	0
Hygrobates	36	0	0	0	23	0	0
| Family: Lebertiidae	0	0	0	0	0	0	0
Lebertia	14	0	6	0	13	0	0
| Family: Mideopsidae	0	0	0	0	0	0	0
Mideopsis	0	0	0	0	0	1	0
| Family: Sperchontidae	0	0	0	0	0	0	0
Sperchon	0	0	9	0	3	10	6
| Family: Torrenticolidae	0	0	0	0	0	0	0
Testudacarus	0	0	0	0	0	1	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0
| Order: Oribatida	0	0	0	0	0	0	12
Phylum: Mollusca	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0
| Family: Pisidiidae	21	0	0	0	3	1	6
Pisidium	0	0	0	0	13	0	0
| Class: Gastropoda	0	0	0	0	0	0	0
| Order: Basommatophora	0	0	0	0	0	0	0
| Family: Physidae	0	0	0	0	0	0	6
Phylum: Annelida	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0
| Family: Lumbriculidae	21	0	9	0	37	0	0
Lumbriculus	0	0	0	0	0	1	0
Stylodrilus heringianus	0	0	0	0	0	1	0
| Order: Tubificida	0	0	0	0	0	0	0
| Family: Naididae	7	0	0	0	0	0	0
Nais	0	0	0	0	3	0	0
| Subfamily: Tubificinae with hair chaeta	0	0	0	0	163	7	0
Totals:	**2197**	**0**	**910**	**0**	**1009**	**583**	**2002**

Taxa present but not included:

Totals:

ND designation of a taxa represents a non-distinct taxa. This adjusts where the associated taxa fall in the metrics for this sample because the individuals are likely represented by Genus or Species level identifications.

Appendix C

Fish Sampling Datasheets & Biological Characteristics

Appendix C

Fish Community Biological Data, Tabulated Results and Statistical Outputs

Table C-1. Electrofishing effort and fish caught in surveys conducted in the RMOW study area, 2020.

Site	Creek	Date	Effort (seconds)	Catch (number of individuals)				CPUE (#/100s)			
				CC	TR	TSB	Total	CC	TR	TSB	Total
CRB-DS-AQ01	Crabapple Creek	06-Aug-19	208	1	-	2	3	0.48	-	0.96	1.44
CRB-DS-AQ01	Crabapple Creek	07-Aug-19	682	31	15	2	48	4.55	2.20	0.29	7.04
JOR-DS-AQ31	Jordan Creek	06-Aug-19	664	3	5	-	8	0.45	0.75	-	1.20
21M-DS-AQ21	21-Mile Creek	06-Aug-19	701	22	4	-	26	3.14	0.57	-	3.71

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

Table C-2. Minnow trap effort and fish caught in surveys conducted in the RMOW study area, 2020.

Site	Creek	Date Traps Set	Date Retrieved	Number of Traps	Effort (hrs)	Catch (number of individuals)				CPUE (#/100s)			
						CC	TR	TSB	Total	CC	TR	TSB	Total
CRB-DS-AQ01	Crabapple Creek	05-Aug-20	06-Aug-20	5	135.83	36	20	8	64	1.27	0.71	0.28	2.26
JOR-DS-AQ31	Jordan Creek	05-Aug-20	06-Aug-20	5	118.33	4	8	6	18	0.16	0.32	0.24	0.73
RGD-DS-AQ12	River of Golden Dreams	05-Aug-20	06-Aug-20	5	128.75	12	-	180	192	0.45	-	6.71	7.16
21M-DS-AQ21	21-Mile Creek	05-Aug-20	06-Aug-20	5	126.67	25	7	2	34	0.95	0.27	0.08	1.29
RGD-AQ11	River of Golden Dreams	05-Aug-20	06-Aug-20	5	132.5	1	2	31	34	0.04	0.07	1.12	1.23

Table C-3. Fish species composition and relative species abundance from fish caught using electrofishing in the RMOW study area, 2016-2020.

Site	Year	Relative Abundance					
		Sculpin		Trout		Three-spined Stickleback	
		%	Total	%	Total	%	Total
21M-DS-AQ21	2016	38	30	57	45	5	4
	2017	71	5	0	0	29	2
	2018	100	15	0	0	0	0
	2019	74	31	26	11	0	0
	2020	85	22	15	4	0	0
	Mean (SD)	74 (22.9)	20.6 (10.9)	20 (23.6)	12 (19.0)	6 (12.6)	1.2 (1.79)
CRB-DS-AQ01	2016	19	10	67	36	15	8
	2017	14	2	29	4	57	8
	2018	67	16	21	5	13	3
	2019	84	26	13	4	3	1
	2020	63	32	29	15	8	4
	Mean (SD)	49 (31.1)	17.2 (12.0)	32 (20.8)	12.8(13.8)	19 (21.6)	4.8 (3.11)
JOR-DS-AQ31	2016	3	1	68	23	29	10
	2017	20	2	60	6	20	2
	2018	67	6	33	3	0	0
	2019	60	3	20	1	20	1
	2020	38	3	62	5	0	0
	Mean (SD)	37 (26.8)	3 (1.87)	49 (20.9)	7.6 (8.82)	14 (13.1)	2.6 (4.22)

Table C-4. Fish species composition and relative species abundance from fish caught using minnow traps in the RMOW study area, 2016-2020.

Site	Year	Relative Abundance					
		Sculpin		Trout		Three-spined Stickleback	
		%	Total	%	Total	%	Total
21M-DS-AQ21	2018	33	3	22	3	44	2
	2019	0	0	50	4	50	4
	2020	38	3	37	3	25	2
	Mean (SD)	24 (20.6)	2 (1.73)	37 (14.0)	3.33 (0.58)	40 (13.1)	2.67 (1.15)
CRB-DS-AQ01	2018	5	1	14	3	82	18
	2019	0	0	50	4	50	4
	2020	31	4	39	5	31	4
	Mean (SD)	12 (16.6)	1.7 (2.08)	34 (18.4)	4 (1.00)	54 (25.8)	8.67 (8.08)
JOR-DS-AQ31	2018	0	0	30	3	70	7
	2019	13	2	31	5	56	9
	2020	10	1	30	3	60	6

	Mean (SD)	8 (6.8)	1 (1.00)	30 (0.58)	3.67 (1.15)	62 (7.2)	7.33 (1.53)
RGD-AQ11	2018	11	2	0	0	89	16
	2019	24	0	9	0	67	6
	2020	3	1	6	2	91	31
	Mean (SD)	13 (10.6)	1 (0.67)	5 (4.58)	0.67 (1.15)	82 (13.3)	17.7 (12.9)
RGD-DS-AQ12	2018	24	11	9	4	67	30
	2019	8	5	3	2	89	56
	2020	6	12	0	0	94	180
	Mean (SD)	13 (9.9)	9.3 (3.79)	4 (4.6)	3 (2.0)	83 (14.4)	88.7 (80.2)

Table C-5. Results of the MK trends analysis for CPUE for each site and species first-pass electrofishing catch data from 2016-2020 in the RMOW.

Site	Species	Kendall's-Tau	p-value	Trend
CRB-DS-AQ01	Sculpin	0.8*	0.05	Increasing
JOR-DS-AQ31	Sculpin	0.4	0.33	No Trend
21M-DS-AQ21	Sculpin	0.74^	0.077	Potentially Increasing
CRB-DS-AQ01	Trout	-0.2	0.62	No Trend
JOR-DS-AQ31	Trout	-0.4	0.33	No Trend
21M-DS-AQ21	Trout	-0.11	0.8	No Trend
CRB-DS-AQ01	Three-spined Stickleback	-0.11	0.8	No Trend
JOR-DS-AQ31	Three-spined Stickleback	-0.6	0.14	No Trend
21M-DS-AQ21	Three-spined Stickleback	-0.6	0.17	No Trend

*indicates statistical significance (p<0.05)
^ not statistically significant trend but potential trend observed (p<0.10)

Table C-6. Statistically significant KS test results comparing two length frequency distributions for fish captured in RMOW from 2016 to 2020

Site	Species	Years/Sites Compared	Year/Site 1 Mean Length (mm) [N]	Year/Site 2 Mean Length (mm) / N	Kendall's Tau	p-value
CRB	Sculpin	2019-2020	61.13 [n=24]	48.80 [n=10]	0.57	0.02
-	Sculpin	21M-JOR	59.47 [n=38]	77.53 [n=15]	0.5	0.01
-	Sculpin	CRB-JOR	59.35 [n=37]	77.53 [n=15]	0.46	0.02
JOR	TSB	2016-2019	42.88 [n=8]	52.50 [n=8]	0.88	0.004
21M	Trout	2016-2020	45.52 [n=21]	70.86 [n=7]	0.67	0.02
-	Trout	21M-RGDDS	56.29 [n=34]	87.5 [n=6]	0.65	0.03

Table C-7. Results of Mann-Kendall trends analysis for the relative abundance of each species at three sites sampled in the RMOW from 2016-2020.

Site	Species	Kendall's-Tau	p-value	Trend
21M-DS-AQ21	Sculpin	0.6	0.14	No Trend
CRB-DS-AQ01	Sculpin	0.4	0.33	No Trend
JOR-DS-AQ31	Sculpin	0.4	0.33	No Trend
21M-DS-AQ21	Trout	-0.11	0.8	No Trend
CRB-DS-AQ01	Trout	-0.4	0.33	No Trend
JOR-DS-AQ31	Trout	-0.4	0.33	No Trend
21M-DS-AQ21	Three-spined Stickleback	-0.6	0.17	No Trend
CRB-DS-AQ01	Three-spined Stickleback	-0.6	0.14	No Trend
JOR-DS-AQ31	Three-spined Stickleback	-0.67	0.12	No Trend

Table C-8. Results of MK trends test comparing mean relative condition for each fish species sampled at teach site in the RMOW from 2016 to 2020.

Site	Kendall's Tau	p-value	Trend	2016 Mean K_n	2017 Mean K_n	2018 Mean K_n	2019 Mean K_n	2020 Mean K_n
Sculpin								
21-Mile Creek	-0.244	0.001	Decreasing	1.09	1.24*	0.97	1.09	0.89
Crabapple Creek	-0.29	0.032	Decreasing	1.17	1.40*	0.88	0.93	0.85
Jordan Creek	-0.4129	0.0596	No Trend	1.46	1.12*	1.00	1.07*	0.76*
Trout								
21-Mile Creek	-0.32	0.0047	Decreasing	0.95	0.73*	0.76	0.71	0.84
Crabapple Creek	0.05	0.63	No Trend	0.88	1.00*	0.85	1.00	0.85
Jordan Creek	-0.11	0.43	No Trend	0.92	0.94*	0.80*	0.89	0.85
Three-spined Stickelback								
21-Mile Creek	-0.06	0.75	No Trend	1.01*	1.29*	0.94*	0.99*	0.99*
Crabapple Creek	-0.12	0.33	No Trend	1.19	1.39*	0.97	1.18	1.03*
Jordan Creek	0.015	0.93	No Trend	1.12*	1.04*	0.93	1.06	0.91*

*Note: * N <5 individuals for that year*

Table C-9. Statistically significant results of multiple comparison tests comparing mean relative condition for each fish species sampled at each site in the RMOW from 2016 to 2020.

Site 1	Site 2	p-value
Sculpin		
Crabapple Creek	21-Mile Creek*	0.04
RGD-DS-AQ12	21-Mile Creek*	0.001
Three-spined Stickleback		
21-Mile Creek*	RGD-DS-AQ12	0.002
RGD-AQ11*	RGD-DS-AQ12	0.0001
Jordan Creek*	RGD-DS-AQ12	0.0001
Crabapple Creek*	RGD-DS-AQ12	0.0001

*Note: * denotes the site with the better condition value*

Table C-10. Statistically significant results of multiple comparison tests comparing mean relative condition between years for each fish species sampled at each site in the RMOW from 2016 to 2020.

Year 1	Year 2	p-value
Sculpin		
21-Mile Creek		
2018	2017*	0.0353
2020	2019*	0.0166
2020	2017*	0.015
2020	2016*	0.0019
Crabapple Creek		
2020	2016*	0.0223
2018	2016*	0.0061
2019	2016*	0.0038
Trout		
21-Mile Creek		
2019	2016*	0.022
Three-spined Stickleback		
Crabapple Creek		
2019*	2018	0.03
RGD-DS-AQ12		
2019	2018*	0.02
2020	2018*	0.02

*Note: * denotes the site with the better condition value*

Table C-11. Fish capture and biological data from surveys conducted in the RMOW study area, 2020.

Site	Creek	Date	Fish ID	Species	Method	Length (mm)	Weight (g)	Comments
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-01	TR	MT1	73.0	4.71	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-02	TR	MT1	95.0	8.82	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-03	CC	MT1	60.0	2.12	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-04	TR	MT1	62.0	2.52	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-05	TSB	MT1	55.0	1.60	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-06	TR	MT2	62.0	2.38	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-07	CC	MT3	65.0	3.10	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-08	TSB	MT3	55.0	2.01	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-09	TSB	MT3	47.0	1.27	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-10	TSB	MT3	49.0	1.21	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-11	CC	MT4	75.0	4.42	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-12	CC	MT4	70.0	3.43	
CRB-DS-AQ01	Crabapple Creek	2020-08-05	CRB-13	TR	MT5	74.0	3.71	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-14	TSB	EF1	47.0	1.11	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-15	TSB	EF1	13.0	1.58	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-16	CC	EF1	49.0	1.01	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-17	CC	EF2	70.0	0.66	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-18	CC	EF2	64.0	0.67	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-19	CC	EF2	77.0	4.72	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-20	CC	EF2	74.0	1.51	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-21	CC	EF2	71.0	2.76	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-22	CC	EF2	68.0	0.66	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-23	TR	EF2	77.0	0.77	Two pics on AD's camera
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-24	TR	EF2	100.0	2.19	Mulitple pics incl. fish viewer
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-25	CC	EF2	75.0	1.22	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-26	TR	EF2	82.0	1.27	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-27	TSB	EF2	60.0	0.47	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-28	CC	EF2	70.0	0.64	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-29	CC	EF2	68.0	0.63	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-30	CC	EF2	67.0	0.54	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-31	CC	EF2	70.0	0.69	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-32	CC	EF2	72.0	0.57	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-33	TSB	EF2	55.0	0.33	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-34	CC	EF2	65.0	0.50	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-35	CC	EF2	44.0	0.11	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-36	CC	EF2	67.0	0.52	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-37	TR	EF2	42.0	0.19	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-38	CC	EF2	65.0	0.58	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-39	CC	EF2	60.0	0.27	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-40	CC	EF2	58.0	0.38	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-41	CC	EF2	67.0	0.66	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-42	CC	EF2	49.0	0.09	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-43	TR	EF2	68.0	0.55	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-44	TR	EF2	33.0	0.04	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-45	CC	EF2	54.0	0.26	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-46	TR	EF2	42.0	0.16	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-47	CC	EF2	62.0	0.25	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-48	TR	EF2	34.0	0.12	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-49	TR	EF2	34.0	0.07	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-50	CC	EF2	36.0	0.16	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-51	TR	EF2	31.0	0.05	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-52	CC	EF2	61.0	0.29	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-53	TR	EF2	32.0	0.03	Mortality
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-54	TR	EF2	27.0	<0.01	No scale reading.
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-55	TR	EF2	33.0	0.04	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-56	CC	EF2	60.0	0.38	

CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-57	CC	EF2	55.0	0.24	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-58	TR	EF2	28.0	0.04	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-59	CC	EF2	52.0	0.18	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-60	TR	EF2	45.0	0.13	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-61	CC	EF2	49.0	0.21	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-62	CC	EF2	45.0	0.18	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-63	CC	EF2	47.0	0.12	
CRB-DS-AQ01	Crabapple Creek	2020-08-07	CRB-64	CC	EF2	48.0	0.22	
21M-DS-AQ21	21-Mile Creek	2020-08-05	21M-01	TR	MT2	101.0	10.96	
21M-DS-AQ21	21-Mile Creek	2020-08-05	21M-02	TR	MT2	54.0	1.89	Mortality.
21M-DS-AQ21	21-Mile Creek	2020-08-05	21M-03	TSB	MT2	53.0	1.50	
21M-DS-AQ21	21-Mile Creek	2020-08-05	21M-04	CC	MT2	50.0	1.16	
21M-DS-AQ21	21-Mile Creek	2020-08-05	21M-05	CC	MT2	55.0	1.71	
21M-DS-AQ21	21-Mile Creek	2020-08-05	21M-06	CC	MT2	55.0	1.63	
21M-DS-AQ21	21-Mile Creek	2020-08-05	21M-07	TSB	MT4	45.0	1.04	Mortality.
21M-DS-AQ21	21-Mile Creek	2020-08-05	21M-08	TR	MT5	85.0	5.94	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-09	TR	EF1	74.0	3.98	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-10	TR	EF1	83.0	5.75	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-11	CC	EF1	48.0	1.14	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-12	CC	EF1	60.0	2.43	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-13	CC	EF1	65.0	3.35	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-14	CC	EF1	53.0	1.51	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-15	CC	EF1	57.0	2.01	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-16	CC	EF1	56.0	1.98	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-17	CC	EF1	40.0	0.70	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-18	CC	EF1	56.0	1.84	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-19	CC	EF1	45.0	0.91	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-20	CC	EF1	51.0	1.23	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-21	CC	EF1	50.0	1.37	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-22	CC	EF1	58.0	2.07	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-23	CC	EF1	64.0	2.68	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-24	CC	EF1	51.0	1.40	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-25	CC	EF1	55.0	1.89	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-26	CC	EF1	59.0	2.20	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-27	CC	EF1	58.0	2.07	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-28	CC	EF1	43.0	0.71	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-29	CC	EF1	48.0	1.05	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-30	CC	EF1	48.0	1.05	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-31	CC	EF1	44.0	0.84	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-32	TR	EF1	69.0	3.12	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-33	TR	EF1	30.0	0.22	
21M-DS-AQ21	21-Mile Creek	2020-08-06	21M-34	CC	EF1	43.0	0.69	
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-01	TSB	MT1	65.0	2.31	*** scale off by 14 grams for JOR
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-02	TSB	MT1	51.0	0.84	
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-03	TSB	MT1	61.0	2.07	
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-04	TR	MT2	108.0	11.67	Photo taken - eye extends past …..
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-05	TSB	MT2	48.0	0.31	
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-06	TSB	MT2	63.0	1.34	
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-07	TSB	MT2	41.0	0.22	
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-08	TR	MT3	47.0	0.24	
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-09	TR	MT4	45.0	0.14	
JOR-DS-AQ31	Jordan Creek	2020-08-05	JOR-10	CC	MT5	108.0	11.87	photos taken
JOR-DS-AQ31	Jordan Creek	2020-08-06	JOR-11	CC	EF1	90.0	1.16	
JOR-DS-AQ31	Jordan Creek	2020-08-06	JOR-12	CC	EF1	79.0	0.74	
JOR-DS-AQ31	Jordan Creek	2020-08-06	JOR-13	CC	EF1	87.0	0.64	
JOR-DS-AQ31	Jordan Creek	2020-08-06	JOR-14	TR	EF1	88.0	0.89	
JOR-DS-AQ31	Jordan Creek	2020-08-06	JOR-15	TR	EF1	44.0	0.07	
JOR-DS-AQ31	Jordan Creek	2020-08-06	JOR-16	TR	EF1	41.0	0.07	
JOR-DS-AQ31	Jordan Creek	2020-08-06	JOR-17	TR	EF1	48.0	0.12	
JOR-DS-AQ31	Jordan Creek	2020-08-06	JOR-18	TR	EF1	32.0	0.03	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-01	TSB	MT1	56.0	1.80	

RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-02	TSB	MT1	58.0	2.69	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-03	TSB	MT1	65.0	1.62	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-04	TSB	MT1	49.0	0.98	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-05	TSB	MT1	60.0	2.28	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-06	TSB	MT1	51.0	1.36	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-07	TSB	MT1	57.0	1.89	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-08	TSB	MT1	54.0	1.46	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-09	TSB	MT1	53.0	1.52	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-10	TSB	MT1	59.0	1.95	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-11	TSB	MT1	55.0	1.76	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-12	TSB	MT1	48.0	1.16	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-13	TSB	MT1	55.0	1.80	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-14	TSB	MT1	56.0	1.68	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-15	TSB	MT1	56.0	1.85	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-16	TSB	MT1	43.0	0.88	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-17	TSB	MT1	50.0	1.18	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-18	TSB	MT1	68.0	2.85	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-19	TSB	MT2	59.0	2.09	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-20	CC	MT2	58.0	2.20	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-21	TSB	MT3	64.0	3.14	Mortality.
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-22	TSB	MT3	79.0	5.34	Photos taken.
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-23	TSB	MT4	55.0	1.71	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-24	TSB	MT5	60.0	2.55	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-25	TSB	MT5	47.0	1.10	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-26	TSB	MT5	47.0	1.03	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-27	TSB	MT5	60.0	2.44	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-28	TSB	MT5	50.0	1.54	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-29	TSB	MT5	53.0	1.39	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-30	TSB	MT5	55.0	1.91	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-31	TSB	MT5	58.0	2.01	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-32	TSB	MT5	53.0	1.68	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-33	TSB	MT5	45.0	0.92	
RGD-AQ11	River of Golden Dreams	2020-08-05	RGD-34	TSB	MT5	40.0	0.53	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-35	TSB	MT1	54.0	1.59	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-36	TSB	MT1	46.0	0.95	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-37	TSB	MT1	53.0	1.36	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-38	TSB	MT1	36.0	0.40	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-39	TSB	MT1	37.0	0.43	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-40	TSB	MT1	59.0	1.65	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-41	TSB	MT1	58.0	1.92	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-42	TSB	MT1	57.0	1.76	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-43	TSB	MT1	48.0	1.27	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-44	TSB	MT1	40.0	0.66	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-45	TSB	MT1	50.0	1.18	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-46	TSB	MT1	49.0	0.95	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-47	TSB	MT1	33.0	0.42	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-48	TSB	MT1	38.0	0.49	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-49	TSB	MT1	42.0	0.74	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-50	TSB	MT1	45.0	0.79	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-51	TSB	MT1	43.0	0.77	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-52	TSB	MT1	44.0	1.25	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-53	TSB	MT1	42.0	0.64	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-54	TSB	MT1	55.0	1.78	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-55	TSB	MT1	61.0	2.25	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-56	TSB	MT1	46.0	0.85	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-57	TSB	MT1	42.0	0.81	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-58	TSB	MT1	39.0	0.67	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-59	TSB	MT1	40.0	0.64	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-60	TSB	MT1	46.0	0.88	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-61	TSB	MT1	44.0	0.84	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-62	TSB	MT1	59.0	1.70	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-63	TSB	MT1	48.0	1.25	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-64	TSB	MT1	39.0	0.56	

RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-65	TSB	MT1	40.0	0.75	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-66	TSB	MT1	43.0	0.74	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-67	TSB	MT1	52.0	1.62	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-68	TSB	MT1	36.0	0.45	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-69	TSB	MT1	44.0	0.75	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-70	TSB	MT1	43.0	0.73	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-71	TSB	MT1	42.0	0.81	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-72	TSB	MT1	41.0	0.58	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-73	TSB	MT1	43.0	0.72	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-74	TSB	MT1	45.0	0.94	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-75	TSB	MT1	44.0	0.83	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-76	TSB	MT1	45.0	1.04	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-77	TSB	MT1	39.0	0.59	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-78	TSB	MT1	45.0	0.84	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-79	TSB	MT1	43.0	0.83	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-80	TSB	MT1	46.0	0.96	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-81	TSB	MT1	43.0	0.95	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-82	TSB	MT1	39.0	0.53	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-83	TSB	MT1	41.0	0.74	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-84	TSB	MT1	45.0	0.77	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-85	TSB	MT1	44.0	0.81	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-86	TSB	MT1	36.0	0.49	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-87	TSB	MT1	37.0	0.56	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-88	TSB	MT1	40.0	0.62	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-89	TSB	MT1	41.0	0.60	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-90	TSB	MT1	39.0	0.70	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-91	TSB	MT1	39.0	0.56	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-92	TSB	MT1	46.0	0.99	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-93	TSB	MT1	45.0	0.99	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-94	TSB	MT1	39.0	0.54	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-95	TSB	MT1	48.0	1.22	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-96	TSB	MT1	40.0	0.63	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-97	TSB	MT1	55.0	1.95	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-98	TSB	MT1	40.0	0.66	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-99	TSB	MT1	43.0	0.87	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-100	CC	MT1	38.0	0.59	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-101	TSB	MT1	38.0	0.57	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-102	TSB	MT1	43.0	0.66	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-103	TSB	MT1	44.0	0.72	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-104	TSB	MT1	42.0	0.76	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-105	TSB	MT1	41.0	0.67	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-106	TSB	MT1	39.0	0.61	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-107	TSB	MT1	36.0	0.44	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-108	TSB	MT1	33.0	0.42	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-109	TSB	MT1	63.0	2.47	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-110	CC	MT2	50.0	1.52	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-111	CC	MT2	40.0	0.58	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-112	TSB	MT2	49.0	1.03	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-113	TSB	MT2	47.0	1.02	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-114	TSB	MT2	44.0	0.85	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-115	CC	MT2	41.0	0.67	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-116	CC	MT2	43.0	0.74	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-117	CC	MT2	42.0	0.72	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-118	CC	MT2	40.0	0.77	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-119	CC	MT3	43.0	0.88	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-120	TSB	MT3	37.0	0.49	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-121	CC	MT3	44.0	0.74	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-122	CC	MT3	37.0	0.50	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-123	CC	MT3	50.0	1.15	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-124	TSB	MT3	41.0	0.64	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-125	TSB	MT3	48.0	1.08	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-126	TSB	MT3	40.0	0.55	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-127	TSB	MT3	40.0	0.62	

RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-128	TSB	MT3	47.0	0.89	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-129	TSB	MT3	55.0	1.74	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-130	TSB	MT3	43.0	0.73	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-131	TR	MT3	37.0	0.53	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-132	TSB	MT3	50.0	1.26	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-133	TSB	MT3	35.0	0.40	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-134	TSB	MT3	47.0	1.08	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-135	TSB	MT3	51.0	1.88	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-136	TSB	MT3	43.0	0.75	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-137	TSB	MT3	44.0	1.14	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-138	TSB	MT3	47.0	0.88	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-139	TSB	MT3	48.0	0.91	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-140	TSB	MT3	43.0	0.87	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-141	TSB	MT3	55.0	1.33	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-142	TR	MT3	40.0	0.59	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-143	TSB	MT3	45.0	0.83	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-144	TSB	MT3	41.0	0.69	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-145	TSB	MT3	46.0	0.84	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-146	TSB	MT3	46.0	0.99	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-147	TSB	MT3	39.0	0.53	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-148	TSB	MT3	33.0	0.37	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-149	TSB	MT3	35.0	0.38	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-150	CC	MT3	50.0	1.12	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-151	TSB	MT3	50.0	1.28	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-152	TSB	MT3	42.0	0.69	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-153	TSB	MT3	46.0	1.03	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-154	TSB	MT3	40.0	0.56	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-155	TSB	MT3	40.0	0.57	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-156	TSB	MT3	40.0	0.52	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-157	TSB	MT3	45.0	0.73	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-158	TSB	MT3	42.0	0.95	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-159	TSB	MT3	51.0	0.68	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-160	TSB	MT3	43.0	1.43	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-161	TSB	MT3	44.0	0.68	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-162	TSB	MT3	46.0	0.75	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-163	TSB	MT3	47.0	0.91	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-164	TSB	MT3	47.0	0.98	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-165	TSB	MT3	44.0	0.90	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-166	TSB	MT3	40.0	0.72	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-167	TSB	MT3	40.0	0.70	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-168	TSB	MT3	45.0	0.98	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-169	TSB	MT3	42.0	0.66	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-170	TSB	MT3	38.0	0.56	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-171	TSB	MT3	41.0	0.68	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-172	TSB	MT3	38.0	0.57	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-173	TSB	MT3	40.0	0.55	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-174	TSB	MT3	62.0	2.33	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-175	TSB	MT3	35.0	0.43	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-176	TSB	MT3	43.0	0.67	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-177	TSB	MT3	40.0	0.69	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-178	TSB	MT3	45.0	0.71	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-179	TSB	MT3	31.0	0.37	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-180	TSB	MT3	34.0	0.40	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-181	TSB	MT3	68.0	3.13	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-182	TSB	MT4	52.0	1.17	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-183	TSB	MT4	44.0	0.82	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-184	TSB	MT4	50.0	1.46	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-185	TSB	MT4	48.0	1.22	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-186	TSB	MT4	47.0	0.97	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-187	TSB	MT4	43.0	0.76	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-188	TSB	MT4	40.0	0.64	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-189	TSB	MT4	39.0	0.82	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-190	TSB	MT4	56.0	1.68	

RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-191	TSB	MT4	74.0	4.56	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-192	TSB	MT4	55.0	2.15	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-193	TSB	MT4	53.0	2.05	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-194	TSB	MT4	41.0	0.93	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-195	TSB	MT4	74.0	3.90	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-196	TSB	MT4	65.0	2.26	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-197	TSB	MT4	68.0	3.73	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-198	TSB	MT4	63.0	2.91	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-199	TSB	MT4	61.0	2.49	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-200	TSB	MT4	56.0	1.60	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-201	TSB	MT4	53.0	1.50	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-202	TSB	MT4	56.0	1.59	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-203	TSB	MT5	43.0	0.68	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-204	TSB	MT5	54.0	1.56	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-205	TSB	MT5	40.0	0.71	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-206	TSB	MT5	38.0	0.64	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-207	TSB	MT5	36.0	0.52	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-208	TSB	MT5	41.0	0.73	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-209	TSB	MT5	39.0	0.55	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-210	TSB	MT5	39.0	0.58	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-211	TSB	MT5	43.0	0.64	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-212	TSB	MT5	48.0	1.05	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-213	TSB	MT5	41.0	0.66	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-214	TSB	MT5	50.0	1.40	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-215	TSB	MT5	44.0	0.71	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-216	TSB	MT5	39.0	0.56	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-217	TSB	MT5	37.0	0.57	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-218	TSB	MT5	56.0	2.47	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-219	TSB	MT5	35.0	0.46	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-220	TSB	MT5	55.0	1.53	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-221	TSB	MT5	43.0	0.74	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-222	TSB	MT5	44.0	0.82	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-223	TSB	MT5	46.0	0.81	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-224	TSB	MT5	39.0	0.56	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-225	TSB	MT5	35.0	0.42	
RGD-DS-AQ12	River of Golden Dreams	2020-08-05	RGD-226	TSB	MT5	40.0	0.60	

The length-frequency distribution curves that were statistically significantly different according to a Kolmogorov-Smirnov Test are included in the subsequent figures.

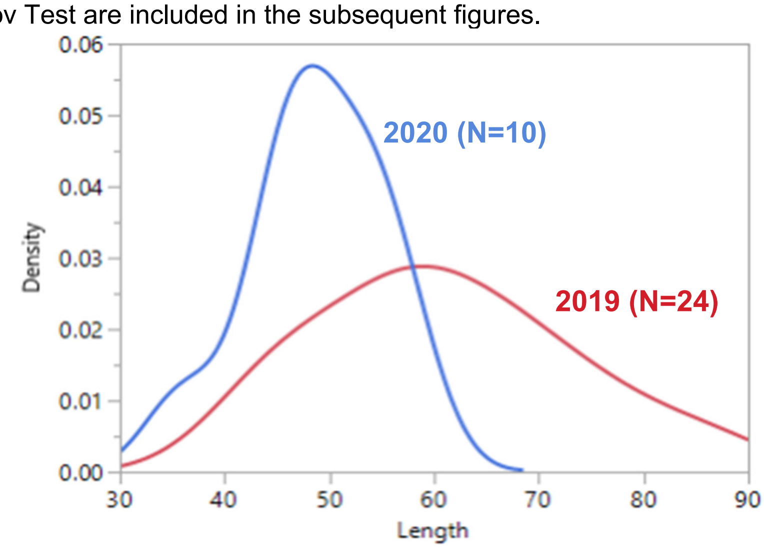

Figure C-1. Length frequency distribution curves for sculpin sp. at Crabapple Creek for 2019 and 2020 at the Resort Municipality of Whistler

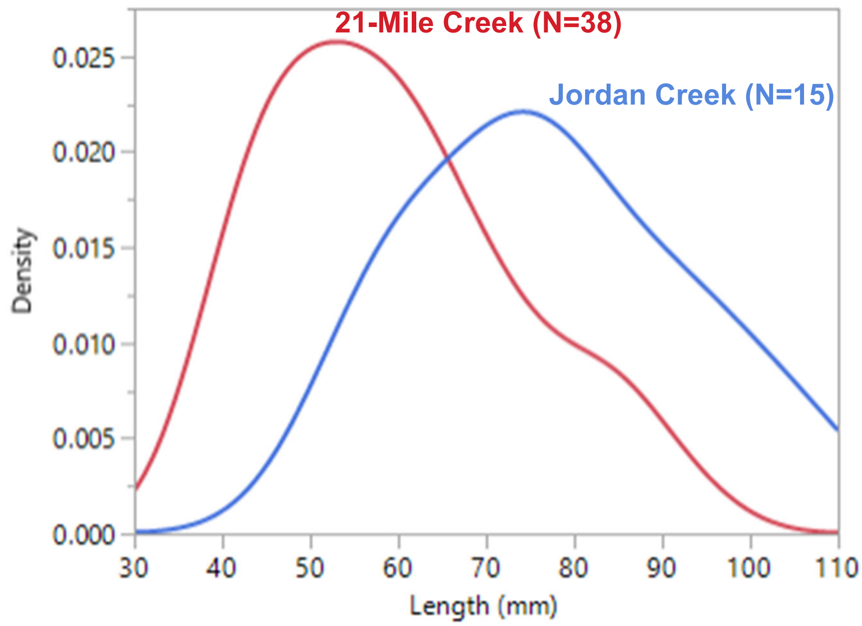

Figure C-2. Length frequency distribution curves with the cumulative lengths of sculpin sp. over 5 years (2016-2020) for 21-Mile Creek and 3 years (2018-2020) for Jordan Creek.

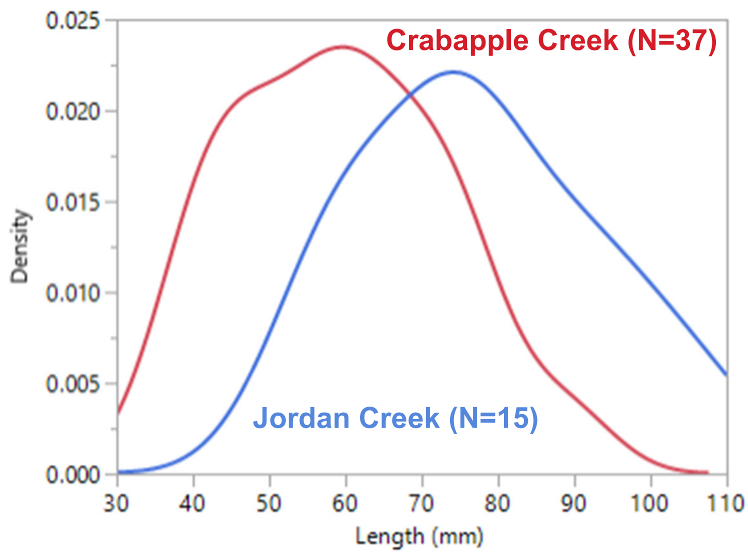

Figure C-3. Length frequency distribution curves with the cumulative lengths of sculpin sp. over 3 years (2018-2020) for Crabapple Creek and Jordan Creek.

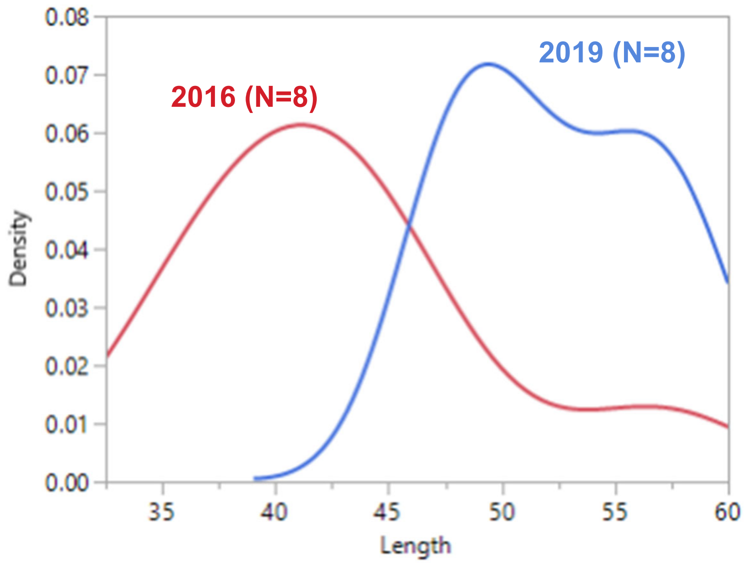

Figure C-4. Length frequency distribution curves for threespine stickleback at Jordan Creek for 2016 and 2019.

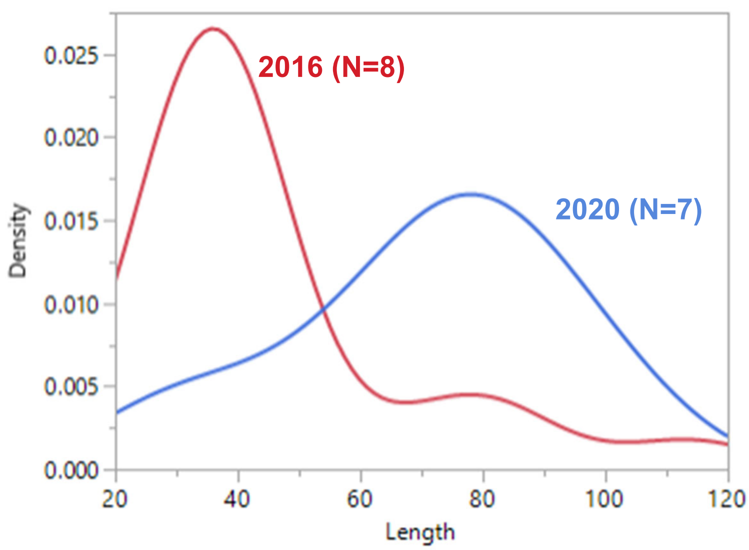

Figure C-5. Length distribution curves for Trout sp. at 21-Mile Creek for 2016 and 2020.

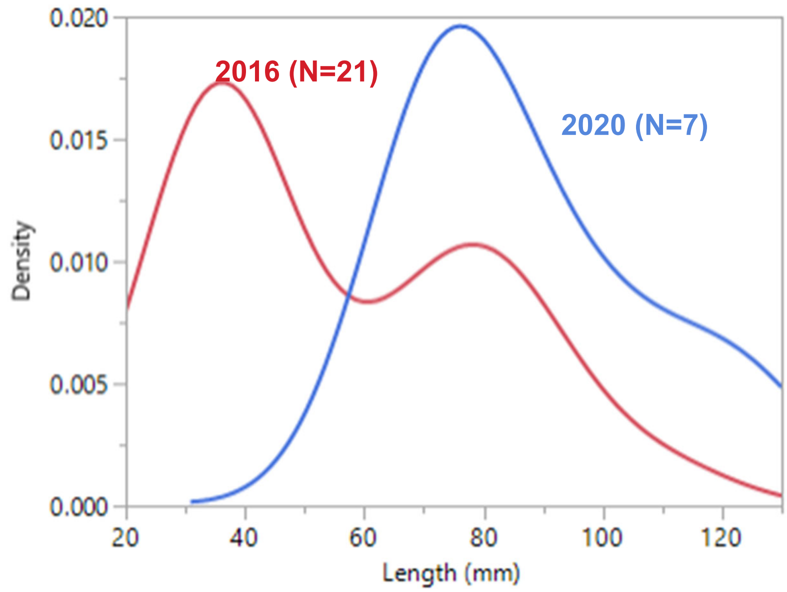

Figure C-6. Cumulative length frequency distribution curves for Trout sp. at 21-Mile Creek and the River of Golden Dreams downstream site (RGD-DS-AQ12).

Appendix D

Site Data for Coastal Tailed Frog Surveys

Appendix E: Coastal Tailed Frog Surveys - Site Data

Valley Side	Site	Date	Surveyors	Easting	Northing	Elev. (m)	Slope (%)	Channel Width (m)	Wetted Width (m)	Flow (rel.)	Stream Disturb-ance	Mean Depth (cm)	Crown Closure	Tree Comp.	Struct. Stage	Stream Morph.	Rock Size	Rock Shape
East	Archibald Creek - 1	2020-09-02	B. Brett, H. Willliamson	502387	5550606	695	17	4.0	3.7	Med	Med.	13	75	Decid.	Pole/Sapl.	Step Pool	Bedrock (Boulder)	Subrounded
East	Archibald Creek - 2	2020-09-01	B.Brett, J.Kozikowska	502854	5550298	835	18	2.7	1.8	Med	Med.	10	80	Mixed	YF	Step Pool	Cobble (Boulder)	Subangular
East	Archibald Creek - 3	2020-09-01	B.Brett, J.Kozikowska	503310	5549422	1026	12	2.2	1.6	Med	Med.	5	95	Conif.	YF	Step Pool (Riffle)	Cobble (Boulder)	Subangular
East	Blackcomb Cr. - Lost Lake	2020-09-02	B. Brett, H. Willliamson	504608	5552632	690	6	5.6	3.8	Med	Low	22	80	Conif.	YF	Riffle (Step Pool)	Cobble (Boulder)	Subrounded
East	Blackcomb Creek - Yummy Numby	2020-09-02	B. Brett, H. Willliamson	505211	5552576	762	15	8.4	5.4	High	Low	18	60	Conif.	OF	Cascade (Step Pool)	Boulder (Cobble)	Subrounded
East	Blackcomb Creek - 942m via Dark Crystal	2020-09-05	B. Brett	505792	5552668	942	25	10.0	3.3	High	Low	19	70	Conif.	OF	Step Pool (Cascade)	Cobble (Boulder)	Subrounded
West	FJ West Creek - 1 (South Flank)	2020-09-08	B. Brett	496383	5548374	648	14	4.1	1.3	Med	Med.	8	80	Mixed	YF	Step Pool	Cobble (Bedrock)	Subangular
West	FJ West Creek - 3 (Into the Mystic)	2020-09-03	B. Brett, H. Willliamson	496022	5549522	1119	14	2.2	1.6	Med	Low	10	30	Conif.	OF	Cascade (Step Pool)	Bedrock (Cobble)	Subrounded
West	Sproatt Creek - 1 (Danimal South)	2020-09-03	B. Brett, H. Willliamson	499063	5549434	692	25	6.6	1.8	Med	Low	10	30	Mixed	Shrub/MF	Riffle (Step Pool)	Boulder (Cobble)	Subangular
West	Sproatt Creek - 2 (Don't Look Back)	2020-09-03	B. Brett, H. Willliamson	498996	5549662	790	32	7.8	1.5	Med	Med.	11	50	Conif.	OF	Riffle (Step Pool)	Boulder (Cobble)	Subrounded
West	Sproatt Creek - 3 (Flank Trail)	2020-09-03	B. Brett, H. Willliamson	498483	5550455	996	24	5.0	2.3	Med	Med.	10	40	Conif.	MF	Step Pool	Boulder (Bedrock)	Subrounded
West	Van West - 1A (Function Junction)	2020-09-04	B. Brett	497611	5548635	604	4	7.0	1.5	High	Med.	5	80	Decid.	Shrub	Riffle (Step Pool)	Cobble (Stones)	Subangular
West	Van West - 1B (Flank Trail)	2020-09-08	B. Brett	497563	5549038	706	18	5.1	1.1	Med	Med	11	95	Conif.	YF	Step Pool	Boulder (Bedrock)	Subangular
West	Van West - 3 (Into the Mystic)	2020-09-03	B. Brett, H. Willliamson	497125	5549816	1036	25	4.2	1.8	Med	Low	10	50	Conif.	OF	Step Pool	Cobble (Boulder)	Subangular
East	Whistler Creek - 1	2020-09-02	B. Brett, H. Willliamson	501041	5549045	692	14	6.2	3.5	Med	Med	13	5	Decid.	Shrub	Step Pool	Cobble (Boulder)	Subangular
East	Whistler Creek - 2	2020-09-01	B.Brett, J.Kozikowska	501649	5547961	972	14	5.1	4.2	Med	Low	11	10	Conif.	OF	Riffle (Step Pool)	Cobble (Boulder)	Subangular
East	Whistler Creek - 3	2020-09-01	B.Brett, J.Kozikowska	501417	5548276	879	25	4.1	3.2	Med	Low	10	40	Conif.	OF	Step Pool	Cobble (Bedrock)	Subangular

Appendix E

Capture Data for Coastal Tailed Frog Surveys

Appendix F: Coastal Tailed Frog Surveys - Capture Data

Valley Side	Site	Date	Surveyors	Easting	Northing	Elev. (m)	Weather	Water Temp. (°C)	Air Temp. (°C)	T1	T2	T3	Tad-poles	Tad-poles /100m2	Meta+ Adults	Survey Area (m2)
East	Archibald Creek - 1	2020-09-02	B. Brett, H.	502387	5550606	695	Sun	10.5	17.0	0	4	0	4	26.7	0	15.0
East	Archibald Creek - 2	2020-09-01	B.Brett, J.K	502854	5550298	835	Cloud	9.0	15.5	0	1	0	1	5.0	0	20.0
East	Archibald Creek - 3	2020-09-01	B.Brett, J.K	503310	5549422	1026	Cloud	8.0	11.5	0	0	0	0	0.0	0	22.0
East	Blackcomb Cr. - Lost Lake	2020-09-02	B. Brett, H.	504608	5552632	690	Sun	9.5	17.2	0	0	0	0	0.0	0	10.0
East	Blackcomb Creek - Yummy Numby	2020-09-02	B. Brett, H.	505211	5552576	762	Sun	9.0	13.0	0	0	0	0	0.0	0	11.0
East	Blackcomb Creek - 942m via Dark Crystal	2020-09-05	B. Brett	505792	5552668	942	Sun	10.0	17.0	0	0	0	0	0.0	0	17.0
West	FJ West Creek - 1 (South Flank)	2020-09-08	B. Brett	496383	5548374	648	Sun	10.0	15.0	0	0	0	0	0.0	0	19.0
West	FJ West Creek - 3 (Into the Mystic)	2020-09-03	B. Brett, H.	496022	5549522	1119	Sun	11.0	17.0	4	0	0	4	23.5	0	17.0
West	Sproatt Creek - 1 (Danimal South)	2020-09-03	B. Brett, H.	499063	5549434	692	Sun	11.0	17.0	0	1	0	1	6.3	0	16.0
West	Sproatt Creek - 2 (Don't Look Back)	2020-09-03	B. Brett, H.	498996	5549662	790	Sun	11.0	17.0	1	3	1	5	21.7	0	23.0
West	Sproatt Creek - 3 (Flank Trail)	2020-09-03	B. Brett, H.	498483	5550455	996	Sun	10.2	14.0	2	3	3	8	66.7	1	12.0
West	Van West - 1A (Function Junction)	2020-09-04	B. Brett	497611	5548635	604	Sun	13.5	23.0	0	0	0	0	0.0	0	18.0
West	Van West - 1B (Flank Trail)	2020-09-08	B. Brett	497563	5549038	706	Sun	10.5	15.0	0	0	0	0	0.0	0	11.0
West	Van West - 3 (Into the Mystic)	2020-09-03	B. Brett, H.	497125	5549816	1036	Sun	10.0	17.0	5	3	0	8	50.0	0	16.0
East	Whistler Creek - 1	2020-09-02	B. Brett, H.	501041	5549045	692	Cloud	11.0	17.0	1	3	2	6	37.5	0	16.0
East	Whistler Creek - 2	2020-09-01	B.Brett, J.K	501649	5547961	972	Cloud	8.3	13.0	7	1	2	10	52.6	0	19.0
East	Whistler Creek - 3	2020-09-01	B.Brett, J.K	501417	5548276	879	Cloud	8.2	13.2	2	1	1	4	26.7	0	15.0

Appendix F

Beaver Lodges by Activity Status, 2017 to 2020

Appendix G: Beaver Lodges by Activity Status, 2017 to 2020.

Location	2020 Status	2019 Status	2018 Status	2017 Status	Easting	Northing
Alpha Lake, near dog beach	Active	Active	Active	Active	499970	5549027
Alpha Lake, northwest side of resident owned island	Inactive	Inactive	Inactive	NR	499861	5548981
Alpha Lake, outlet at Millar Creek	Active	Active	Active	NR	499208	5549034
Alpha Lake, South shore near outlet at Millar Creek	Inactive	Inactive	Inactive	NR	499208	5548997
Alpha Lake, South shore near outlet at Millar Creek	Inactive	Inactive	Inactive	NR	499214	5548991
Alta Vista Pond	Active	Active	Active	Active	501458	5550235
Alta Vista Pond	Inactive	NR	NR	NR	501544	5550444
Alta Vista Pond	Inactive	NR	NR	NR	501552	5550477
Beaver Lake #1, westside north	Inactive	Inactive	Inactive	Inactive	500012	5550828
Beaver Lake #2, westside middle	Inactive	Inactive	Inactive	Inactive	500012	5550802
Beaver Lake #3, westside south	Inactive	Inactive	Inactive	Inactive	500027	5550773
Beaver Lake #4; northeast side	Inactive	Inactive	Inactive	Inactive	500072	5550831
Chateau GC #18 lower pond	Inactive	Inactive	Inactive	Inactive	504184	5552221
Chateau GC #18 lower pond	Inactive	Inactive	Summer?	Summer?	504184	5552221
Chateau GC #18 main pond	Inactive	Inactive?	NR	NR	504245	5552249
Chateau GC #18 main pond	Active	NR	NR	NR	504228	5552240
Chateau GC #2 pond lodge	Inactive	Inactive?	Inactive?	Active	504612	5552324
Fitz Creek Pond - Blackcomb Way/Nancy Greene Dr.	Inactive	Inactive	NR	NR	503300	5552575
Fitz Creek Pond - Blackcomb Way/Nancy Greene Dr.	Inactive?	Active	Active	NR	503275	5552571
Fitzsimmons Creek Fan, downstream right end	Inactive	Inactive	Inactive	Inactive	503847	5554866
Fitzsimmons Creek, back channels near Old Mill Rd.	Inactive	Inactive?	Active	NR	504212	5554643
Green Lake Lodge e. of float plane base	Inactive	Inactive	Inactive	Unknown	503740	5554600
Lost Lake	Active	Active	Active	Unknown	504458	5552740
Millar Cr. Wetlands - bet. hydro tower and Valley Tr. bench	Active	Active	Inactive?	NR	498284	5548908
Millar Cr. Wetlands -FJ (Valley Trail access)	Active	Active	NR	NR	498321	5548863
Millar Cr. Wetlands -FJ (Valley Trail access)	Active	Active	NR	NR	498328	5548894
Millar Cr. Wetlands -FJ (Valley Trail access)	Active	Active	NR	NR	498398	5548903
Millar Cr. Wetlands -FJ (water access)	Active	Inactive	NR	NR	497931	5548588
Millar Cr. Wetlands -FJ (water access)	Active	Active	Active	NR	497706	5548388
Millar Cr. Wetlands -FJ (water access)	Active	NR	NR	NR	497737	5548390
Millar Cr. Wetlands -FJ (water access)	Active	Active	Active	NR	497796	5548408
Millar Cr. Wetlands -FJ (water access)	Inactive	Active	Inactive	NR	497818	5548447
Millar Cr. Wetlands -FJ (water access)	Active?	Active?	NR	NR	498156	5548764
Millar Cr. Wetlands -FJ (water access)	Inactive	Inactive	NR	NR	498146	5548795
Millar Cr., downstream of. wetland to Hwy 99	Active	NR	NR	NR	496821	5548379
Millar Cr., downstream of. wetland to Hwy 99	Inactive	NR	NR	NR	496888	5548391
Millar Cr., downstream of. wetland to Hwy 99	Active?	NR	NR	NR	496812	5548373
Nicklaus North GC, #10 pond	Inactive	Inactive	Inactive	Inactive	502764	5554086
Nicklaus North GC, #12 pond	Inactive	Inactive	Inactive	Inactive	502746	5553748
Nicklaus North GC, #15 pond	Inactive	Inactive	Inactive	Inactive	503235	5554601
Nita Lake	Inactive	Inactive	Inactive	Inactive	500290	5549772
Rainbow Park, west side upstream of Alta Lake	Inactive	Inactive	Inactive	Inactive	501148	5551850
Rainbow Park, west side upstream of Alta Lake	Inactive	Inactive	Inactive	Inactive	501148	5551850
Rainbow Park, west side upstream of Alta Lake	Active?	Inactive	Inactive	Inactive	501148	5551850
Rainbow Wetlands, NE end near 21-Mile Creek	Active?	Active	Active	Active	501848	5552727
Rainbow Wetlands, NE end near 21-Mile Creek	Active	NR	NR	NR	501777	5552792
ROGD1 - Alta Lake entrance to fish weir	Inactive?	Active	Active	Active	501744	5552517
ROGD4 - RR bridge to bend nearest Valley Tr.	Inactive	Inactive	Inactive	Inactive	502120	5553004
ROGD4 - RR bridge to bend nearest Valley Tr.	Active?	Active	NR	NR	502126	5553026
ROGD4 - RR bridge to bend nearest Valley Tr.	Inactive	Inactive	Inactive	Inactive	502302	5553215
ROGD4 - RR bridge to bend nearest Valley Tr.	Active	Active	NR	NR	502312	5553214
ROGD4 - RR bridge to bend nearest Valley Tr.	Active	Active	Active	NR	502327	5553188
ROGD4 - RR bridge to bend nearest Valley Tr.	Inactive	Inactive	Inactive	Inactive	502334	5553183
ROGD4 - RR bridge to bend nearest Valley Tr.	Active	Active	Active?	NR	502349	5553202
ROGD4 - RR bridge to bend nearest Valley Tr.	Inactive?	Inactive	Inactive	NR	502358	5553224
ROGD4 - RR bridge to bend nearest Valley Tr.	Active	Active	NR	NR	502406	5553403
ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active	NR	NR	NR	502294	5553771
ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Inactive?	Inactive?	Inactive	NR	502304	5553839
ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active	Inactive	Inactive	NR	502311	5553661
ROGD5 - bend nearest Valley Tr. to Hwy. 99 bridge	Active	Inactive?	Inactive	NR	502308	5553673
ROGD6 - Hwy. 99 bridge to Green Lake	Inactive	NR	NR	NR	503029	5554719
ROGD6 - Hwy. 99 bridge to Green Lake	Inactive	Inactive	Inactive	NR	503050	5554860
ROGD6 - Hwy. 99 bridge to Green Lake	Active?	Inactive?	Unknown	NR	503202	5554930
ROGD6 - Hwy. 99 bridge to Green Lake	Inactive	Inactive	Inactive	Inactive	503185	5554836

ROGD6 - Hwy. 99 bridge to Green Lake	Active	Active	Inactive?	NR	503187	5554830
Spruce Grove Park, entrance	Active	Active	Active	Active	503652	5553307
Tennis Club Amenity Stream	Inactive	Inactive	Inactive	Inactive	503139	5552271
Wedge Pond	Active	Active	Active	Inactive	503223	5555744
Whistler GC, #15 fairway, n. or green.	Inactive	Inactive?	Inactive	Inactive	502167	5550989
Whistler GC, #15 fairway, s. of #16 outflow	Inactive	Active?	Active	Active	502356	5551107
Whistler GC, #15 fairway, s. of #16 outflow	Inactive	Inactive	Inactive	Inactive	502346	5551092
Whistler GC, #5 tee pond	Inactive	Inactive	Inactive	Inactive	502367	5551766
Whistler GC, #6 green pond	Inactive?	Active	NR	NR	502361	5552148
Whistler GC, Crabapple Cr. #10 sand trap	Inactive	Active?	Active	Active	502293	5551708
Whistler GC, Crabapple Cr. s. of #10 green	Inactive	Inactive?	Active	NR	502290	5551566
Wildlife Refuge, middle pond	Active	Active	Active	Active	501825	5553543
Wildlife Refuge, middle pond	Active	NR	NR	NR	501750	5553298
Wolverine Creek	Inactive	Inactive	Inactive	Inactive	501201	5549629

Appendix G

Beaver Dams on the River of Golden Dreams, September 11, 2020

Appendix H:: Beaver Dams on the River of Golden Dreams, September 11, 2020

Map Code	Status	Easting	Northing	Impoundment Height (cm)			Dam Width (m)	Breach Width (m)	Comments
				Actual	Without Breach	Maximum (Flood)			
ROGD1-1	Active	501758	5552522	15	15	25	8	1	Constant rebuilding through summer. Some new branches, but not as active as earlier.
ROGD4-1	Active	502340	5553225	25	30	50	8	1	Bigger lodge complex vs. 2019. Dam looks like it's been cleared this year -- only branches, little mud.
ROGD4-2	Active	502340	5553309	25	30	35	9	1	Similar to 4-1. Higher on edges = more impoundment after boating activity stops in fall?
ROGD4-3	Active	502421	5553430	40	40	40+	7	none	No full breach. Material on edge suggests possible higher maximum. Most difficult dam for people to
ROGD4-4	Active	502377	5553591	40	50	75	8	1	Similar to 4-1 /4-2 but more material (branches + MS) on DS left side = higher when boating inactive.
ROGD5-1	Active	502291	5553684	40	50	60	8	2	More substantial (branches + MS) than other dams. No doubt bigger when boating is inactive.
ROGD5-2	Active	502283	5553770	10	15	30	9	4	V. shallow dam, lodge adjacent upstream so why not bigger? 80cm deep pond US. No underwater
ROGD5-3	Active?	502429	5553974	5	15	15	10	3	Barely slows water. Recent branches not clearly structural so may have floated from upstream. No pool above. Active?
ROGD5-4	Inactive?	502621	5554167	0	10	15	9	3	No structure on DS right side; fresh branches = washed up or repair?
ROGD5-5	Active	502439	5554305	30	40	60	11	2	Water pooled above but no lodges detected nearby. Easy to cross.
ROGD6-1	Active	503032	5554681	20	20	20	13	1	"Messy" as though not maintained, yet there are new branches on top. Easy to cross.
ROGD6-2	Inactive	502994	5554792	0	0	0	10	5	Big dam in past but no recent rebuilding. No impoundment.

Appendix H

Northern Goshawk Records since 2001

Appendix I: Northern Goshawk Records since 2001

Location	Date	Easting	Northing	Elev. (m)	Record	Observer(s)	Source
Blackcomb Alpine	2000-03-14	507070	5549311	1867	Visual	B Max Götz	eBird
Valley Trail to Rainbow Beach	2001-03-03	501773	5552539	643	Visual	B Max Götz	eBird
Valley Trail to Rainbow Beach	2007-06-02	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Valley Trail to Rainbow Beach	2008-02-02	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Blackcomb Alpine	2009-02-14	507070	5549311	1867	Visual	Peter Dunwiddie	eBird
Whistler Village and vicinity	2009-08-22	503156	5551541	683	Visual	Daniel Airola	eBird
Whistler Golf Club	2011-08-06	502208	5551354	684	Visual	Christopher Di Corrado	eBird
Valley Trail to Rainbow Beach	2011-08-15	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Fitzsimmons Fan & Nicklaus North GC	2011-11-02	503656	5554556	636	Visual	Chris Dale	eBird
Valley Trail to Rainbow Beach	2011-11-05	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Valley Trail to Rainbow Beach	2012-02-13	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Valley Trail to Rainbow Beach	2012-05-05	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Valley Trail to Rainbow Beach	2013-03-02	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Valley Trail to Rainbow Beach	2013-03-14	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Valley Trail to Rainbow Beach	2013-05-04	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Comfortably Numb w. of Wedge Creek	2014-06-30	506935	5555480	829	Nest	Pablo Jost, Naomi Sands	BC MOE
Valley Trail to Rainbow Beach	2014-08-02	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Valley Trail to Rainbow Beach	2014-12-06	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Lost Lake and vicinity	2015-03-15	504636	5552716	687	Visual	Cole Gaerber	eBird
Valley Trail to Rainbow Beach	2015-07-04	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Brew Creek	2015-07-24	490637	5545029	829	Audible	T. Tripp, C. Churchland	T. Tripp, C. Churchland
Comfortably Numb @ Jeff's Trail	2015-07-24	506387	5555458	823	Nest	T. Tripp, C. Churchland	T. Tripp, C. Churchland
Blackcomb Alpine	2016-03-12	507070	5549311	1867	Visual	Nina Rach	eBird
Valley Trail to Rainbow Beach	2016-05-07	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Millar's Pond	2016-05-20	499601	5548228	727	Nest	Brent Matsuda	RMOW Eco. Mon. Prog.
Millar's Pond	2016-06-06	499601	5548228	727	Visual	Bob Brett	RMOW Eco. Mon. Prog.
Millar's Pond	2016-06-09	499601	5548228	727	Visual	Bob Brett	RMOW Eco. Mon. Prog.
Callaghan Valley Road	2016-06-10	490798	5549818	679	Visual	BBS Team	eBird
Millar's Pond	2016-06-12	499601	5548228	727	Visual	Bob Brett	RMOW Eco. Mon. Prog.
Millar's Pond	2016-06-12	499601	5548228	727	Nest	B. Brett, G. Clulow & others	Whistler Naturalists
Valley Trail to Rainbow Beach	2016-07-02	501773	5552539	643	Visual	C. Dale, H. Baines & others	eBird
Musical Bumps Trail	2016-09-12	504873	5543244	1907	Visual	Bob Brett	Personal
Millar's Pond	2016-09-20	499601	5548228	727	Visual	Bob Brett	RMOW Eco. Mon. Prog.
Millar's Pond	2016-09-20	499601	5548228	727	Visual	Bob Brett	RMOW Eco. Mon. Prog.
Whistler Village and vicinity	2016-11-30	503156	5551541	683	Visual	Daniel Tinoco	eBird
Millar's Pond	2017-06-03	499601	5548228	727	Nest	B. Matsuda & Mike Toochin	Whistler BioBlitz
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	Personal
Millar's Pond	2017-08-17	499601	5548228	727	Visual	Bob Brett	RMOW Eco. Mon. Prog.
Bayshores, ~500m e of active nest	2017-10-09	500005	5543876	671	Visual	Dave McPeake	RMOW Eco. Mon. Prog.
Westside Road (unspecified)	2018-04-14	499982	5550268	742	Visual	Christa Vandeberg	Personal
Alta Lake Road n. of Wildlife Refuge	2018-05-01	501524	5553719	685	Visual	Bob Brett	RMOW Eco. Mon. Prog.
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	Whistler Naturalists
Kadenwood 2018 FireSmart site	2018-10-02	500291	5548095	756	Visual	Bob Brett	RMOW project
Kadenwood 2018 FireSmart site	2018-10-10	500386	5548095	870	Visual	Leo Coudrau	RMOW project
Near Emerald Forest south gravel pit	2019-01-05	501730	5552795	644	Visual	C. Dale, H. Baines & others	Naturalists' bird count
Lost Lake (beach area)	2019-04-25	504629	5552704	694	Visual (?)	Jagoda Kozikowska	verbal
Chateau Golf Course, n. of hole #8	2019-05-25	504431	5553657	739	Visual (?)	Dan Nash	email
Whistler Olympic Park	2019-06-22	491761	5554069	851	Visual	Paul Maury	eBird
Baxter Creek, Rainbow Housing	2019-07-01	503086	5556357	725	Visual (?)	Scott Aitken	verbal
Kadenwood Drive	2019-07-01	500168	5548864	633	Visual (?)	Arthur De Jong	verbal
Lost Lake disc golf, hole 21	2019-07-14	503973	5553968	693	Visual (?)	Bob Brett	personal
Comfortably Numb w. of Wedge Creek	2019-07-20	506935	5555480	829	Auditory	Trystan Willmott, Bob Brett	Brett 2020
Sarajevo Drive, Creekside	2019-08-01	500615	5548650	741	Visual	Unknown (via W. Naturalists)	Whistler Naturalists
Kill Me Thrill Me vicinity	2019-08-06	506279	5557196	634	Visual (?)	Dan Raymond	email
Powderwood condos, Whistler Road	2019-12-14	501356	5549526	732	Visual	Elizabeth Barrett	email
Bud Light Trail, flying overhead	2020-03-20	505082	5552139	800	Visual	Kristina Swerhun	Pers. Comm. to B. Brett
Base 2 (Glacier Lane), flying overhead	2020-03-21	503619	5550760	748	Visual	Bob Brett	own record
Millar's Pond	2020-05-05	499601	5548228	727	Visual	Bob Brett	Pers. Comm. to B. Brett
Millar's Pond, uphill	2020-05-05	499601	5548228	727	Visual (?)	Ella	Pers. Comm. to B. Brett
3 Birds/Bush Doctor vicinity, westside	2020-06-01	499466	5549887	833	Nest?	Bruce Worden	Pers. Comm. to B. Brett
Powderwood condos, Whistler Road	2020-06-01	501356	5549526	732	Visual	Elizabeth Barrett	email
Fitzsimmons Fan & Nicklaus North GC	2020-08-19	503656	5554556	636	Visual	Chris Dale	eBird
Fitzsimmons Fan & Nicklaus North GC	2020-08-30	503656	5554556	636	Visual	Liz Barrett	eBird
Valley Trail to Rainbow Beach	2020-08-30	503656	5554556	636	Visual	Liz Barrett	eBird

Appendix I

Timing and Duration of Ice on Alta Lake, 1942 to 1976 and 2001 to 2020

Appendix J: Timing and Duration of Ice on Alta Lake, 1942-1976 and 2001-2020

	Ice-On		Ice-Off				
Winter	Date	Day Count	Date	Day Count	Days Frozen	Barrel	Notes
1942/43	1942-12-04	338	1943-04-19	109	136	No Data	
1943/44	1943-12-15	349	1944-04-13	104	120	No Data	
1944/45	1944-12-15	350	1945-04-27	117	133	No Data	
1945/46	**1945-11-08**	**312**	1946-04-20	110	**163**	No Data	
1946/47	1946-11-20	324	1947-04-13	103	144	No Data	
1947/48	1947-12-11	345	1948-05-07	128	148	No Data	
1948/49	1948-12-18	353	1949-04-19	109	122	No Data	
1949/50	1949-12-14	348	1950-04-24	114	131	No Data	
1950/51	1950-12-02	336	1951-04-19	109	138	No Data	
1951/52	1951-12-13	347	**1952-05-21**	**142**	160	No Data	
1952/53	1952-12-22	357	1953-05-08	128	137	No Data	
1953/54	1954-01-10	375	1954-05-05	125	115	No Data	
1954/55	1954-12-26	360	1955-05-07	127	132	No Data	
1955/56	1955-12-18	352	No Data	N/A	N/A	No Data	
1956/57	1956-12-01	336	1957-04-23	113	143	No Data	
1957/58	1957-12-26	360	1958-04-08	98	103	No Data	
1958/59	1958-11-26	330	1959-04-23	113	148	No Data	
1959/60	1959-12-05	339	1960-04-16	107	133	No Data	
1960/61	1960-12-10	345	1961-04-10	100	121	No Data	
1961/62	1961-12-01	335	1962-04-09	99	129	1962-04-21	
1962/63	No Data	N/A	**1963-03-23**	**82**	N/A	No Data	
1963/64	1963-12-13	347	1964-04-24	115	133	No Data	
1964/65	1964-12-11	346	1965-04-22	112	132	No Data	
1965/66	1965-12-12	346	1966-04-21	111	130	No Data	
1966/67	No Data	N/A	1967-04-30	120	N/A	No Data	
1967/68	1967-12-12	346	1968-04-27	118	137	No Data	
1968/69	1968-12-05	340	1969-05-07	127	153	No Data	
1969/70	**1970-01-15**	**380**	1970-04-06	96	**81**	No Data	
1970/71	1970-12-04	338	1971-05-06	126	153	No Data	
1971/72	1971-12-14	348	1972-05-02	123	140	No Data	
1972/73	1972-12-28	363	1973-04-11	101	104	No Data	
1973/74	1973-11-24	328	1974-04-28	118	155	No Data	
1974/75	No Data	N/A	No Data	N/A	N/A	No Data	
1975/76	1975-12-12	346	No Data	N/A	N/A	No Data	
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	2002-04-14	Barrel used as ice-off date.
2002/03	No Data	N/A	2003-03-17	76	N/A	2003-03-17	Barrel used as ice-off date.
2003/04	No Data	N/A	2004-03-25	85	N/A	2004-03-25	Barrel used as ice-off date.
2004/05	No Data	N/A	No Data	N/A	N/A	No Data	Data missing in Cascade (2015).
2005/06	**2006-01-06**	**371**	2006-03-08	67	61	No Data	
2006/07	**2006-11-30**	**334**	2007-04-10	100	131	No Data	
2007/08	2007-12-10	344	**2008-04-29**	**120**	**141**	2008-04-29	
2008/09	2008-12-20	355	2009-04-28	118	129	2009-04-29	
2009/10	2009-12-08	342	2010-03-28	87	110	2011-03-28	
2010/11	2010-12-04	338	2011-04-23	113	140	2011-04-23	
2011/12	No Data	N/A	2012-04-23	114	N/A	2012-04-23	Barrel used as ice-off date.
2012/13	2012-12-16	351	2013-04-03	93	108	2013-04-02	
2013/14	2013-12-21	355	2014-04-14	104	114	No Data	
2014/15	2014-12-26	360	**2015-02-20**	**51**	**56**	No Data	
2015/16	2015-12-24	358	2016-03-16	76	83	No Data	
2016/17	No Data	N/A	2017-04-24	114	N/A	2017-04-24	Barrel used as ice-off date.
2017/18	No Data	N/A	2018-04-10	100	N/A	No Data	
2018/19	2019-01-01	366	2019-04-12	102	101	No Data	
2019/20	2020-01-01	366	2020-04-16	107	106	No Data	

Note: "Barrel" date is the day the Alta Lake floats past Cypress Point. Barrel date was used for the following years in which it was the only ice-off data for winters 2001/02 through 2003/04, 2011/12, and 2016/17. The Ice-off and barrel dates are usually within two days of each other (Stephen Vogler via text, March 28, 2019).