Living Lakes CANADA

MARCH 2020

FLATHEAD RIVER BIOMONITORING PROGRAM

SUMMARY REPORT

Prepared by:

Kyle Prince, BSc, P.Biol

Raegan Mallison, BSc

Heather Leschied, BES

Living Lakes CANADA

Acknowledgements:

The following people are gratefully acknowledged for assistance and information contributions during this study:

Kari Stuart-Smith, Canadian Forest Products Ltd.

Erin Sexton, Flathead Lake Biological Station, University of Montana

Matthew Heller, Great Northern Landscape Conservation Cooperative, U.S. Fish and Wildlife Service

John Bergenske, Wildsight

Field team:

Ryland Nelson, Wildsight

Raegan Mallinson, Living Lakes Canada

Ryan van der Marel, Living Lakes Canada

Heather Leschied, Living Lakes Canada

Funding and in-kind contributions for this project were provided by:

Columbia Basin Trust

U.S. Fish and Wildlife Service

World Wildlife Fund - Canada

Living Lakes Canada

Wildsight

Columbia Basin Watershed Network in partnership with Selkirk College Selkirk Geospatial Research Centre

Title Page Photograph: Flathead River Valley, photo credit Heather Leschied

Abstract

The Canadian Flathead watershed located in southeastern British Columbia bordering Alberta and the United States is a part of the Crown of the Continent Ecosystem (CCE) and houses extremely high biodiversity and significant headwaters to several large freshwater systems. It holds vast amounts of natural resources, lies entirely within traditional Ktunaxa Nations territory, and currently has minimal environmental protection measures in place. It also offers a unique opportunity to observe the isolated effects of timber harvest practices on aquatic health because of its remote location and lack of other human developments. The Flathead River Biomonitoring Program collected benthic macroinvertebrate samples and water quality data in five tributaries in the Canadian Flathead River watershed between 2013 and 2017. The Canadian Aquatic Biomonitoring Network (CABIN) methodology developed by Environment and Climate Change Canada (ECCC) was utilized for field data collection and interpretation. Geomorphic Road Analysis Inventory Package (GRAIP) modeling was applied to estimate sediment delivery to each sub-basin, and Canadian Climate Normal data was acquired and displayed against weather from 2017 to demonstrate the extreme conditions experienced during the final sampling year. The sample site with no influence from timber harvest, FLT07 (Cate Creek), displayed potential signs of disturbance in 2017 yet this may be attributed to extreme weather conditions and large variations in stream flow. Other evidence present suggests Cate Creek's aquatic function remained intact, including a very high %EPT metric, in the face of environmental extremes. It is unclear whether the Cate Creek sub-watershed would display these signs of persistent stream health if it had any major anthropogenic disturbance on the landscape. Large, intact naturally functioning areas have been frequently recommended for resilience and adaptation to climate change (Bay et al. 2009) such as the Canadian Flathead watershed, specifically the Cate Creek sub-basin in this case. Other study sites with varying harvest levels displayed potential changes in hydrologic function based on the CABIN site assessment and community metrics, including site FLT06 (Howell Creek) and FLT04 (Flathead River). It is likely that some signs of potential stress are due to manipulated landscapes via roads and forestry activities; however, we are unable to state this without further information gathered. We recommend further research be conducted in this ecologically and culturally important area including monitoring focused around estimated sediment delivery sites (provided by the GRAIP analysis); more in-depth water chemistry, temperature, and flow monitoring techniques be utilized; continued use of CABIN protocol over a similar temporal period with an emphasis on climatic conditions; and including a fisheries component into the research. It is also recommended that some level of sustainable forest management occur to reduce the risk of extreme wildfire while still promoting greater protection for the Canadian Flathead watershed in alignment with the vision of the Ktunaxa Nation.

Table of Contents

Abstract **3**

1 Introduction **9**

1.1 Study Area 11

1.1.1 Watershed Physical Characteristics 11

1.1.2 First Nations Land use 11

1.1.3 Natural Resource Extraction 12

1.1.4 Study Sites 14

2 Methods **16**

2.1 Data Collection-CABIN 16

2.2 Data Analysis-CABIN 17

2.2.1 Reference Condition Approach- BEAST Analysis 17

2.2.2 Ordination Graphs and Confidence Ellipses 17

2.2.3 Probabilities and Errors 17

2.2.4 RIVPACS Analysis 18

2.2.5 Community Metrics 18

2.2.6 Water Chemistry 19

2.3 Geomorphic Road Analysis and Inventory Package (GRAIP) 20

2.4 Canadian Climate Normal (1981-2010) and Weather Data for 2017 20

3 Results **21**

3.1 CABIN Analysis Results 21

3.1.1 Overall Results 21

3.1.2 Reference Condition Approach- BEAST Analysis 21

3.1.3 Ordination Graphs and Confidence Ellipses 22

3.1.4 Probabilities and Errors 22

3.1.5 RIVPACS Analysis 22
3.1.6 Community Metrics 23
3.1.7 Water Chemistry Results 29
3.2 Geomorphic Road Analysis and Inventory Package (GRAIP) Results 30
3.3 Canadian Climate Normal (1981-2010) and 2017 Weather Data 31
4 Discussion 33
5 Conclusions and Recommendations 35
5.1 Conclusion 35
5.2 List of Recommendations 36
6 References 38

List of Figures

Figure 1-1- Historic Harvested Areas in Flathead watershed divided into sub-watersheds affecting study sites. 13

Figure 1-2-Harvested area during study years 2013-2017 in sub-watersheds potentially affecting study sites. 14

Figure 2-1-Heather Leschied performs kick at Flathead River Mainstem site (FLT04). Photo credit Raegan Mallinson. 16

Figure 2-2-Ryland Nelson collects dissolved oxygen sample at Howell Creek site (FLT06). Photo credit Raegan Mallinson. 19

Figure 3-1-Caddisfly at Cate Creek Site. Photo credit Heather Leschied. 23

Figure 3-2- Displays abundance of benthic macroinvertebrate samples over time at all sample sites..... 24

Figure 3-3- Displays Species Richness (different number of taxa observed) over sampling period (2013-2017) for all sites. 25

Figure 3-4-Displays the percentage of different functional feeding groups at site FLT04 (Flathead River) over the duration of the study. 26

Figure 3-5-Displays the percentage of different functional feeding groups at site FLT06 (Howell Creek) over the duration of the study. 27

Figure 3-6-Displays the percentage of different functional feeding groups at site FLT07 (Cate Creek) over the duration of the study. 27

Figure 3-7-Displays the percentage of different functional feeding groups at site FLT08 (Cauldry Creek) over the duration of the study. 28

Figure 3-8-Displays the percentage of different functional feeding groups at site FLT09 (Sage Creek) over the duration of the study 28

Figure 3-9-Displays estimated cumulative GRAIP values for Reaches in Flathead Watershed study area including each sub-watershed where test sites occurred. Units are in $Kg/Km^2/Year$..... 31

Figure 3-10-Displays Canadian Climate Normal (1981-2010) compared to Weather data in 2017 from the Fernie weather station approximately 35 km Northwest of the study area. 32

F**igure 3-11**- Flathead River. photo credit Heather Leschied 32

List of Tables

Table 1-1-Displays harvest totals in hectares for each sub-watershed affecting the study sites, over a historic period (1959-2012) and over the duration of the biomonitoring study (2013-2017) 13
Table 1-2-Displays each site and its basic characteristics. Note most values are averages between sites that were sampled within the same reach over the duration of the study 15
Table 2-1 Detailed information for Climate Station used to display Canadian Climate Normal, and Weather Data for 2017. 20
Table 3-1-CABIN Analytical results on site assessment, displays sites FLT04, FLT06, FLT07, FLT08, and FLT09 across sampling years 2013-2017. Green indicates no disturbance and the site appears equivalent to the reference groups, yellow indicates potentially mild disturbance. 22
Table 3-2-RIVPACS analysis results for all sites and all years of sampling. Shows RIVPACS Observed:Expected ratio of taxa at test sites. CABIN Site assessment condition is colour-shaded relative to results in table 3-1 .. 23
Table 3-3-Displays the % of organisms present at each site that fall within the EPT families across all sampling years..... 25
Table 3-4-Displays a quick view of BC government aquatic health guidelines ranges and maximums. See document for full information 29
Table 3-5-Water chemistry and air temperature data for all sites over all sampling years. Note FLT09 was not sampled in 2013..... 30

List of Appendices

Appendix A- CABIN Data Analysis Results 43
Appendix B-CABIN Database Site Assessment Reports 45
Appendix C- Map Resources 146

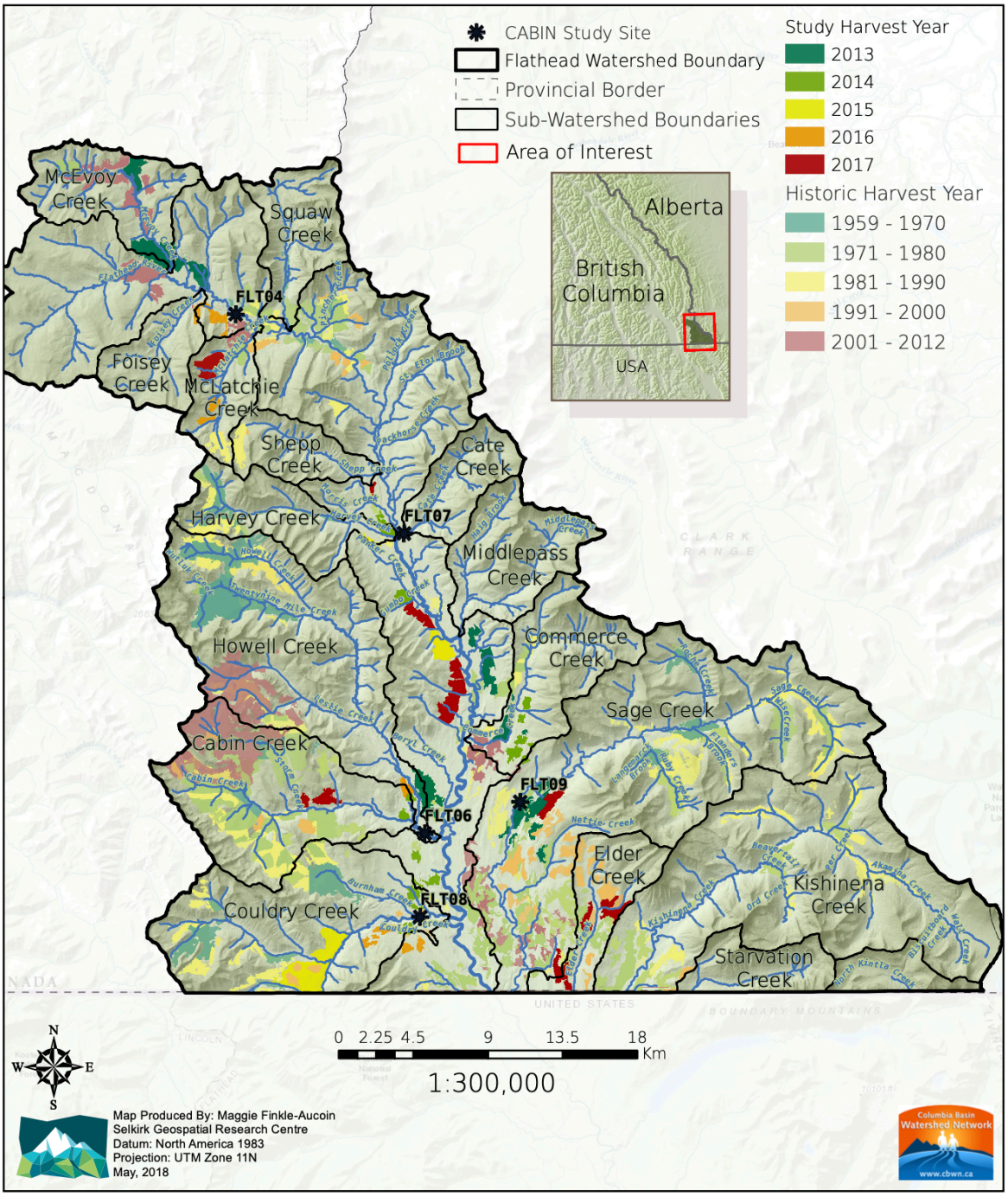


***Figure 1-0**- Map of Flathead River watershed, Canadian portion. Includes each study site FLT04, FLT06, FLT07, FLT08, and FLT09 which were sampled each year from 2013-2017*

1 Introduction

The Flathead River is a trans-boundary tributary of the Columbia River, flowing from the Canadian Rocky Mountains south into Montana. The Canadian Flathead watershed is a wilderness area located in South-eastern British Columbia bordering Alberta and the United States. The entire Canadian portion of this watershed area lies within traditional Ktunaxa Nations territory and has a long history of indigenous use (Birdstone, V. 2010). It supports high levels of species diversity, a large variety of vegetation, and high-quality water which eventually flows into the United States. The Canadian Flathead River watershed is the Northwest section of a larger landscape titled the Crown of the Continent Ecosystem (CCE) which is an approximately 18 million-acre ecosystem stretching from the Continental Divide between British Columbia, Alberta, and Montana (see Appendix C). This system is significant because it includes the headwaters of three extensive continental river systems (Columbia, Missouri/Mississippi, and Saskatchewan) along with notable ecological importance (Hauer and Sexton 2010). The Flathead River watershed is known for supporting habitat connectivity, extremely high biodiversity, and a complete array of major carnivore and ungulate species including the highest density of grizzly bears (*Ursus arctos*) in interior North America (Weaver et al. 2001). This area also harbours abundant and diverse aquatic life and provides critical habitat for bull trout (*Salvelinus confluentus*), non-hybridized westslope cutthroat trout (*Oncorhynchus clarkia lewisi*), and many other fish species (Hauer and Sexton 2010). These qualities provide the watershed with a high level of resiliency towards the uncertain future of climate change (Bay et al. 2009).

Approximately 40% of watershed lies in B.C. with the other 60% in Montana where it is known as the “North Fork” of the Flathead River. The North Fork is protected by a national “Wild and Scenic River” classification, and is within the Waterton-Glacier International Peace Park, United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site, and International Biosphere Reserve (Hauer and Sexton 2010). This internationally shared watershed with relatively pristine headwaters in Canada holds great importance in the U.S. and has naturally attracted a lot of conservation interest from a variety of groups in the United States and Canada. Significant research has been conducted by the University of Montana via the Flathead Lake Biological Station along with various other entities including the State of Montana Fish and Game, National Park Service, Glacier National Park, and the U.S. Forest Service in the Flathead National Forest.

The area is rich in natural resources, including large stands of mature timber and a vast untapped reserve of coal similar to the adjacent Elk valley near Fernie, B.C. With the exception of the Akamina-Kishinena

Provincial Park which encompasses 109 km^2 (BC Parks [accessed 2019]), the Canadian Flathead has been officially unprotected until very recently. In 2010 with mounting pressure for a large mining development, and conversely increasing advocacy from conservationists and First Nations, the British Columbia Government passed the "Flathead Watershed Area Conservation Act" which halted all mining and exploration. Although this legislative move supports conservation efforts in the watershed, the limited protection offered by the legislation does not correlate with the area's substantial ecological and cultural importance. Conservation groups and First Nations are continuing to promote increased protection for the Flathead Valley that aligns with the vision of the Ktunaxa Nation.

The Canadian Flathead watershed offers a unique opportunity to observe the isolated effects of timber harvest practices on aquatic health because of its remote location and lack of other human developments. The Flathead River Biomonitoring Program collected benthic macroinvertebrate samples, the community of organisms that live in the substrates along the bottom of a river or stream, and water quality data in five tributaries in the Canadian Flathead River watershed between 2013 and 2017. The project explored the ecological and functional relationships between the landscape of an unpopulated, but commercially logged catchment by investigating spatial and temporal trends in the benthic invertebrate communities. The intent of the project was to examine the aquatic health of five different sub-basins, one of which had no previous logging activity, to observe any effects on benthic macroinvertebrates and their community composition at each site over the five-year period, in an effort to support landscape conservation and improve resource management in the watershed.

The methodology applied for field data collection and interpretation is the Canadian Aquatic Biomonitoring Network (CABIN) method developed by Environment and Climate Change Canada. Biomonitoring is a powerful tool used to assess environmental health, it is a systematic use of living organisms or their response to determine the quality of the environment (Rosenberg et al. 1997). Benthic macroinvertebrates are excellent indicators of aquatic health because they are ubiquitous, highly diverse, can be associated with pollution tolerance, are relatively long lived, and they exhibit high site fidelity (Mandaville 2002). They also play an important role in food webs, are major players in energy transfer, and are a key food source for many species of freshwater fishes (Harrison et al. 2007). The use of benthic macroinvertebrates in biodiversity studies of freshwater systems is supported by the extensive background knowledge available for them (Rosenberg et al. 1997). Assessing stream health based on these organisms provides a temporally integrated measure of ecosystem health compared to a "snapshot" given from physical and chemical assessments (Carter et al. 2006). The benthic macroinvertebrate communities in the Transboundary Flathead River

watershed are acknowledged as being extremely diverse (Hauer and Sexton 2010) making them excellent candidates for indicators of aquatic health.

1.1 Study Area

1.1.1 Watershed Physical Characteristics

The Canadian portion of the Transboundary Flathead watershed flows from British Columbia, southwards for approximately 50 km. It occupies 1570 km^2 of land with mountain ranges on either side varying from 3000m to 2300m in elevation. Its large undeveloped valley bottoms range from 4-10km wide and provide crucial wildlife habitat (Weaver 2001). This important habitat is home to an impressive assemblage of mammals and a full suite of carnivores including iconic animals like the grizzly bear (*Ursus arctos*), wolf (*Canis lupus*), and wolverine (*Gulo gulo*) (Weaver 2001). There is also many species of ungulates including moose (*Alces alces*), elk (*Cervus elaphus*), white-tailed deer (*Odocoileus virginanus),* mule deer (*O. hemionus*), bighorn sheep (*Ovis canadensis*), and mountain goat (*Oreamnos americanus*) (Weaver 2001). The generally high-quality water also provides habitat for important fish species (Hauer and Sexton 2010). The Flathead watershed is a range-wide stronghold for bull trout (*Salvelinus confluentus*) and non-hybridized westslope cutthroat (*Oncorhynchus clarkia lewisi*) providing connected coldwater habitats to complete their life cycles (Jones et al. 2014) (D'Angelo et al. 2014). It is notable that grizzly bear, wolverine, and bull trout have provincial status as species of "special concern" (Government of British Columbia 2019) and internationally these three species are designated as threatened (US Fish and Wildlife Service 2019). There is an extremely high diversity of benthic macroinvertebrates present in the streams (Hauer and Sexton 2013) and two species of stonefly exclusively found in Glacier National Park's high alpine streams were recently designated as "threatened" in the United States Species at Risk Act (Scott 2019) (U.S. Fish and Wildlife Service 2019). The diverse vegetation in the watershed is described in detail by (Weaver 2001) who outlines information provided by (Habeck 1970, Singer 1979, and Jenkins 1985). The Flathead watershed hosts diverse communities of vegetation where floodplains are dominated by cottonwood (*Populus trichocarpa*), spruce (*Picea spp*.), and willow (*Salix spp*.); coniferous forests of lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), spruce, and subalpine fir (*Abies lasciocarpa*) dominate the upland areas.

1.1.2 First Nations Land use

The Canadian Flathead watershed lies within the traditional territory of the Ktunaxa Nation, which includes Kinbasket peoples ("Ktunaxa"). Of the six bands, four are located in British Columbia and two are in the

United States. The Canadian First Nations communities that make up the Ktunaxa are the ?Akisqnuk First Nation, Tobacco Plains Indian Band (?akinkumasnuqit), St. Mary's Band (?Aq'am), and Lower Kootenay Band (Yaqan Nukiy). The two bands residing in the United States are Bonners Ferry Band (?akankminik) who are located in Northern Idaho, and the Elmo Montana Band (ksanka) members who were moved onto the Confederated Salish Kootenai Tribe by the U.S. government in 1855 from the Jennings, Montana area (Birdstone, V. 2010). The Indian Reserve lands of the Tobacco Plains Band lie closest to the watershed. There are archeological records supporting indigenous history, going back at least ten to twelve thousand years, demonstrating the long-term connection with the landscape (Birdstone, V. 2010). The Ktunaxa traditionally followed a nomadic seasonal subsistence movement cycle determined by the location, timing, and abundance of a broad range of animal and plant resources. The people traveled extensively in the greater area including through the Flathead valley, hunting, trapping, fishing, and harvesting vegetation (SRMP 2003). The Ktunaxa are reviving their involvement in the land by increasing collaboration with the British Columbia Government on management plans and environmental issues.

1.1.3 Natural Resource Extraction

The Canadian Flathead watershed lacks any municipal development with human influence limited to forestry, mining remnants, and recreational activities including OHV use, back-country camping, hunting and fishing. Mining activity in the Flathead has been relegated to the past, with the successful implementation of the "Flathead Watershed Area Conservation Act" in 2010. Historically, there has been some mining activity and exploration but no major operations like the neighbouring Elk Valley near Fernie, B.C.

Commercial Forestry is the main anthropogenic activity influencing the Canadian Flathead watershed. It has been ongoing since the mid-twentieth century. Harvest totals in Hectares are reported below for each sub-watershed corresponding to a sample site. Below in Table 1-1 forest harvest area totals are provided for a historic timeline (1952-2012), and while the study took place (2013-2017). These values are also displayed in Figure 1-1 and 1-2 respectively. In both presentations it is clear that FLT07 (Cate Creek) has not had any harvest, while historically FLT06 (Howell Creek) and FLT09 (Sage Creek) have experienced the highest amounts. During the study period FLT08 (Cauldry Creek) is highest followed by FLT09 (Sage Creek). Forest harvest data was provided by Canadian Forest Products Ltd. (Canfor).

Table 1-1*-Displays harvest totals in hectares for each sub-watershed affecting the study sites, over a historic period (1959-2012) and over the duration of the biomonitoring study (2013-2017)*

Total Harvest Area (Ha)		
Sub-watersheds	Historic (1959-2012)	During Study (2013-2017)
FLT04-Flathead River	746	333
FLT06-Howell Creek	8527	352
FLT07-Cate Creek	0	0
FLT08-Cauldry Creek	1932	810
FLT09-Sage Creek	5328	559

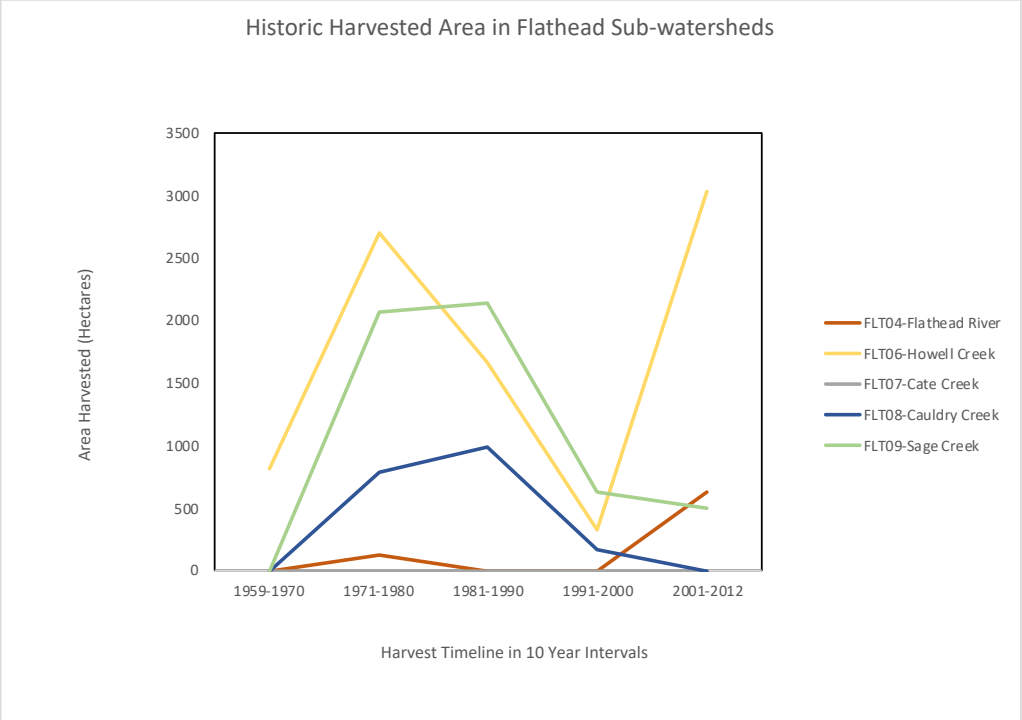


Figure 1-1*- Historic Harvested Areas in Flathead watershed divided into sub-watersheds affecting study sites.*

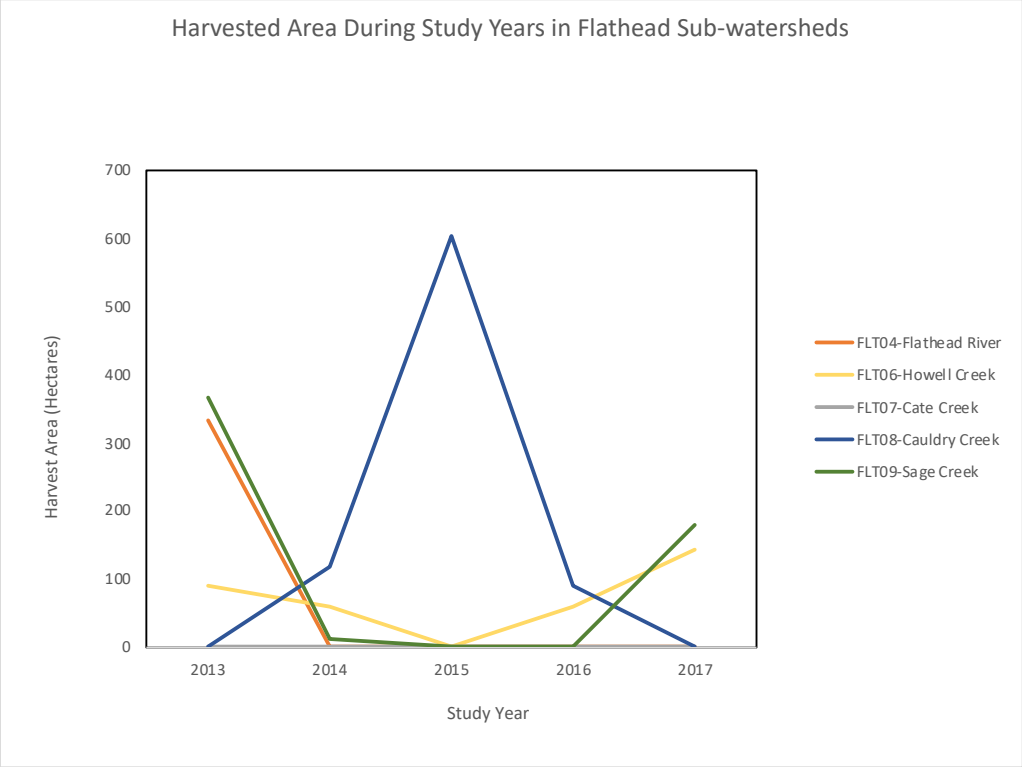


***Figure 1-2**-Harvested area during study years 2013-2017 in sub-watersheds potentially affecting study sites.*

1.1.4 Study Sites

Four study sites were initially selected, and after the first sampling year an additional site was added for a total of five study sites monitored in the Canadian Flathead watershed over the remainder of the study period. Each study site was situated near the downstream limit of a sub-watershed exposing them to all cumulative influences that may occur in that system, with the exception of FLT04 which was on the mainstem of the river, located far upstream closer to the headwaters (see Figure 1-0 above, or detailed maps for each site in Appendix C). Listed below in Table 1-2, is key information regarding location, stream size, stream flow, and habitat characteristics for each study site. Stream order, average channel depth, and the difference between bankfull width and wetted width indicate approximate water levels at each study site. This table's

values are averages for the five sets of measurements that were taken over the duration of the study within the same reach for each site. Each year's individual values can be found in the Appendix B.

Table 1-2*-Displays each site and its basic characteristics. Note most values are averages between sites that were sampled within the same reach over the duration of the study*

Site	FLT04	**Name**	Flathead River
Basin	Flathead	**Ecoregion**	Northern Continental Divide
Latitude	49.3673889	**Longitude**	-114.6855278
Altitude (m)	1514	**StreamOrder**	5
CH-Depth-Avg (cm)	21.78	**CH-Velocity-Avg (m/s)**	0.558
CH-Width-Bankfull (m)	19.9	**CH-Width-Wetted (m)**	13
SU-%Bedrock (%)	0	**SU-%Pebble (%)**	23.2
SU-%Boulder (%)	7.2	**SU-%Sand (%)**	0
SU-%Cobble (%)	63.8	**SU-%Silt+Clay (%)**	1.8
SU-%Gravel (%)	4	**SU-Embeddedness**	4

Site	FLT06	**Name**	Howell Creek
Basin	Flathead River	**Ecoregion**	Northern Continental Divide
Latitude	49.0864722	**Longitude**	-114.5293611
Altitude	1103	**StreamOrder**	5
CH-Depth-Avg (cm)	26.4	**CH-Velocity-Avg (m/s)**	0.664
CH-Width-Bankfull (m)	18.8	**CH-Width-Wetted (m)**	15.2
SU-%Bedrock (%)	0	**SU-%Pebble (%)**	22.6
SU-%Boulder (%)	8	**SU-%Sand (%)**	0
SU-%Cobble (%)	67	**SU-%Silt+Clay (%)**	0.4
SU-%Gravel (%)	2	**SU-Embeddedness**	4

Site	FLT07	**Name**	Cate Creek
Basin	Flathead River	**Ecoregion**	Northern Continental Divide
Latitude	49.2490556	**Longitude**	-114.5461389
Altitude	1382	**StreamOrder**	3
CH-Depth-Avg (cm)	11.46	**CH-Velocity-Avg (m/s)**	0.82
CH-Width-Bankfull (m)	28.48	**CH-Width-Wetted (m)**	4.2
SU-%Bedrock (%)	0	**SU-%Pebble (%)**	48.4
SU-%Boulder (%)	1.4	**SU-%Sand (%)**	0
SU-%Cobble (%)	43.6	**SU-%Silt+Clay (%)**	1.2
SU-%Gravel (%)	5.4	**SU-Embeddedness**	4

Site	FLT08	**Name**	Cauldry Creek
Basin	Flathead River	**Ecoregion**	Northern Continental Divide
Latitude	49.0408333	**Longitude**	-114.5345556
Altitude	1272	**StreamOrder**	4
CH-Depth-Avg (cm)	22.16	**CH-Velocity-Avg (m/s)**	0.72
CH-Width-Bankfull (m)	12	**CH-Width-Wetted (m)**	9.42
SU-%Bedrock (%)	0	**SU-%Pebble (%)**	28.2
SU-%Boulder (%)	5.2	**SU-%Sand (%)**	0
SU-%Cobble (%)	63.2	**SU-%Silt+Clay (%)**	1.4
SU-%Gravel (%)	2	**SU-Embeddedness**	4

Site	FLT09	**Name**	Sage Creek
Basin	Flathead River	**Ecoregion**	Northern Continental Divide
Latitude	49.0954167	**Longitude**	-114.4564167
Altitude	1283	**StreamOrder**	3
CH-Depth-Avg (cm)	20.78	**CH-Velocity-Avg (m/s)**	0.46
CH-Width-Bankfull (m)	20.8	**CH-Width-Wetted (m)**	15.55
SU-%Bedrock (%)	0	**SU-%Pebble (%)**	39.75
SU-%Boulder (%)	5	**SU-%Sand (%)**	0
SU-%Cobble (%)	51	**SU-%Silt+Clay (%)**	1.75
SU-%Gravel (%)	4	**SU-Embeddedness**	5

2 Methods

2.1 Data Collection-CABIN

Collecting data on benthic macroinvertebrates, habitat, and water quality was achieved using the Canadian Aquatic Biomonitoring Network (CABIN) techniques, following the CABIN Field Procedures for Wadeable Streams protocol (Environment Canada 2012a). The Living Lakes Canada field team was trained and certified in the CABIN field methodology by Environment and Climate Change Canada (ECCC) staff. Each site was monitored annually in the late summer/early fall, in the same reach year to year, and benthic macroinvertebrate samples were then examined by an approved taxonomist following the CABIN laboratory methods (Environment Canada 2012b). Pina Vola, Benthic Macroinvertebrate Taxonomist from Surrey, B.C. was contracted to examine all of the samples collected. All data collected has been entered online into the ECCC national CABIN database where site assessment and data analysis tools were later utilized for this report.

Figure 2-1*-Heather Leschied performs kick at Flathead River Mainstem site (FLT04). Photo credit Raegan Mallinson.*

2.2 Data Analysis-CABIN

2.2.1 Reference Condition Approach- BEAST Analysis

The CABIN system uses the Reference Condition Approach (RCA) as the base for its study design (Reynoldson et al. 1999). The "reference condition" is defined by a representative group of minimally disturbed sites organized by selected physical, chemical, and biological characteristics (Rosenberg et al. 1999). This approach captures the natural variation of benthic macroinvertebrate communities caused by environmental factors and develops expected communities based on those results. Its beneficial because once established any test site suspected to have environmental disturbance can be compared to the appropriate subset of reference sites (Rosenberg et al. 1999). CABIN uses the BEnthic Assessment of SedimenT (BEAST) model to evaluate which group of reference sites are most appropriate to compare to the test site in question. It then evaluates how the test site compares to the chosen group of reference sites. The ultimate goal of the BEAST assessment is to understand whether the test site is in reference condition or not (Environment Canada 2012e). The results from comparing test sites to reference groups is relayed by deeming a test site as; similar to reference, mildly divergent, divergent, or highly divergent. Increased divergence indicates higher predicted environmental stress.

2.2.2 Ordination Graphs and Confidence Ellipses

The BEAST assessment uses a graphical display of the expected and observed communities with three multivariate axes to represent all benthic data (Sylvestre et al. 2005). The degree of stress is represented by the location of the test site community on the plot relative to the cloud of predicted reference site communities. Confidence ellipses surrounding the reference sites (90%, 99%, and 99.9%) are drawn on the ordination to depict four categories of stress which are similar to reference, potentially stressed, moderately stressed, and severely stressed (Sylvestre et al. 2005). The further the test site lies from the cloud of reference sites the higher predicted environmental stress.

2.2.3 Probabilities and Errors

Error rates represent the likelihood of a reference site not sorting to the proper group, this number is determined during the model building process. The error values are the same for each site that is analyzed. Probabilities refer to the probability of each test site sorting into each group based on habitat. These numbers can confirm that an assigned group for each test site has the highest probability by a large enough

margin. This would be important when encountering close probability values where similar values may indicate further efforts are required to describe more habitat characteristics at the test site (Environment Canada 2012e).

2.2.4 RIVPACS Analysis

The River InVerterbrate Prediction and Classification System (RIVPACS) is used to demonstrate which benthic macroinvertebrate taxa were expected to be identified at the test site, and which taxa were actually observed (Environment Canada 2012e). Based on key physical characteristics of the test site, RIVPACS offers specific predictions of what benthic macroinvertebrates should be expected in the absence of major environmental disturbances (Wright et al. 2000). The assessment of biological condition is then gathered from comparing expected organisms versus organisms present (Wright et al 2000). If the organisms you expect to see are not observed then is it assumed that there is some form of environmental disturbance occurring at the test site. The important results from a RIVPACS analysis are the observed to expected ratios (O:E), generally a lower value indicates poor condition while a ratio close to 1 indicates good condition. Very high values can also suggest an enriched community or biodiversity hot spot (Environment Canada 2012d).

2.2.5 Community Metrics

The metrics tool provided by the CABIN database allows further summarization of test site results and offers insight into macroinvertebrate community descriptions such as species abundance, richness, and community composition. This last element can be a helpful addition to an argument for site stress level because it outlines what percent of pollution tolerant or intolerant taxa were present. Describing community structure and function can be helpful to identify environmental disturbance (Environment Canada 2012d). The metrics summary is limited because it does not establish natural variation in a community composition, therefore can only provide descriptions of the community (Environment Canada 2012e). Generally, the more environmental disturbance that occurs at a site the greater the alteration in the benthic macroinvertebrate communities' structure. The organisms living in these altered aquatic environments have adapted to those altered conditions and therefore the traits present at a site will reflect the level of disturbance (Guimaráes, RM. Et al, 2009).

Benthic macroinvertebrate abundance can be an indicator of aquatic health, often changes in abundance to taxa occur in response to stress (Wright et al. 2000). It is generally accepted that higher species richness or

higher diversity is a indicator of community health (Sylvestre et al. 2005). The Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa have been used extensively throughout North America as indicators of stream environmental condition (Hauer and Sexton 2010). They are known to be very sensitive to organic pollution, and the decreased percent composition of these sensitive insect orders can be an indicator of toxic stress (Sylvestre et al. 2005). The functional feeding groups (FFG) is a classification of organisms based on physical traits, and behavioral characteristics exhibited to collect food and different particle sizes (Madomguia et al. 2016). These organisms have adapted to a specific environment and increased environmental disturbance often leads to changes in FFG composition (Guimaráes, RM. Et al, 2009).

2.2.6 Water Chemistry

Water chemistry results have been compiled and examined using the British Columbia Approved Water Quality Guidelines for Aquatic Life, Wildlife, and Agriculture Summary Report (2019) as a reference to check for any indication of potential issues. The water chemistry parameters collected align with the CABIN protocol. Due to limited sample holding times and the remote nature of the sample sites, no additional parameters were collected. Information from the water chemistry data is limited because it was not collected over a large temporal scale offering just a glimpse of current conditions while benthic sampling occurred.

Figure 2-2*-Ryland Nelson collects dissolved oxygen sample at Howell Creek site (FLT06). Photo credit Raegan Mallinson.*

2.3 Geomorphic Road Analysis and Inventory Package (GRAIP)

This analysis was developed by the United States Department of Agriculture and United States Forest Service, and is designed to understand the impacts of road systems with erosion and sediment delivery to streams. GRAIP is a detailed road inventory process and modeling toolset for understanding various site-specific impacts of forest roads on water quality (Rocky Mountain Research Station, accessed 2019). GRAIP estimates the amount of sediment generated for each road segment by applying a modified base erosion rate with road slope, segment length, flow path vegetation, and road surface type (Reaser FP. 2016). The GRAIP results focused on in this study are estimates of sediment delivery to streams measured in $Kg/km^2/year$, determined for each sub-watershed that directly affects the corresponding sample site.

The analysis was performed by Matthew Heller, Data Manager, GIS Administrator, and Cartographer with the Great Northern Landscape Conservation Cooperative, housed within the U.S. Fish and Wildlife Service.

2.4 Canadian Climate Normal (1981-2010) and Weather Data for 2017

Climate and weather data were extracted from the Government of Canada's Historical Climate Data Archive for the Fernie, B.C. weather station which lies approximately 35km northwest of the study area (Government of Canada [accessed 2019]). See table 2-1 below for exact weather station information:

Table 2-1 *Detailed information for Climate Station used to display Canadian Climate Normal, and Weather Data for 2017.*

Station Name	Province	Station ID
Fernie	BC	1152850
Latitude	**Longitude**	**Elevation**
49°29'19.400" N	115°04'23.900" W	1001.0 m

Precipitation and temperature data have been compiled over a thirty year period (1981-2010) to achieve what is considered a climate normal for the area. Temperature and precipitation for 2017 have been included in the graph in the results section to demonstrate the extreme weather experienced that year.

3 Results

3.1 CABIN Analysis Results

3.1.1 Overall Results

Based on the CABIN analytical tool's results, all test sites show little overall impairment. This suggests environmental disturbance is minimal or below an observable threshold to display major effects on the benthic macroinvertebrate ecosystem. There are some shifts and variation for site assessment and community metrics over study years that suggest some environmental stress along with one large change at one study site however, no absolute conclusions can be reached without further research.

3.1.2 Reference Condition Approach- BEAST Analysis

The reference model used in the RCA analysis was the Preliminary Okanagan-Columbia Reference Model (2010) provided in the CABIN database. The model is noted to be preliminary, meaning caution must be taken regarding its conclusions of site assessments. The CABIN BEAST tool determined that the highest probability for reference group membership at all sites, in all years was group three (see Table 3-1). Therefore, all sites were predicted to and compared to group three. Overall, based on Table 3-1 below, none of the test sites displayed signs of environmental stress in the first two years of sampling (2013, 2014) where every site was deemed in "reference condition". Note the site assessment descriptor and the colours in Table 3-1 display the results. Green is in reference condition/unstressed, and yellow indicates mildly divergent/potentially stressed. Generally, site condition experienced a mild downward trend across all sites, except FLT08 which did not exhibit any level of stress according to this assessment. Over the next 3 years the other study sites display "mildly divergent" at some point but in some instances such as FLT09 and FLT06 their state returns to "reference condition" the following year. FLT04 and FLT07 both end with "mildly divergent" results, due to the temporal restriction of the study it is unclear whether they continue a downward trend or recover. It is noteworthy that FLT04 displays three consecutive years of "mildly divergent" results perhaps indicating a consistent form of disturbance present. Mildly divergent indicates "potentially stressed" according to the CABIN results, leaving uncertainty towards the degree of environmental stressors that may be present.

Table 3-1-*CABIN Analytical results on site assessment, displays sites FLT04, FLT06, FLT07, FLT08, and FLT09 across sampling years 2013-2017. Green indicates no disturbance and the site appears equivalent to the reference groups, yellow indicates potentially mild disturbance.*

	2013	2014	2015	2016	2017
FLT04	Reference Condition	Reference Condition	Mildly Divergent	Mildly Divergent	Mildly Divergent
Probability	94%	94%	94%	94%	94%
FLT06	Reference Condition	Reference Condition	Reference Condition	Mildly Divergent	Reference Condition
Probability	87%	87%	86%	86%	86%
FLT07	Reference Condition	Reference Condition	Reference Condition	Reference Condition	Mildly Divergent
Probability	75%	77%	77%	77%	78%
FLT08	Reference Condition	Reference Condition	Reference Condition	Reference Condition	Reference Condition
Probability	86%	87%	85%	86%	86%
FLT09	N/A	Reference Condition	Mildly Divergent	Reference Condition	Reference Condition
Probability	N/A	84%	84%	84%	85%

3.1.3 Ordination Graphs and Confidence Ellipses

Ordination graphs featuring confidence ellipses can be found for every site, and each study year in the Appendix B. They were not included here because the same results are more concisely displayed in Table 3-1 above.

3.1.4 Probabilities and Errors

The error value as explained in section 2.2.3 is the same for all sites in regards to the reference group 3, which is pre-determined in model development. In Australia and the United Kingdom acceptable error rates for river assessments range from 25-30% (Environment Canada 2012d). In the model used to analyze this data the error rate reads 22.2% for group 3 (See site data in Appendix B). All probabilities for correct reference group comparison are unquestionably high for group 3, for all sites with values from 75% up to 94% (see Table 3-1 above). This leaves little doubt that the assigned reference group 3 is the best fit for each site giving higher confidence in each site's disturbance level assessment.

3.1.5 RIVPACS Analysis

The RIVPACS Observed:Expected (O:E) ratios are summarized in Table 3-2 below, these are based on a probability of > 70% of occurrence at reference sites. The CABIN site assessment conditions are also reflected in this table from colour-shaded backgrounds, as seen above in Table 3-1. The RIVPACS ratios are generally very high across all sites with the exception of FLT07 in 2017 where it is 0.87. In the first two years every site is > 1.00 which can indicate little to no environmental stress and a potential biodiversity hot spot

(Environment Canada 2012d). Overall the values seem to reflect the general trend where initial sample years demonstrate highly undisturbed sites, but then begin to show increasing potential disturbance levels during later sampling years. FLT04 and FLT07 demonstrate this trend best because the last sample year reported them as "mildly divergent/potentially stressed" along with decreased RIVPACS ratios, including the lowest ratio in the entire dataset.

***Table 3-2**-RIVPACS analysis results for all sites and all years of sampling. Shows RIVPACS Observed:Expected ratio of taxa at test sites. CABIN Site assessment condition is colour-shaded relative to results in table 3-1*

RIVPACS O:E (p > 0.7)					
Site	**2013**	**2014**	**2015**	**2016**	**2017**
FLT04-Flathead River	1.05	1.05	1.05	0.95	0.95
FLT06-Howell Creek	1.05	1.05	1.05	1.05	1.05
FLT07-Cate Creek	1.06	1.06	0.96	0.96	0.87
FLT08-Cauldry Creek	1.05	1.05	0.96	1.05	1.05
FLT09-Sage Creek	N/A	1.05	1.05	1.05	0.96

3.1.6 Community Metrics

It is important to note that community metrics provided by the CABIN database cannot be compared across sites but only over time within one site using replicate samples. This is because earlier site assessment tools provided by CABIN account for natural variation while community metrics do not (Environment Canada 2012e).

***Figure 3-1**-Caddisfly at Cate Creek Site. Photo credit Heather Leschied.*

Abundance across nearly all sites increased over time to peak in 2015, afterwards lowering to an average level in 2017 (see Figure 3-2 below). The study year 2015 appears to be an excellent abundance year for benthic macroinvertebrate production at all sites except FLT08 (Cauldry Creek) which increases the following two sampling years. FLT07 (Cate Creek) is noteworthy, demonstrating the greatest fluctuations of all the sites. These drastic changes reflect the volatility of the habitat, as it is the smallest sample site experiencing the greatest seasonal changes (See Table 1-2 in section 1.1.4 for site information).

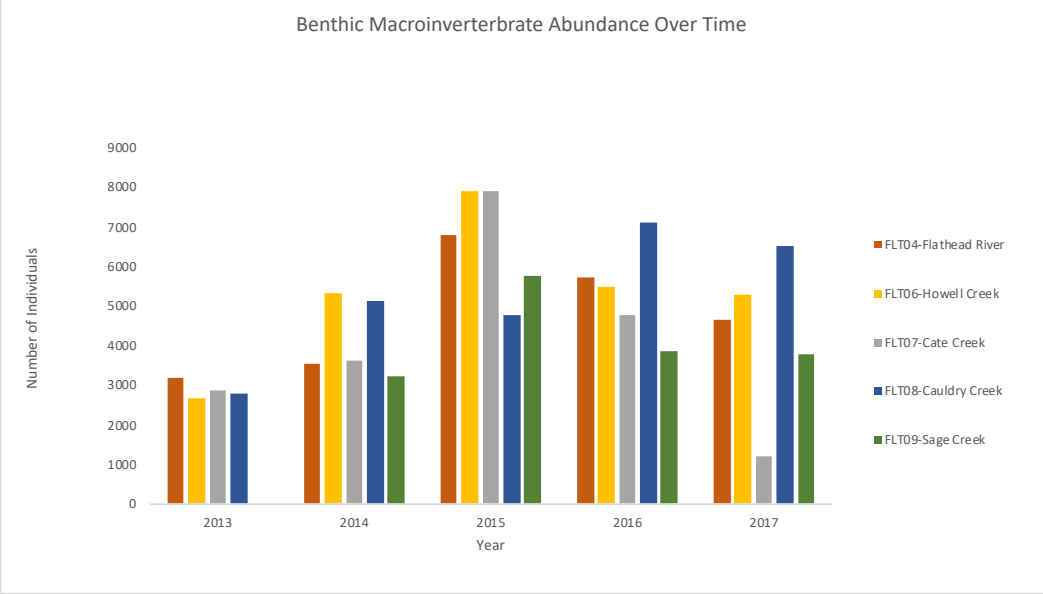


***Figure 3-2**- Displays abundance of benthic macroinvertebrate samples over time at all sample sites*

Generally, higher diversity is an indicator of a healthier community (Sylvestre et al. 2005). Species richness across all the study sites remains relatively even with small changes between years (see Figure 3-3 below). Cate Creek (FLT07) experiences the lowest species richness and greatest fluctuation throughout the sampling period which once again is likely a result of drastic changes in site condition between sampling years.

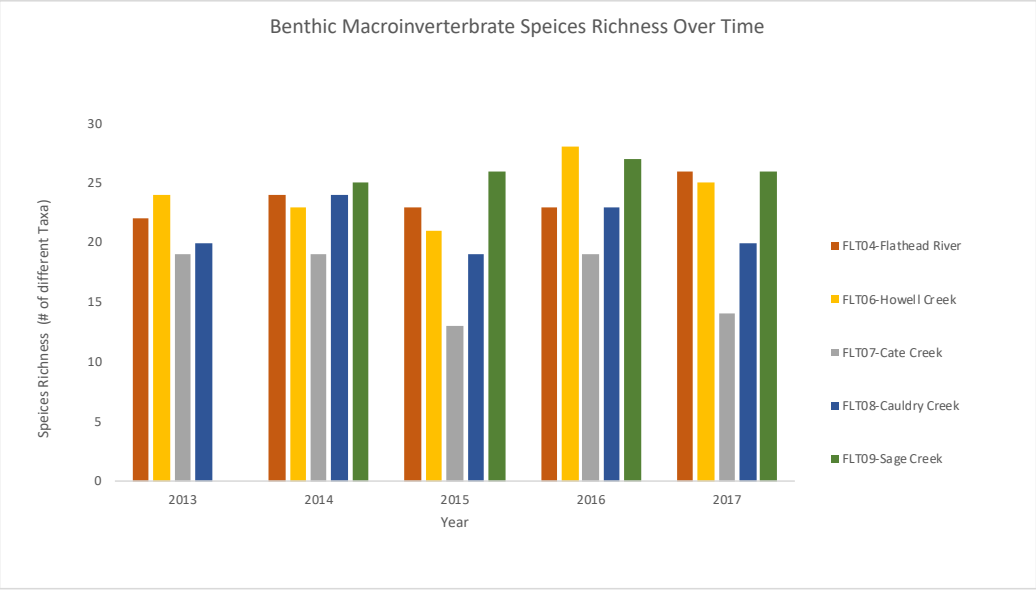


***Figure 3-3**- Displays Species Richness (different number of taxa observed) over sampling period (2013-2017) for all sites.*

The Ephemeroptera, Plecoptera, and Trichoptera taxa (EPT) are recognized across the biomonitoring field as key indicators of stream and river ecosystem health (Hauer and Sexton 2010). In the Flathead study results there is generally a high percentage of EPT individuals at each site with some notable changes between study years. Notice that FLT04 and FLT06 experience significant drops in %EPT over the sampling time period going from 73%-35% and 85%-59% respectively(see Table 3-3 below) (standard deviation is 12%, see Appendix B). These substantial decreases in %EPT taxa could represent a decline in water quality not captured by the abundance or richness metrics displayed previously. FLT08 (Cauldry Creek) and FLT09 (Sage Creek) demonstrate fluctuations however, they seem to show signs of equalization or slow recovery. Meanwhile FLT07 (Cate Creek) stays at an incredibly high percent of EPT individuals through the entire duration of the study (See Table 3-3 below) indicating the highest water quality and aquatic health of all sites based on this metric.

***Table 3-3**-Displays the % of organisms present at each site that fall within the EPT families across all sampling years*

% EPT Individuals					
Study Site	**Sampling Year**				
	2013	**2014**	**2015**	**2016**	**2017**
FLT04-Flathead River	72.64	61.99	43.32	43.15	35.23
FLT06-Howell Creek	84.95	60.82	75.70	65.03	58.92
FLT07-Cate Creek	98.26	92.01	98.73	97.65	98.24
FLT08-Cauldry Creek	94.66	83.38	89.49	77.23	79.64
FLT09-Sage Creek	N/A	80.68	64.84	80.95	78.04

The Functional Feeding Groups (FFG) are displayed below between Figures 3.4-3.8 for each sample site over the entire sampling period. Overall, the Flathead watershed sample sites exhibit relatively stable FFG compositions with no major trends or indication of shifts. Sample site FLT04 (Flathead River) does see a decrease in numbers within the Scraper group diminishing by about 20%. A similar result is shown with FLT07 (Cate Creek) over the duration of the sampling period however, strong conclusions regarding disturbance cannot be made from these slight changes in FFG compositions.

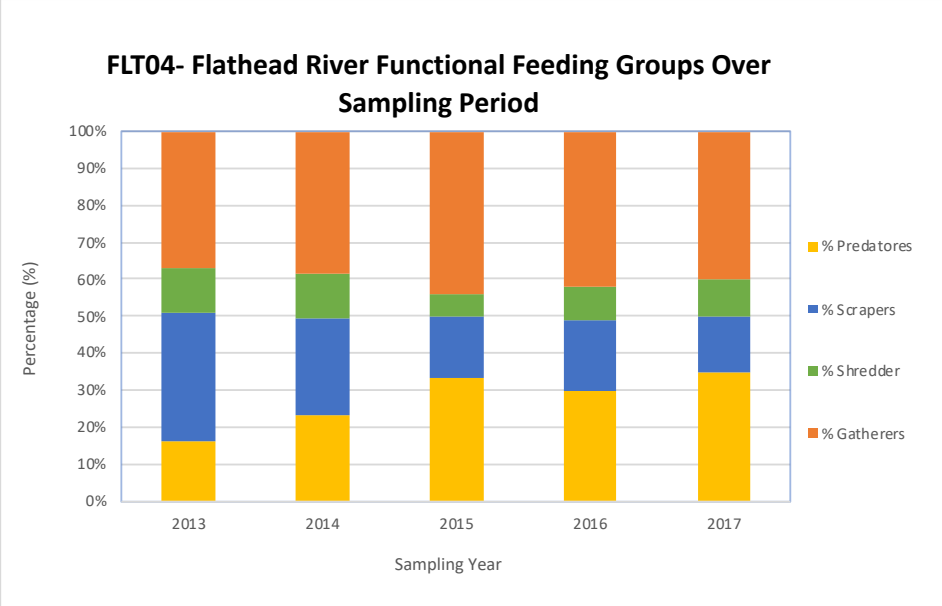


Figure 3-4*-Displays the percentage of different functional feeding groups at site FLT04 (Flathead River) over the duration of the study.*

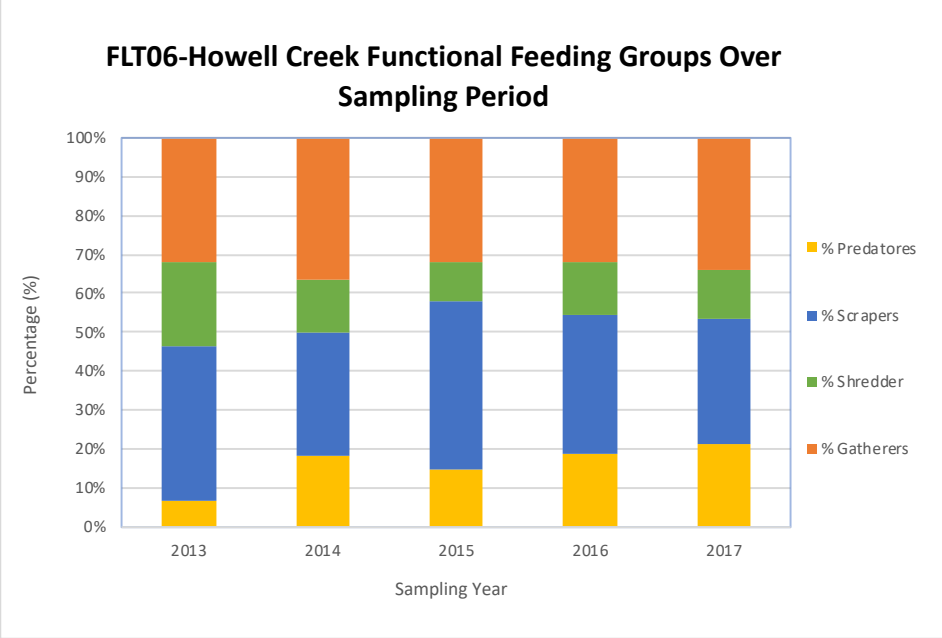


Figure 3-5*-Displays the percentage of different functional feeding groups at site FLT06 (Howell Creek) over the duration of the study.*

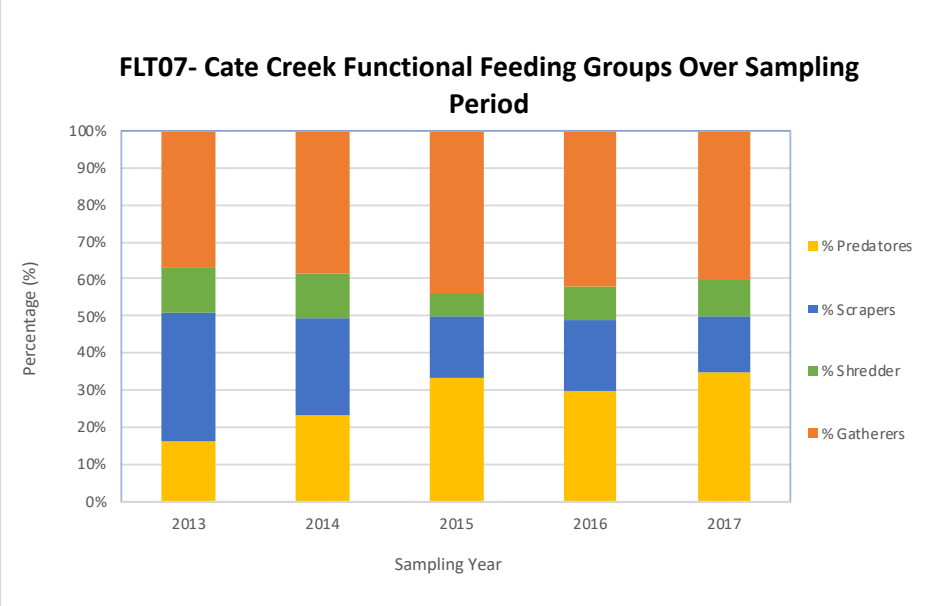


Figure 3-6*-Displays the percentage of different functional feeding groups at site FLT07 (Cate Creek) over the duration of the study.*

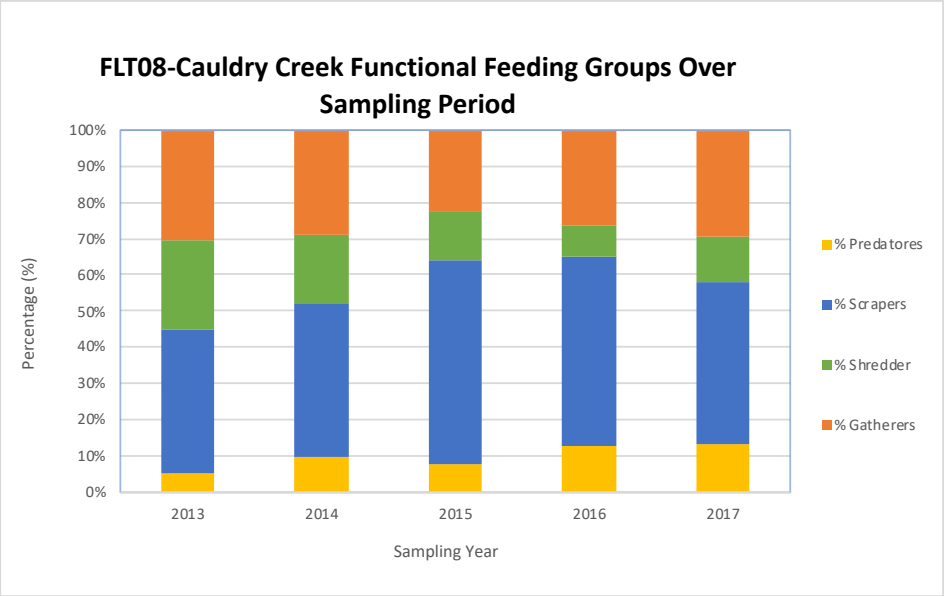


Figure 3-7*-Displays the percentage of different functional feeding groups at site FLT08 (Cauldry Creek) over the duration of the study.*

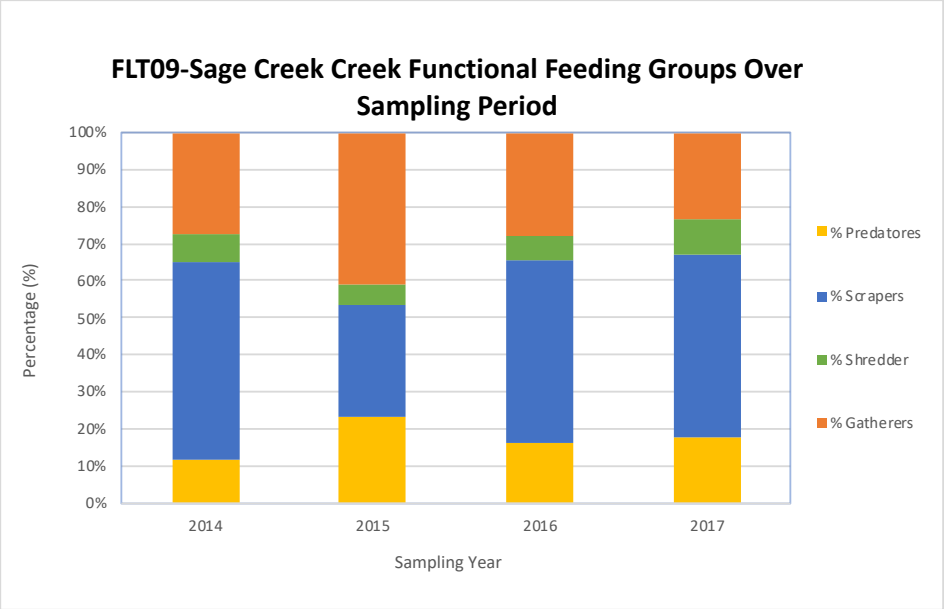


Figure 3-8*-Displays the percentage of different functional feeding groups at site FLT09 (Sage Creek) over the duration of the study*

.

3.1.7 Water Chemistry Results

The results from water chemistry measurements (see Table 3-5 below) indicate that all the sample sites were within the B.C. Government aquatic health standards at the time of sampling (Ministry of Environment and Climate Change 2019). A short summary of these standards relevant to data collected at the study sites can be seen in Table 3-4 below. It is important to note that the water chemistry measurements taken alongside the benthic macroinvertebrate samples are a glimpse in time and many B.C. Government water quality guidelines require data over an extended period of time to establish baseline information and reach any conclusions on water quality.

Table 3-4*-Displays a quick view of BC government aquatic health guidelines ranges and maximums. See document for full information*

Water Quality Measurement	Acceptable Range For Aquatic Life
Dissolved Oxygen (mg/L)-instantaneous minimum	5-9 mg/L (Depending on life stage requirements)
pH for Freshwater	6.5-9.0
Water Temperature (Varies depending on Water Use)	<18 °C <15 °C (Bull Trout)
Turbidity (NTU)	Depends on changes and background measurements but generally anything less than 5 NTU is low and clear. Any big changes 5-10 within certain time, and if pre-existing level was a certain amount matters a lot.

Table 3-5*-Water chemistry and air temperature data for all sites over all sampling years. Note FLT09 was not sampled in 2013.*

FLT04-Flathead River					
Information Collected	2013	2014	2015	2016	2017
Bottom Dissolved Oxygen (mg/L)	11	10	10	11	10
pH	7.1	8.2	8.4	8.5	9
Specific Conductance (µS/cm)	87	163.6	178.2	180.1	192.7
Water Temperature (°C)	5	9.5	6	10.4	16.1
Turbidity (NTU)	4.32	1.83	1.31	0.6	0.5
FLT06-Howell Creek					
Bottom Dissolved Oxygen (mg/L)	10	10	8	11	9
pH	8.2	8.2	8.5	8.8	8.6
Specific Conductance (µS/cm)	257.4	267.7	273.4	279.3	267
Water Temperature (°C)	5.3	8	7.1	5.5	9.2
Turbidity (NTU)	1.14	0.87	1.2	0.5	0.7
FLT07-Cate Creek					
Bottom Dissolved Oxygen (mg/L)	9	9	10	11	10
pH	7.9	8	8.4	8.4	8.6
Specific Conductance (µS/cm)	253.8	263.7	285.8	273	270
Water Temperature (°C)	6.7	9	8.2	9	12.5
Turbidity (NTU)	0.41	0.69	1.95	0.4	0.25
FLT08-Cauldry Creek					
Bottom Dissolved Oxygen (mg/L)	10	10	10	11	8.5
pH	7.9	8	8.1	8.6	8.5
Specific Conductance (µS/cm)	188.5	187.2	200.6	230	235
Water Temperature (°C)	5.6	9.5	7.2	8.6	8.9
Turbidity (NTU)	0.59	0.68	1.08	0.5	0.5
FLT09-Sage Creek					
Bottom Dissolved Oxygen (mg/L)	N/A	11	10.6	10.5	10
pH	N/A	7.6	8.1	8.4	8.4
Specific Conductance (µS/cm)	N/A	148.5	170.9	162.3	157
Water Temperature (°C)	N/A	6.8	10	11.4	15
Turbidity (NTU)	N/A	0.57	1.06	0.3	0.6

3.2 Geomorphic Road Analysis and Inventory Package (GRAIP) Results

The GRAIP analysis is well suited to capture the multiple effects of roads at a sub-watershed scale. The Flathead GRAIP results are divided into the different sub-watersheds and shown below in Figure 3.9, note that Cate Creek (FLT07) is estimated to experience very little sediment deposition into streams. Howell Creek (FLT06) has consistently high GRAIP values across all study years approaching 200,000 Kg/km^2/Year of estimated sediment loading in waterways. These estimated sediment deposition values reflect the difference in historic logging activity (Table 1-1, page 12) and road infrastructure associated with forestry activities in each sub-basin.

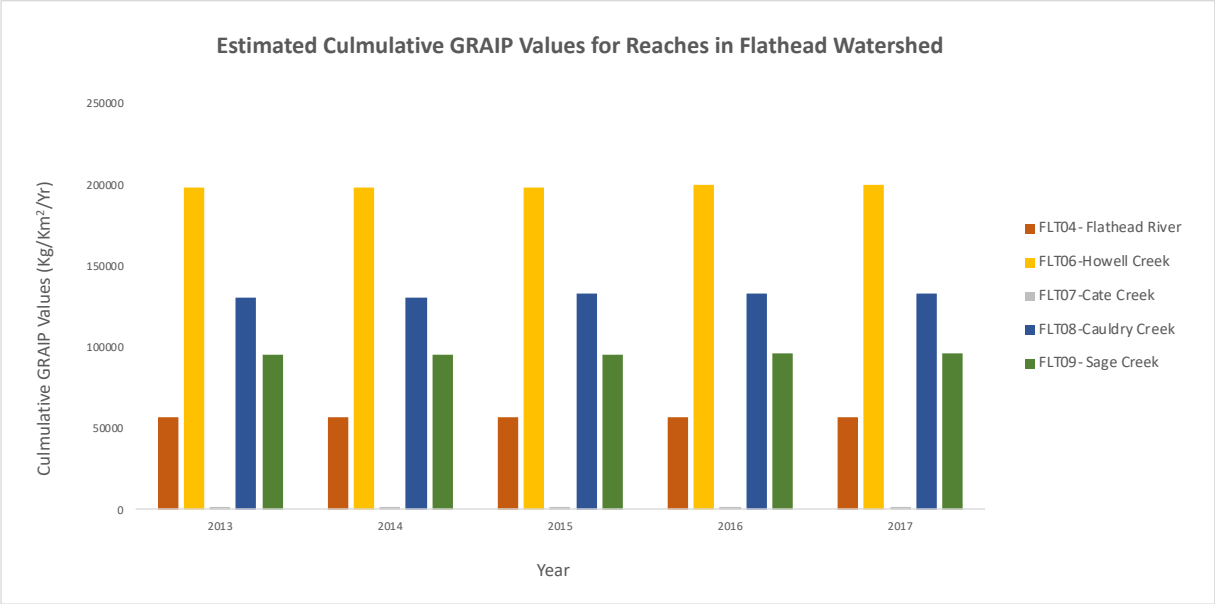


Figure 3-9*-Displays estimated cumulative GRAIP values for Reaches in Flathead Watershed study area including each sub-watershed where test sites occurred. Units are in Kg/Km²/Year*

3.3 Canadian Climate Normal (1981-2010) and 2017 Weather Data

Canadian Climate Normal (1981-2010) and Weather Data from 2017 are displayed in Figure 3-10 below. The data was gathered from the Fernie station (see Table 2-1 for station details) which is approximately 35 km Northwest of the study area. As shown in Figure 3-10, 2017 was an exceptionally warm year with significantly less precipitation in the summer months. July for instance, averaged 3 degrees Celsius warmer than the normal, with only 4.8mm of precipitation compared to a normal of 67mm. Extreme weather affected water flow and temperature at all study sites which all exhibited increased water temperatures in 2017 (see Table 3-5 above). This effect was even more apparent on smaller streams in the study area such as Cate Creek (FLT07).

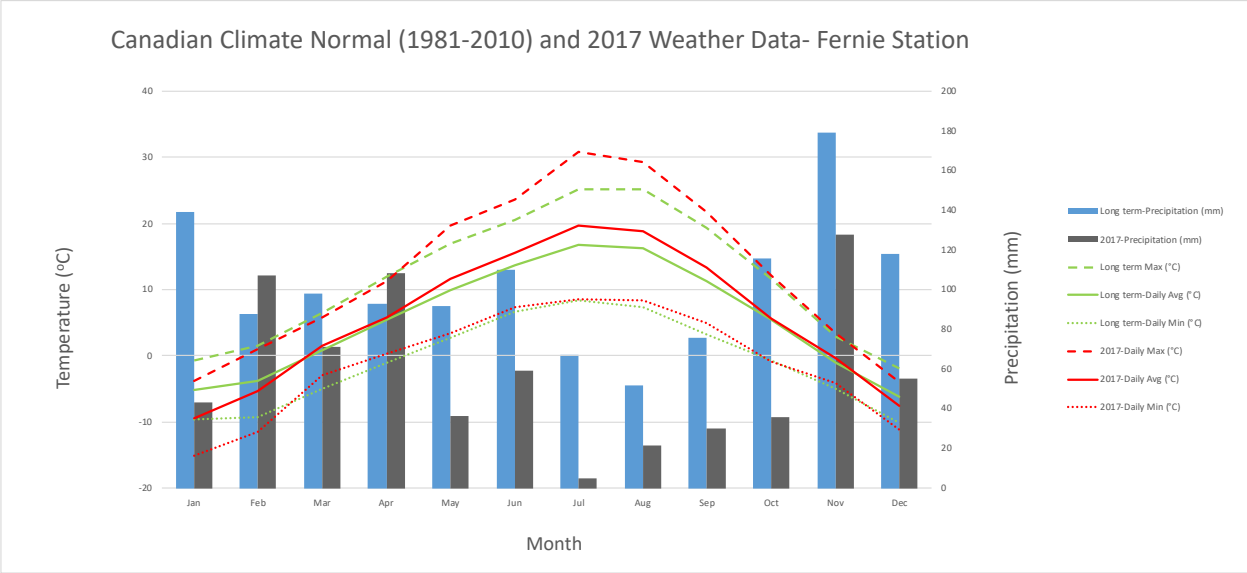


Figure 3-10*-Displays Canadian Climate Normal (1981-2010) compared to Weather data in 2017 from the Fernie weather station approximately 35 km Northwest of the study area.*

Figure 3-11*- Flathead River. photo credit Heather Leschied*

4 Discussion

The central theme of the Flathead River Biomonitoring Program was to apply the CABIN methodology to sample a basin with no human settlement, where the only major anthropogenic influence was forestry. The Flathead River watershed offered the opportunity to isolate the effects of forestry activities in the watershed on aquatic health. Site disturbance and changes in benthic macroinvertebrate communities were observed using five sub-watersheds, one of which had no historic or recent timber harvest, over the five year sampling period. However, FLT07 (Cate Creek), the only site without influence from forestry activity exhibits the greatest changes and potential signs of stress according to some of the results. Therefore, this discussion offers reasoning why Cate Creek showed potential signs of stress, and then evaluates the other four sites to observe any potential effects from timber harvest based on the study results.

FLT07 (Cate Creek)'s potential signs of disturbance all occur in 2017 where it is given a "potentially stressed" CABIN Site assessment, the lowest RIVPACS score of all sites (0.87), and exhibits a significant drop in species abundance. These changes may be attributed to extreme weather conditions and large variations in stream flow as compared to previous sampling years. 2017 was an exceptionally hot and dry year in South-eastern B.C., and Cate Creek experienced low flow rates (see site information Appendix B). The 2017 weather variation as compared to an established climate normal is shown in Figure 3-10 above, where it is consistently hotter and dryer than the average established over 30 years (1981-2010). The summer of 2017 was considered one of the worst wildfire seasons in B.C.'s history. Over 1.2 million hectares of land burned throughout the province. Three days following the completion of the 2017 sampling period, a series of fires ignited in the Flathead River watershed. While none of these fires impacted the study sample sites they are a testament to the hot and dry conditions in the Flathead River watershed, which resulted in a wildfire of note known as the Kenow Mountain wildfire which burned 15,500 hectares in the Flathead Valley, and into Alberta and Waterton Lakes National Park (BC Government Wildfire History [accessed 2019]). Further examples of these acute weather trends were observed during sample and data collection, with the difference in site characteristics compared to the previous sample years. Cate Creek's average channel depth was only 5.7cm in 2017 while in previous years averaged 13cm. The difference between bankfull width and wetted width was 40m in 2017, in previous years the difference averaged 21.5m. The water temperature was 12.5 ^{o}C in 2017 while in previous years averaged 8 ^{o}C. Despite experiencing such changes in weather conditions, and the potential for diminishing aquatic health, there is other evidence present that suggests Cate Creek's aquatic function remained intact. Perhaps the strongest evidence that Cate Creek was still ecologically healthy is the %EPT metric. Results were consistently high for this metric, above ninety percent

throughout the entire study (see Table 3-3) even under the variable conditions of 2017. As discussed earlier, EPT taxa are known to be pollution sensitive and indicators of high-quality water (Carter et al. 2006). The species richness, and functional feeding group compositions remained stable throughout the study period for Cate Creek which can be interpreted as other possible indicators of aquatic health (see Figure 3-3 and Figure 3-6, respectively). This evidence towards overall stream health in the face of environmental extremes suggests a strong resilient nature present in a previously unimpacted aquatic ecosystem. This is an important attribute in the face of climate change where further extreme weather and increases in temperature are expected by 2050 (Bay et al. 2009). It is unclear whether the Cate Creek sub-watershed would display these signs of persistent stream health in the face of extreme conditions if it had any major anthropogenic disturbance on the landscape. Large intact naturally functioning areas have been frequently recommended for resilience and adaptation to climate change (Bay et al. 2009).

The other study sites would have experienced similar extreme weather conditions in 2017 however, due to their larger size they did not experience such drastic changes in water flow, temperature and benthic macroinvertebrate abundance (see Appendix B.) It must be acknowledged that extreme weather could have had some effect on their results but likely not at the same magnitude as FLT07 (Cate Creek). The four other sites that were monitored had all exhibited some form of potential stress throughout the monitoring period. However, due the preliminary nature of the model and the diverse responses of sites, these potentially stressed results can't be directly tied to any cause, including forestry. FLT09 (Sage Creek), and FLT08 (Cauldry Creek) have the highest levels of timber harvest during the study period, and have mixed results regarding aquatic health. FLT06 (Howell Creek) hosts the highest level of historic harvest by a wide margin, nearly one third or 3,000 Hectares and consequently receives the highest estimated sediment delivery to waterways. It is important to acknowledge that sediment in water bodies is a normal and important occurrence (DFO 2000) however, sedimentation loading beyond normal ranges due to altered environmental and hydrological conditions is a threat to aquatic health (Orndorff 2017). It is well documented that increased forestry road density and high frequency traffic result in higher levels of erosion (Araujo 2011) with negative effects on aquatic health. The CABIN site assessment for FLT06 (Howell Creek) and poor %EPT individuals metric could be attributed to potential changes in hydrologic function, but further studies would need to be conducted to be certain. FLT04 (Flathead River) had low historic harvest amounts, a moderate recent harvest total, and some interesting aquatic health results that could potentially be an immediate effect from timber harvest. The CABIN site assessment was "potentially stressed" for the last three years of sampling, the RIVPACS score was lower in the final two years of the study, and the %EPT individuals is exceptionally low for the Flathead watershed and decreases significantly during the sampling period (72%-35% see Table 3-3 above) ending with the lowest EPT% of all the study sites. These combined attributes indicate potentially diminishing aquatic

health, and the fact that this study site is located at the headwaters of the Flathead River may warrant extra attention if further investigation and research occur.

It would appear that the effects from harvest were not concentrated enough or did not reach a detectable threshold in the aquatic ecosystems of the Canadian Flathead watershed for the methods used in this study. Benthic macroinvertebrates exhibit high site fidelity therefore are somewhat equipped to with-stand naturally occurring short term fluxes in suspended and benthic sediments (Orndorff 2017), and somewhat increased turbidity over a short term may not be enough to cause this shift in community composition at current development levels in the Flathead watershed. Increased and/or unchecked harvest or extreme forest fire activity could change that. Benthic macroinvertebrate's tolerance to increasing sediment is limited, and continually high-levels of sediment input may completely change the natural community structure of benthic macroinvertebrates (Wood and Armitage 1997). It is likely some signs of potential stress are due to manipulated landscapes via roads and forestry activities however, we are unable to state this based on our study results without further information gathered.

5 Conclusions and Recommendations

5.1 Conclusion

Overall, the Canadian Flathead watershed remains an intact and wild place teeming with impressive levels of biodiversity however, that is not guaranteed to continue. This area is still relatively unprotected, and even though development has been occurring at a relatively small scale our study efforts likely observed some of the negative effects. While the study results are not strong enough to draw certain conclusions, the information gathered does provide insight into potential warning signs. More rigorous monitoring with additional data collection would be required to examine exact causes of potential stress in the aquatic system. Aside from potential further human impact, there are also the uncertainties that will come with climate change that could further influence this watershed.

The Canadian Flathead watershed will stand the best chance of dealing with climatic challenges by remaining as intact and undeveloped as possible. Climate warming is predicted to increase water temperatures in freshwater systems worldwide, climate warming in the Rocky Mountains of North America is occurring at two to three times the rate of the global average (Jones et al. 2014). All sites in this biomonitoring program exhibited increased water temperatures over the duration of the study period (see Table 3-5, page 29).

Climatic trends over both the past century and more recent decades indicate major changes in temperature and precipitation in British Columbia (Pojar 2010). Drier and warmer conditions in central and southern British Columbia are expected to lead to larger, more frequent, and severe wildfires (Pojar 2010) and this could bring rapid change to the aquatic environment. Increased temperatures, reduced snowpack, and declines in stream flow are already occurring in the Flathead watershed (Bay et al. 2009).

With further research to confirm predictions, the Cate Creek site could be used as an example of an intact ecosystem's ability to handle climatic change when other stressors are not present. The increasing acute threat to natural systems is a combination of climate change and intensifying anthropogenic changes (Pojar 2010). It is well understood that reduced pressure on species and ecosystems from other sources than climate change, and maintaining functioning, connected ecosystems, maximize the adaptive capacity of the landscape in the face of uncertainty associated with future climate change (Bay et al. 2009). If Cate Creek had experienced some significant anthropogenic disturbance it is unlikely it would retain such a strong presence of % EPT individuals, which is a strong indicator of high-quality water. Unfortunately, due to the limits of the monitoring program it is unclear how FLT07 responded in the years following the completion of the study, and whether other indicators of aquatic health made a recovery. One thing remains certain, climate change is already affecting British Columbia and is predicted to have more severe impacts for already fragmented landscapes (pojar 2010), and large, intact ecosystems are best suited to handle changes caused by it (Bay et al. 2009). Maintaining the Canadian Flathead watershed's habitat connectivity, ecological integrity, and rich biodiversity has never been more important.

5.2 List of Recommendations

- Consider analyzing the site data again with the updated CABIN RCA model, expected to be complete in 2020.
- Consider analysing identified source sites of sediment contribution (Outlined in GRAIP model) for adverse effects on benthic macroinvertebrate communities, and potentially including fish species which will willingly disperse from unfit habitat.
- Re-sample sites using the CABIN protocol over a similar temporal period with an emphasis on climatic conditions.
- Include more in-depth water chemistry, temperature, and flow monitoring elements into a future study along with a fisheries component.

- Promote greater protection for the Canadian Flathead watershed in alignment with the vision of the Ktunaxa Nation
- Continue with some level of sustainable forestry to reduce the risk of extreme wildfire, especially in the wake of climate change where such events are expected in greater frequency.

6 References

Araujo, H. A. 2011. "Population Responses of Coho and Chinook Salmon to Sedimentation Associated with Forest Roads in a Coastal Watershed of the Lower Fraser River". Simon Fraser University. 129 pp

Bay, L. Broberg, L. Carlson, A. Cross, M. Deuel, K. Hanna, D. 2009. A Climate-Impacts Assessment of the Crown of the Continent: a product of the crown of the continent conservation initiative. [accessed 2019 Nov 23] https://cpaws-southernalberta.org/wp-content/uploads/2018/06/Crown_Impacts_Assess_FINAL.pdf

Birdstone, V. 2010. Columbia Valley Transmission Corridor: Supplemental Ktunaxa Nation Oral History and Traditional Use Information. Written Evidence of the Ktunaxa Nation Council. [accessed 2019 Nov 21] http://www.bcuc.com/Documents/Proceedings/2010/DOC_25494_C7-4_KNC_Written-Evidence.pdf

BC Parks. Akamina-Kishinena Provincial Park. [accessed 2019 Dec 13] http://www.env.gov.bc.ca/bcparks/explore/parkpgs/akamina/

British Columbia Government. Wildlife History, Wildfire Season Summary. [accessed 2019 Dec 17]. https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary

Carter, JL. Resh, VH. Hannaford, MJ. Myers, MJ. 2006. Chapter 35. Macroinvertebrates as Biotic Indicators of Environmental Quality. Hauer RF, Laberti GA, editors. Methods in Stream Ecology 2nd ed. Burlington (MA), USA. Academic Press, Elsevier. pg. 805-831.

D'Angelo VS, Muhlfeld CC, Steed A, Miller BJ. 2014. Identification of Critical Habitats and Life Histories of Westslope Cutthroat Trout (*Oncohynchus clarkia lewisi*) in the Transboundary North Fork Flathead River, British Columbia, Canada. U.S. Geological Survey, Northern Rocky Mountain Science Center, Glacier Field Station. Montana Department of Fish and Wildlife and Parks, Kalispell, Montana.

Department of Fisheries and Oceans. 2000. Effects of sediment on fish and their habitat. DFO Pacific Region Habitat Status Report 2000/01. [accessed 2019 Nov 21] https://www.dfo-mpo.gc.ca/Library/255660.pdf

Environment Canada. 2012a. Canadian Aquatic Biomonitoring Network (CABIN) Field Manual: Wadeable Streams. Science and Technology Branch, Environment Canada, Dartmouth, NS. [accessed 2019 Nov 1] http://publications.gc.ca/site/eng/422979/publication.html

Environment Canada. 2012b. Canadian Aquatic Biomonitoring Network Laboratory Methods: Processing, Taxonomy and Quality Control of benthic Macro-invertebrate Samples. [accessed 2019 Nov 1]: http://publications.gc.ca/site/eng/476513/publication.html

Environment Canada. 2012c. CABIN training course, Module 3 – Sample Processing and Introduction to Taxonomy and Benthic Invertebrates. Science and Technology Branch, Environment Canada, Dartmouth, NS.

Environment Canada. 2012d. CABIN training course, Module 4 – Study Design and the Statistics of Model Building. Science and Technology Branch, Environment Canada,
Dartmouth, NS.

Environment Canada. 2012e. CABIN training course, Module 5 – CABIN Assessment and Reporting. Science and Technology Branch, Environment Canada, Dartmouth, NS.

Government of British Columbia, Ministry of Environment. BC Species and Ecosystem Explorer. [accessed 2019 Dec 17] http://a100.gov.bc.ca/pub/eswp/

Government of Canada. Canadian Climate Normals 1981-2010 Station Data. [accessed 2019 Dec 12] https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?stnID=1180&autofwd=1

Guimaráres, RM, Facure, KG, Pavanin, LA. And Jacobucci, GB. 2009. Water quality characterization of urban streams using benthic macroinvertebrate community metrics. Acta Limnol. Bras., 2009, vol. 21, no. 2, p. 217-226

Habeck, J.R. 1970. The vegetation of Glacier National Park. National Park Service and
University of Montana, Missoula, Montana.

Harrison, ET. Norris, RH. Wilkinson, SN. 2007. The Impact of Fine Sediment Accumulation on Benthic Macroinvertebrates: Implication for River Management. Proceedings of the 5th Australian Stream Management Conference. Australian Rivers Making a Difference. Charles Start University. Thurgoona, New South Wales. [accessed 2019 Nov 21]
https://cdn.csu.edu.au/__data/assets/pdf_file/0011/749936/Harrison_Evan_139.pdf

Hauer, RF. and Sexton, EK. 2010. Transboundary Flathead Water Quality and Aquatic Life: Biennial Report. Flathead Lake Biological Station, The University of Montana. [accessed on 2019 Nov 21]
http://irmaservices.nps.gov/datastore/v4/rest/DownloadFile/465874?accessType=DOWNLOAD

Hauer, RF. Sexton, EK. 2013. Transboundary Flathead River: Water Quality and Aquatic Life Use. Flathead Lake Biological Station, University of Montana. [accessed 2019 Nov 21]
http://files.cfc.umt.edu/cesu/NPS/UMT/2008/08Hauer_GLAC_water_quality_fnlrpt.pdf

Hilsenhoff WL. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist 20: 31-39.

Hilsenhoff, WL. 1988. Rapid Field Assessment of Organic Pollution with a Family-level Biotic Index. Journal for the North American Benthological Society. Vol. 7 No. 1 (Mar 1988) pp. 65-68. [accessed 2019 Nov 12]
http://www.webpages.uidaho.edu/fish415/Wilhelm%20files/2435%201988%20Hilsenhoff.pdf

Jenkins, K.J. 1985. Winter habitat and niche relationships of sympatric cervids along the North Fork of the Flathead River, Montana. Dissertation, University of Idaho, Moscow, Idaho, USA.

Jones LA, Muhlfeld CC, Marshall LA, Mcglynn BL, and Kershner JL. 2014. Estimating Thermal Regimes of Bull Trout and Assessing the Potential Effects of Climate Warming on Critical Habitats. River Research and Applications 30: pp. 204-216

Madomguia D, Zebaze Togouet SH. and Fomena A. Macro Invertebrates Functional Feeding Groups, Hilsenhoff Biotic Index, Percentage of Tolerant Taxa and Intolerant Taxa as Major Indices of Biological Assessment in Ephemeral Stream in Sudano-Sahelian Zone. International Journal of Current Microbiology and Applied Sciences. ISSN: 2319-7706 Volume 5 Number 10 (2016) pp. 792-806

Mandaville, SM. 2002. Benthic Macroinvertebrates in Freshwaters- Taxa Tolerance Values, Metrics, and Protocols. Soil and Water Conservation Society of Metro Halifax. Project H-1. [accessed 2019 Nov 1] http://lakes.chebucto.org/H-1/tolerance.pdf

Ministry of Environment and Climate Change Strategy. 2019. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife, and Agriculture-Summary Report. Water Protection and Sustainability Branch. [accessed 2019 Nov 21] https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf

Ministry of Sustainable Resource Development. 2003. Southern Rocky Mountain Management Plan. Corporate Land and Resource Governance Division. PO Box 9631 Stn Prov Govt. Victoria, B.C. V8W 9M2. [accessed 2019 Nov 15] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/kootenayboundary-region/southernrockymtn-mp/southernrockymountain_mp_plan.pdf

Orndorff, A. 2017. Evaluating the Effects of Sedimentation from Forest Roads: A Review. Soil and Water Science Department, University of Florida. [accessed 2019 Nov 25]: https://soils.ifas.ufl.edu/media/soilsifasufledu/sws-main-site/pdf/technical-papers/Orndorff_Adam_Immediate_Release.pdf

Peckarsky, B.L. 1984. Do predaceous stoneflies and siltation affect the structure of stream insect communities colonizing enclosures? Canadian Journal of Zoology 63: 1519-1530.

Pojar J. 2010. A Climate for Conservation Nature, Carbon, and Climate Change in British Columbia. Working Group on Biodiveristy, Forest and Climate-An Alliance of Environmental Non-governmental Organizations. [accessed 2019 Dec 13] https://www.cpaws.org/wp-content/uploads/2018/02/NewClimate_report_CPAWS.pdf

Reaser FP. 2016 East Fork Millicoma River Road Sediment Reduction Plan Phase 1 (Draft). Coos Watershed

Richards, C., and K. L. Bacon. 1994. Influence of fine sediment on macroinvertebrate colonization of surface and hyporheic stream substrates. Great Basin Naturalist 54:106-113

Rocky Mountain Research Station. Air, Water, and Aquatic Environments Program. United States Department of Agriculture. U.S. Forest Service. The Geomorphic Road Analysis and Inventory Package (GRAIP). [accessed 2019 Nov 21] https://www.fs.fed.us/GRAIP/index.shtml

Rosenberg, D.M., T.B. Reynoldson and V.H. Resh. (1999) Establishing reference conditions for benthic invertebrate monitoring in the Fraser River Catchment, British Columbia, Canada. Fraser River Action Plan, Environment Canada, Vancouver BC DOE FRAP 1998-32.

Rosenberg, D.M., Davies, I.J., Cobb, D.G., and Wiens, A.P. 1997. Ecological Monitoring and Assessment Network (EMAN) Protocols for Measuring Biodiversity: Benthic Macroinvertebrates in Fresh Waters. Dept. of Fisheries & Oceans, Freshwater Institute, Winnipeg, Manitoba. 53, Appendices. [accessed 2019 Dec 13] http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.130.9387&rep=rep1&type=pdf

Reynoldson, T.B., S.P. Thompson, D. Milani and C. Logan. 1999. Biological assessment of combined sewers: an initial examination. Environment Canada, National Water Research Institute, Burlington/Saskatoon, NWRI Contribution No. 99-239.

Scott, T. 2019 Nov 30. Rare Glacier Stoneflies Gain Federal Protection. Two Obscure Stoneflies Found Exclusively in Glacier National Park's High Alpine Streams were Listed as Threatened under the Endangered Species Act. Flathead Beacon. [accessed 2019 Dec 17] https://flatheadbeacon.com/2019/11/30/rare-glacier-stoneflies-gain-federal-protection/

Sylvestre, S. Fluegel, M. Tuominen, T. 2005. Benthic Invertebrate Assessment of Streams in The Georgia Basin Using the Reference Condition Approach: Expansion of the Fraser River Invertebrate Monitoring Program 1998-2002. Environment Canada Environmental and Conservation Branch, Aquatic and Atmospheric Sciences Division. #201-401 Burrad Street, Vancouver, B.C. V6S 3C5. [accessed 2019 Nov 13] http://publications.gc.ca/site/eng/9.700394/publication.html

Singer, F.J. 1979. Habitat partitioning and wildfire relationships of cervids in Glacier National Park, Montana. Journal of Wildlife Management 43:437-444.

United States Fish and Wildlife Service. Environmental Conservation Online System; Conserving the Nature of America. Threatened and endangered Species. [accessed 2019 Dec 17] https://ecos.fws.gov/ecp/

Weaver, J.L. 2001. The Transboundary Flathead: a critical landscape for carnivores in the Rocky Mountains. WCS Working Paper No. 18. Wildlife Conservation Society. New York, N.Y.

Wood, P.J., and P.D. Armitage. 1997. Biological Effects of Fine Sediment in the Lotic Environment. Environmental Management 21 (2) (March): 203–17. [accessed 2019 Nov 25] http://www.air.idaho.gov/media/525755-Biological_Effects_Fine_Sediment_lotic_Environment_Wood_Armitage_1997.pdf

Wright, JF. Sutcliffe, DW. Furse, MT. 2000. Assessing the Biological Quality of Fresh Waters: RIVPACS and Other Techniques. Freshwater Biological Association. Ambleside, Cumbira, UK.

Appendix A- CABIN Data Analysis Results

Table A-1- *Functional Feeding Group Percentages for all sites during all study years.*

FLT04-Flathead River Functional Feeding Groups				
Year	% Predatores	% Scrapers	% Shredder	% Gatherers
2013	23.27	49.37	17.92	52.83
2014	34.46	38.70	17.51	57.34
2015	54.87	27.43	10.32	72.27
2016	49.85	32.94	15.45	70.55
2017	58.87	25.27	17.20	67.20
FLT06-Howell Creek Functional Feeding Groups				
Year	% Predatores	% Scrapers	% Shredder	% Gatherers
2013	11.29	67.71	36.68	53.92
2014	27.81	47.50	20.63	55.31
2015	19.49	57.22	13.67	42.53
2016	27.96	54.71	20.36	48.63
2017	31.62	48.11	18.65	50.81
FLT07-Cate Creek Functional Feeding Groups				
Year	% Predatores	% Scrapers	% Shredder	% Gatherers
2013	2.32	87.83	57.97	60.58
2014	8.54	80.72	39.39	47.38
2015	3.79	84.60	44.44	52.02
2016	6.01	88.25	32.11	37.86
2017	2.64	76.54	5.87	20.23
FLT08-Cauldry Creek Functional Feeding Groups				
Year	% Predatores	% Scrapers	% Shredder	% Gatherers
2013	9.79	78.04	48.37	59.05
2014	15.64	69.27	31.01	47.49
2015	10.21	76.28	18.02	30.33
2016	18.54	78.87	13.15	39.44
2017	18.97	65.38	18.46	43.33
FLT09- Sage Creek Functional Feeding Groups				
Year	% Predatores	% Scrapers	% Shredder	% Gatherers
2014	13.77	62.08	8.83	31.69
2015	31.99	41.79	7.78	56.20
2016	18.35	55.81	7.24	31.78
2017	20.11	57.14	11.11	26.98

***Table A-2**-Hilsenhoff Family Index, Shannon-Wiener Diversity, Simpson's Diversity, and Simpson's Evenness metrics for all sites across all study years.*

FLT04-Flathead River				
Year	Hilsenhoff Family index	Shannon-Wiener Diversity	Simpson's Diversity	Simpson's Evenness
2013	3.64	2.08	0.80	0.22
2014	3.64	2.43	0.87	0.32
2015	4.53	1.97	0.74	0.16
2016	4.51	2.10	0.78	0.20
2017	4.69	2.25	0.79	0.18
FLT06-Howell Creek				
Year	Hilsenhoff Family index	Shannon-Wiener Diversity	Simpson's Diversity	Simpson's Evenness
2013	3.17	2.34	0.85	0.28
2014	4.32	2.48	0.89	0.38
2015	3.62	2.41	0.87	0.36
2016	3.25	2.60	0.89	0.34
2017	4.27	2.40	0.86	0.29
FLT07-Cate Creek				
Year	Hilsenhoff Family index	Shannon-Wiener Diversity	Simpson's Diversity	Simpson's Evenness
2013	2.68	1.34	0.61	0.14
2014	3.16	1.70	0.71	0.18
2015	2.81	1.51	0.69	0.25
2016	3.17	1.57	0.66	0.15
2017	3.22	1.12	0.46	0.13
FLT08-Cauldry Creek				
Year	Hilsenhoff Family index	Shannon-Wiener Diversity	Simpson's Diversity	Simpson's Evenness
2013	2.65	1.92	0.77	0.21
2014	3.22	2.31	0.86	0.29
2015	2.75	2.24	0.85	0.35
2016	3.18	2.31	0.86	0.31
2017	3.37	2.36	0.88	0.40
FLT09-Sage Creek				
Year	Hilsenhoff Family index	Shannon-Wiener Diversity	Simpson's Diversity	Simpson's Evenness
2013	3.63	2.19	0.79	0.19
2014	3.33	2.24	0.84	0.25
2015	2.68	2.36	0.85	0.24
2016	2.66	2.39	0.86	0.28
2017	3.04	2.50	0.86	0.28

***Table A-3**-Hilsenhoff Biotic Index, displays the value assigned to a stream associated with level of perceived pollution based on different organisms present and their known tolerance levels. (Table modeled after Hilsenoff 1988)*

Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very Good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly Poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.00	Very Poor	Severe organic pollution

Appendix B-CABIN Database Site Assessment Reports

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT04
Sampling Date	Oct 03 2013
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.36750 N, 114.68353 W
Altitude	1509
Local Basin Name	Flathead River
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	1.6%	94.1%	4.0%	0.2%
CABIN Assessment of FLT04 on Oct 03, 2013	Similar to Reference				

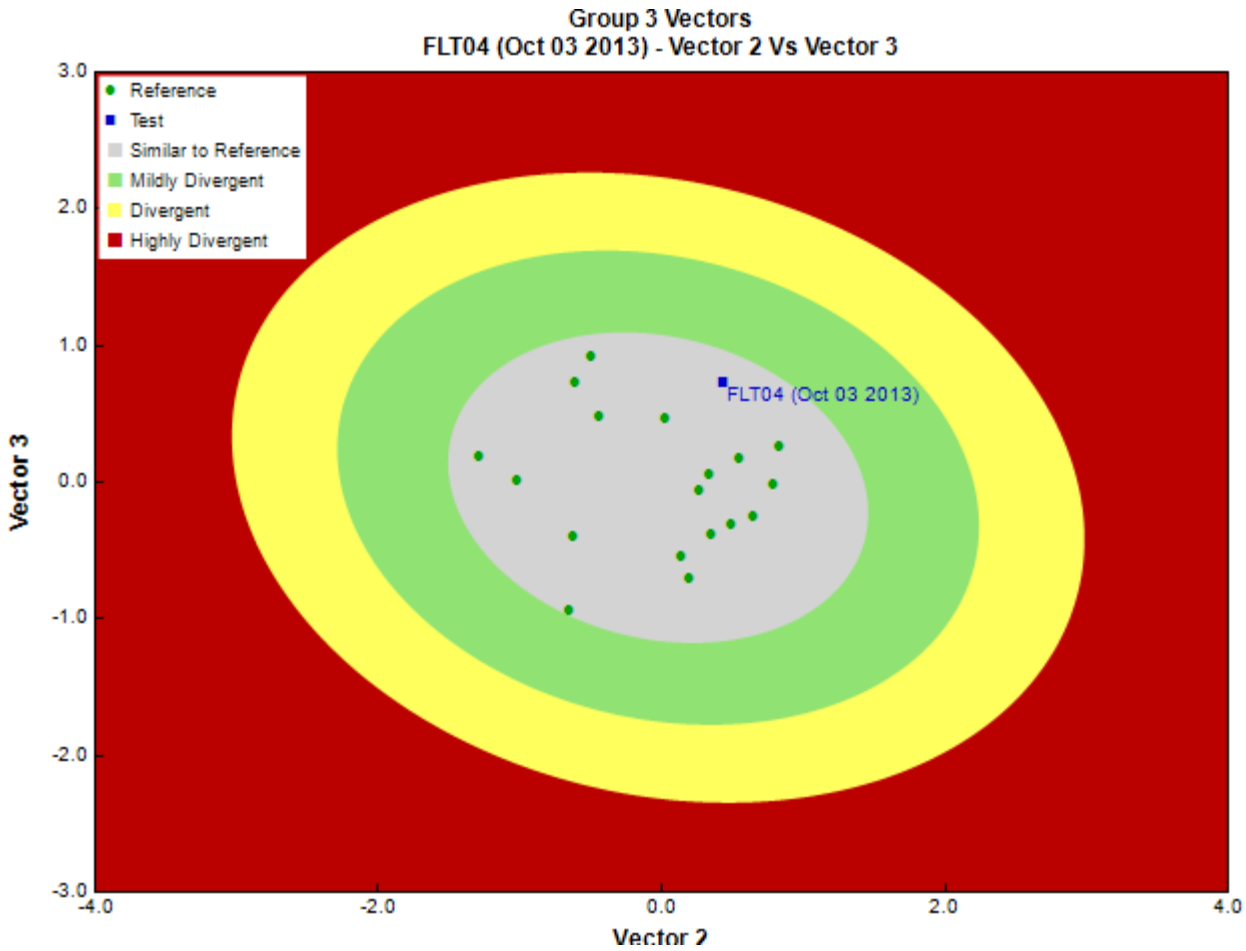


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	April 26, 2014
	Marchant Box
Sub-Sample Proportion	10/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	1	10.0
	Insecta	Coleoptera	Elmidae	7	70.0
		Diptera	Chironomidae	60	600.0
			Psychodidae	3	30.0
			Tipulidae	16	160.0
		Ephemeroptera	Ameletidae	2	20.0
			Baetidae	16	160.0

			Ephemerellidae	41	410.0
			Heptageniidae	120	1,200.0
			Leptophlebiidae	8	80.0
		Plecoptera	Capniidae	1	10.0
			Chloroperlidae	3	30.0
			Nemouridae	13	130.0
			Perlodidae	2	20.0
			Taeniopterygidae	9	90.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Trichoptera	Apataniidae	2	20.0
			Brachycentridae	7	70.0
			Hydropsychidae	1	10.0
			Hydroptilidae	1	10.0
			Lepidostomatidae	1	10.0
			Limnephilidae	1	10.0
			Rhyacophilidae	3	30.0
			Total	318	3,180.0

Metrics

Name	FLT04	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.32	0.4 ± 0.2
Number Of Individuals		
% Chironomidae	18.9	6.9 ± 11.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.24
Apataniidae	22%	24%	28%	25%	3%	0.28
Athericidae	0%	2%	0%	17%	0%	0.01
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.03
Capniidae	78%	55%	50%	92%	68%	0.52
Ceratopogonidae	0%	55%	28%	42%	5%	0.29
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.51
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.79
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00

Lebertiidae	78%	65%	39%	58%	5%	0.40
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.13
Leuctridae	22%	43%	56%	67%	54%	0.56
Limnephilidae	22%	31%	6%	25%	41%	0.07
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.17
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.37
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.06

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.37
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.01
Pisidiidae	0%	6%	0%	8%	0%	0.00
Planariidae	0%	8%	67%	17%	3%	0.64
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.90
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.39
Sperchontidae	78%	63%	50%	42%	65%	0.50
Stygothrombidiidae	0%	4%	0%	17%	0%	0.01
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.30
Torrenticolidae	11%	86%	11%	17%	11%	0.13
Uenoidae	22%	37%	17%	25%	46%	0.17
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.23
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	0.98
RIVPACS : Expected taxa P>0.70	10.51
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	32.3	22.5 ± 10.5
Depth-Max (cm)	61.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Rapids (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0030000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0

Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.71	0.50 ± 0.25
Velocity-Max (m/s)	1.13	0.75 ± 0.28
Width-Bankfull (m)	26.0	15.6 ± 12.8
Width-Wetted (m)	20.9	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	11	6 ± 7
%Cobble (%)	68	61 ± 27
%Gravel (%)	1	1 ± 2
%Pebble (%)	20	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	13.30	79.45 ± 47.98

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
Dg (cm)	11.9	73.9 ± 48.0
Dominant-1st (Category(0-9))	7	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	4	2 ± 1
SurroundingMaterial (Category(0-9))	4	3 ± 1
Topography		
Reg-SlopeLT30% (%)	63.11378	27.92073 ± 14.83033
SlopeLT30% (%)	63.11378	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	11.0000000	10.4922222 ± 0.8833463
General-pH (pH)	7.1	8.0 ± 0.6
General-SpCond (µS/cm)	87.0000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	4.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	5.0000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	4.3200000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT04
Sampling Date	Sep 14 2014
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.36739 N, 114.68553 W
Altitude	1517
Local Basin Name	Flathead River
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	2.0%	94.1%	3.6%	0.2%
CABIN Assessment of FLT04 on Sep 14, 2014	Similar to Reference				

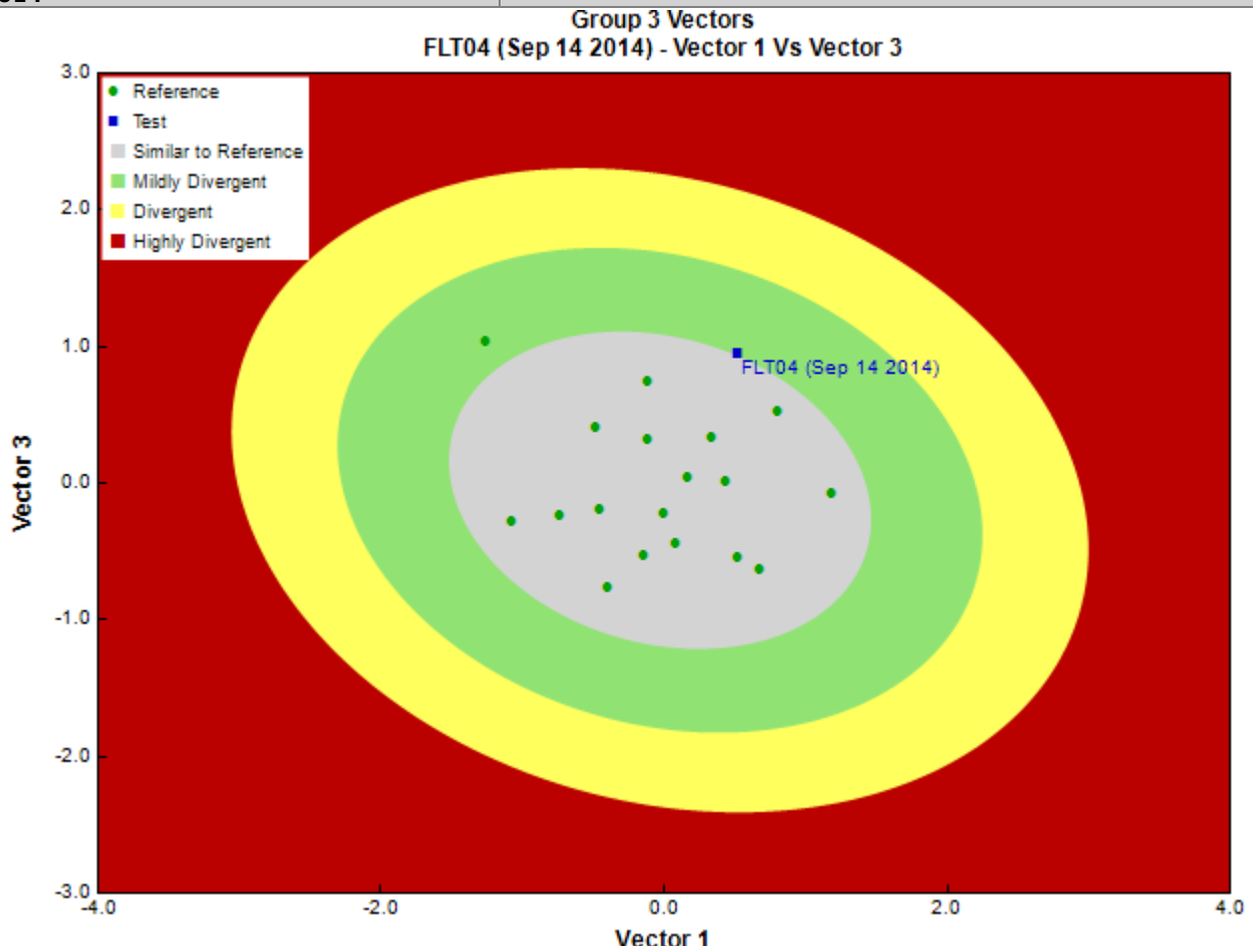


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400

Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 28, 2015
	Marchant Box
Sub-Sample Proportion	10/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	1	10.0
			Sperchontidae	1	10.0
			Torrenticolidae	4	40.0
	Insecta	Coleoptera	Elmidae	25	250.0
		Diptera	Ceratopogonidae	2	20.0
			Chironomidae	82	820.0
			Psychodidae	4	40.0
			Simuliidae	3	30.0
			Tipulidae	8	80.0
		Ephemeroptera	Baetidae	50	500.0
			Ephemerellidae	57	570.0
			Heptageniidae	39	390.0
			Leptophlebiidae	4	40.0
		Plecoptera		12	120.0
			Capniidae	1	10.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Chloroperlidae	9	90.0
			Nemouridae	3	30.0
			Perlidae	5	50.0
			Perlodidae	5	50.0
			Taeniopterygidae	6	60.0
		Trichoptera	Apataniidae	10	100.0
			Brachycentridae	7	70.0
			Hydropsychidae	4	40.0
			Lepidostomatidae	2	20.0
			Rhyacophilidae	10	100.0
			Total	354	3,540.0

Metrics

Name	FLT04	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.52	0.4 ± 0.2
Number Of Individuals		
% Chironomidae	24.0	6.9 ± 11.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.24
Apataniidae	22%	24%	28%	25%	3%	0.28
Athericidae	0%	2%	0%	17%	0%	0.01
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.03
Capniidae	78%	55%	50%	92%	68%	0.52
Ceratopogonidae	0%	55%	28%	42%	5%	0.29
Chironomidae	100%	100%	100%	100%	95%	1.00

Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.51
Empididae	67%	55%	50%	67%	57%	0.51
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.79
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.01
Lebertiidae	78%	65%	39%	58%	5%	0.40
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.13
Leuctridae	22%	43%	56%	67%	54%	0.56
Limnephilidae	22%	31%	6%	25%	41%	0.07
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.17
Mideopsidae	0%	2%	0%	0%	0%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Naididae	0%	8%	39%	0%	3%	0.37
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.06
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.37
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.01
Pisidiidae	0%	6%	0%	8%	0%	0.00
Planariidae	0%	8%	67%	17%	3%	0.64
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.91
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.39
Sperchontidae	78%	63%	50%	42%	65%	0.50
Stygothrombidiidae	0%	4%	0%	17%	0%	0.01
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.30
Torrenticolidae	11%	86%	11%	17%	11%	0.13
Uenoidae	22%	37%	17%	25%	46%	0.17
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.23
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	0.98
RIVPACS : Expected taxa P>0.70	10.51

RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	18.7	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	59.00	67.33 ± 71.65
Depth-Max (cm)	30.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0030000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.39	0.50 ± 0.25
Velocity-Max (m/s)	0.94	0.75 ± 0.28
Width-Bankfull (m)	25.6	15.6 ± 12.8
Width-Wetted (m)	13.8	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	3	6 ± 7
%Cobble (%)	55	61 ± 27
%Gravel (%)	6	1 ± 2

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
%Pebble (%)	31	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	5	0 ± 1
D50 (cm)	7.25	79.45 ± 47.98
Dg (cm)	5.2	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	4	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	63.11378	27.92073 ± 14.83033
SlopeLT30% (%)	63.11378	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.2	8.0 ± 0.6
General-SpCond (µS/cm)	163.6000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	15.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	9.5000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	1.8300000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT04
Sampling Date	Sep 16 2015
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.36739 N, 114.68553 W
Altitude	1517
Local Basin Name	Flathead River
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	1.9%	94.2%	3.8%	0.2%
CABIN Assessment of FLT04 on Sep 16, 2015	Mildly Divergent				

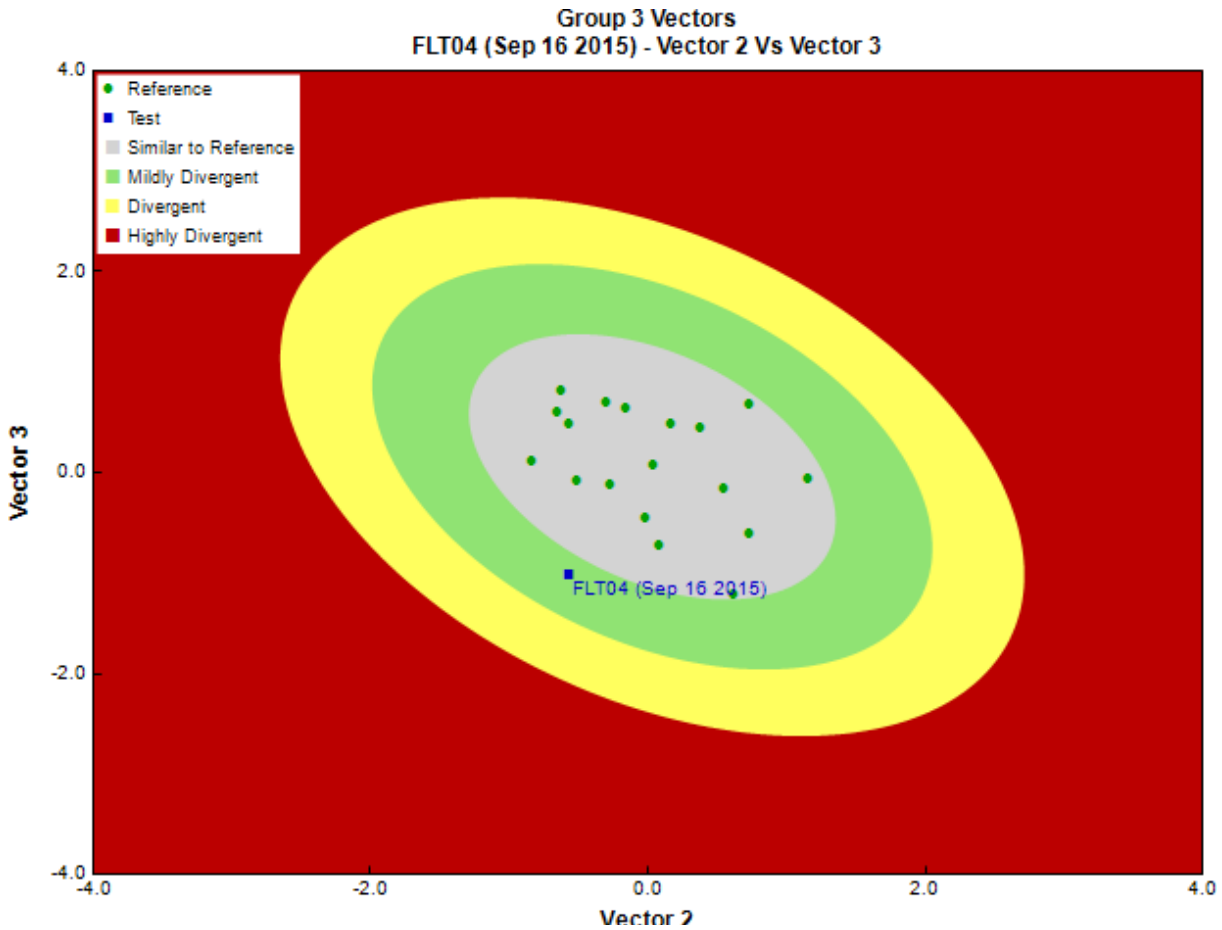


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 24, 2016
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydryphantidae	1	20.0
			Hygrobatidae	1	20.0
			Sperchontidae	2	40.0
	Insecta	Coleoptera	Elmidae	10	200.0
		Diptera	Ceratopogonidae	4	80.0
			Chironomidae	161	3,220.0
			Psychodidae	3	60.0
			Tipulidae	9	180.0

		Ephemeroptera	Ameletidae	1	20.0
			Baetidae	27	540.0
			Ephemerellidae	32	640.0
			Heptageniidae	43	860.0
			Leptophlebiidae	7	140.0
		Plecoptera		2	40.0
			Chloroperlidae	2	40.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Nemouridae	7	140.0
			Perlidae	1	20.0
			Perlodidae	5	100.0
			Taeniopterygidae	1	20.0
		Trichoptera	Apataniidae	3	60.0
			Brachycentridae	5	100.0
			Hydropsychidae	7	140.0
			Hydroptilidae	2	40.0
			Rhyacophilidae	3	60.0
			Total	339	6,780.0

Metrics

Name	FLT04	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.57	0.4 ± 0.2
Number Of Individuals		
% Chironomidae	47.8	6.9 ± 11.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.24
Apataniidae	22%	24%	28%	25%	3%	0.28
Athericidae	0%	2%	0%	17%	0%	0.01
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.03
Capniidae	78%	55%	50%	92%	68%	0.52
Ceratopogonidae	0%	55%	28%	42%	5%	0.29
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.51
Empididae	67%	55%	50%	67%	57%	0.51
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.79
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11

Hygrobatidae	0%	29%	0%	0%	11%	0.01
Lebertiidae	78%	65%	39%	58%	5%	0.40
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.13
Leuctridae	22%	43%	56%	67%	54%	0.56
Limnephilidae	22%	31%	6%	25%	41%	0.07
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.17
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.37

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.06
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.37
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.01
Pisidiidae	0%	6%	0%	8%	0%	0.00
Planariidae	0%	8%	67%	17%	3%	0.64
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.90
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.39
Sperchontidae	78%	63%	50%	42%	65%	0.50
Stygothrombidiidae	0%	4%	0%	17%	0%	0.01
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.30
Torrenticolidae	11%	86%	11%	17%	11%	0.13
Uenoidae	22%	37%	17%	25%	46%	0.17
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.23
RIVPACS : Observed taxa P>0.50	12.00
RIVPACS : O:E (p > 0.5)	0.91
RIVPACS : Expected taxa P>0.70	10.51
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	22.6	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	30.00	67.33 ± 71.65
Depth-Max (cm)	35.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0030000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0

Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.61	0.50 ± 0.25
Velocity-Max (m/s)	0.99	0.75 ± 0.28
Width-Bankfull (m)	17.3	15.6 ± 12.8
Width-Wetted (m)	10.3	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	4	6 ± 7
%Cobble (%)	67	61 ± 27
%Gravel (%)	4	1 ± 2
%Pebble (%)	23	31 ± 28
%Sand (%)	0	0 ± 0

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
%Silt+Clay (%)	2	0 ± 1
D50 (cm)	9.15	79.45 ± 47.98
Dg (cm)	7.6	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	4	3 ± 1
Topography		
Reg-SlopeLT30% (%)	63.11378	27.92073 ± 14.83033
SlopeLT30% (%)	63.11378	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.4	8.0 ± 0.6
General-SpCond (µS/cm)	178.2000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	7.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	6.0000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	1.3100000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT04
Sampling Date	Sep 13 2016
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.36747 N, 114.68356 W
Altitude	1514
Local Basin Name	Flathead River
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary

Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	2.0%	94.2%	3.6%	0.2%
CABIN Assessment of FLT04 on Sep 13, 2016	Mildly Divergent				

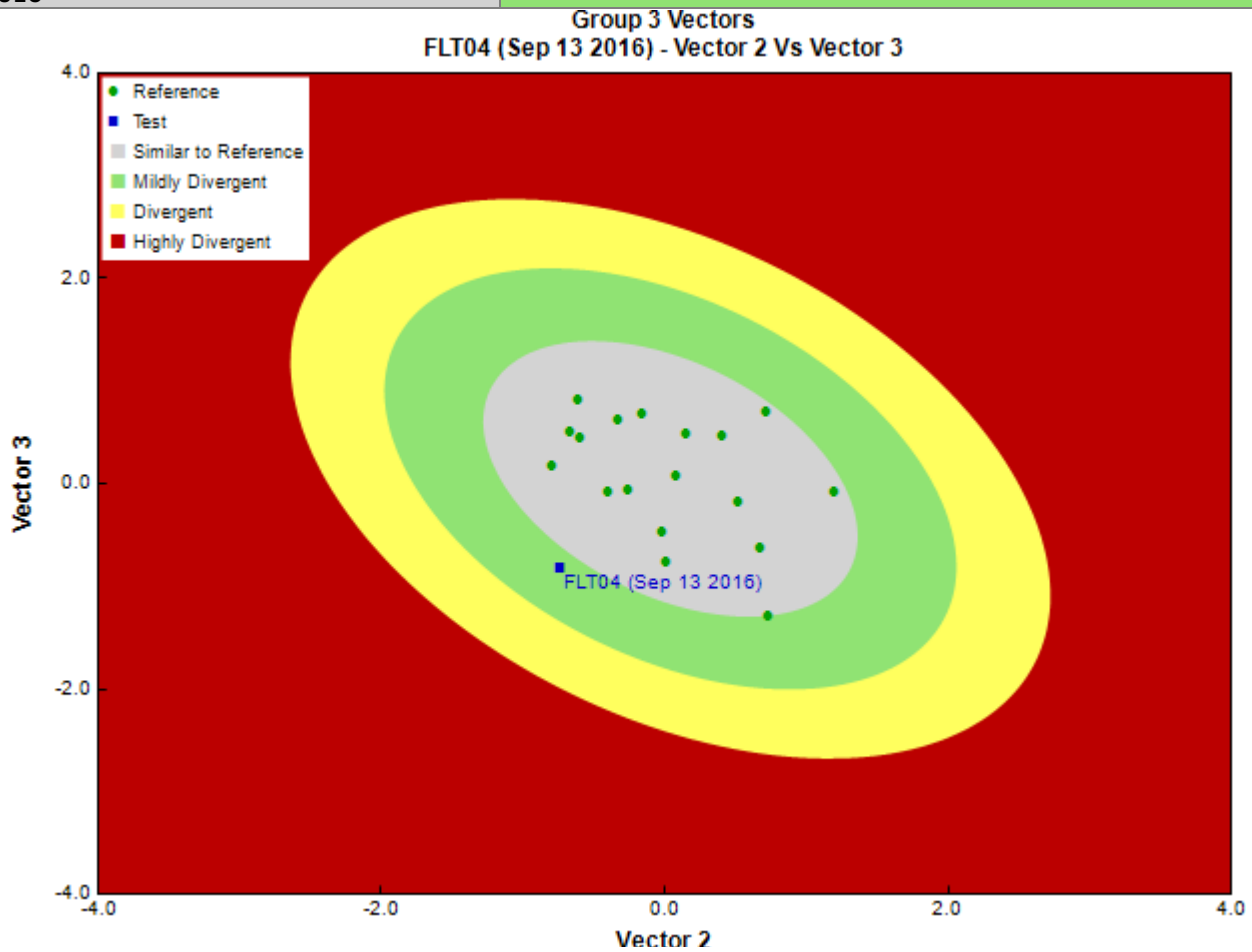


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	February 15, 2017
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	1	16.7
			Sperchontidae	4	66.7
			Torrenticolidae	1	16.7
	Insecta	Coleoptera	Elmidae	20	333.4
		Diptera	Chironomidae	142	2,366.7
			Psychodidae	9	150.0
			Simuliidae	7	116.7
			Tipulidae	11	183.3
		Ephemeroptera	Ameletidae	1	16.7
			Baetidae	11	183.3
			Ephemerellidae	29	483.4
			Heptageniidae	62	1,033.4
			Leptophlebiidae	7	116.7
		Plecoptera	Chloroperlidae	3	50.0
			Nemouridae	7	116.6

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Perlidae	1	16.7
			Perlodidae	2	33.3
		Trichoptera	Apataniidae	7	116.7
			Brachycentridae	7	116.7
			Glossosomatidae	4	66.7
			Hydropsychidae	2	33.4
			Lepidostomatidae	1	16.7
			Rhyacophilidae	4	66.7
			Total	343	5,717.2

Metrics

Name	FLT04	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.55	0.4 ± 0.2
Number Of Individuals		
% Chironomidae	41.4	6.9 ± 11.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.24
Apataniidae	22%	24%	28%	25%	3%	0.28
Athericidae	0%	2%	0%	17%	0%	0.01
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.03
Capniidae	78%	55%	50%	92%	68%	0.52
Ceratopogonidae	0%	55%	28%	42%	5%	0.29
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00

Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.51
Empididae	67%	55%	50%	67%	57%	0.51
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.79
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.01
Lebertiidae	78%	65%	39%	58%	5%	0.40
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.13
Leuctridae	22%	43%	56%	67%	54%	0.56
Limnephilidae	22%	31%	6%	25%	41%	0.07
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.17
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.37
Nemouridae	100%	100%	100%	100%	100%	1.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Pelecorhynchidae	0%	22%	6%	0%	0%	0.06
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.37
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.01
Pisidiidae	0%	6%	0%	8%	0%	0.00
Planariidae	0%	8%	67%	17%	3%	0.64
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.91
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.39
Sperchontidae	78%	63%	50%	42%	65%	0.50
Stygothrombidiidae	0%	4%	0%	17%	0%	0.01
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.30
Torrenticolidae	11%	86%	11%	17%	11%	0.13
Uenoidae	22%	37%	17%	25%	46%	0.17
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.23
RIVPACS : Observed taxa P>0.50	11.00
RIVPACS : O:E (p > 0.5)	0.83
RIVPACS : Expected taxa P>0.70	10.51
RIVPACS : Observed taxa P>0.70	10.00
RIVPACS : O:E (p > 0.7)	0.95

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	18.6	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	26.50	67.33 ± 71.65
Depth-Max (cm)	31.5	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	4	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0030000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.45	0.50 ± 0.25
Velocity-Max (m/s)	0.89	0.75 ± 0.28
Width-Bankfull (m)	15.6	15.6 ± 12.8
Width-Wetted (m)	10.6	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	13	6 ± 7
%Cobble (%)	57	61 ± 27
%Gravel (%)	5	1 ± 2
%Pebble (%)	23	31 ± 28
%Sand (%)	0	0 ± 0

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
%Silt+Clay (%)	2	0 ± 1
D50 (cm)	9.35	79.45 ± 47.98
Dg (cm)	8.2	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	63.11378	27.92073 ± 14.83033
SlopeLT30% (%)	63.11378	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	11.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.5	8.0 ± 0.6
General-SpCond (µS/cm)	180.1000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	11.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	10.4000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.6000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT04
Sampling Date	Aug 28 2017
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.36747 N, 114.68558 W
Altitude	1512
Local Basin Name	Flathead River
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	2.1%	94.1%	3.6%	0.2%
CABIN Assessment of FLT04 on Aug 28, 2017	Mildly Divergent				

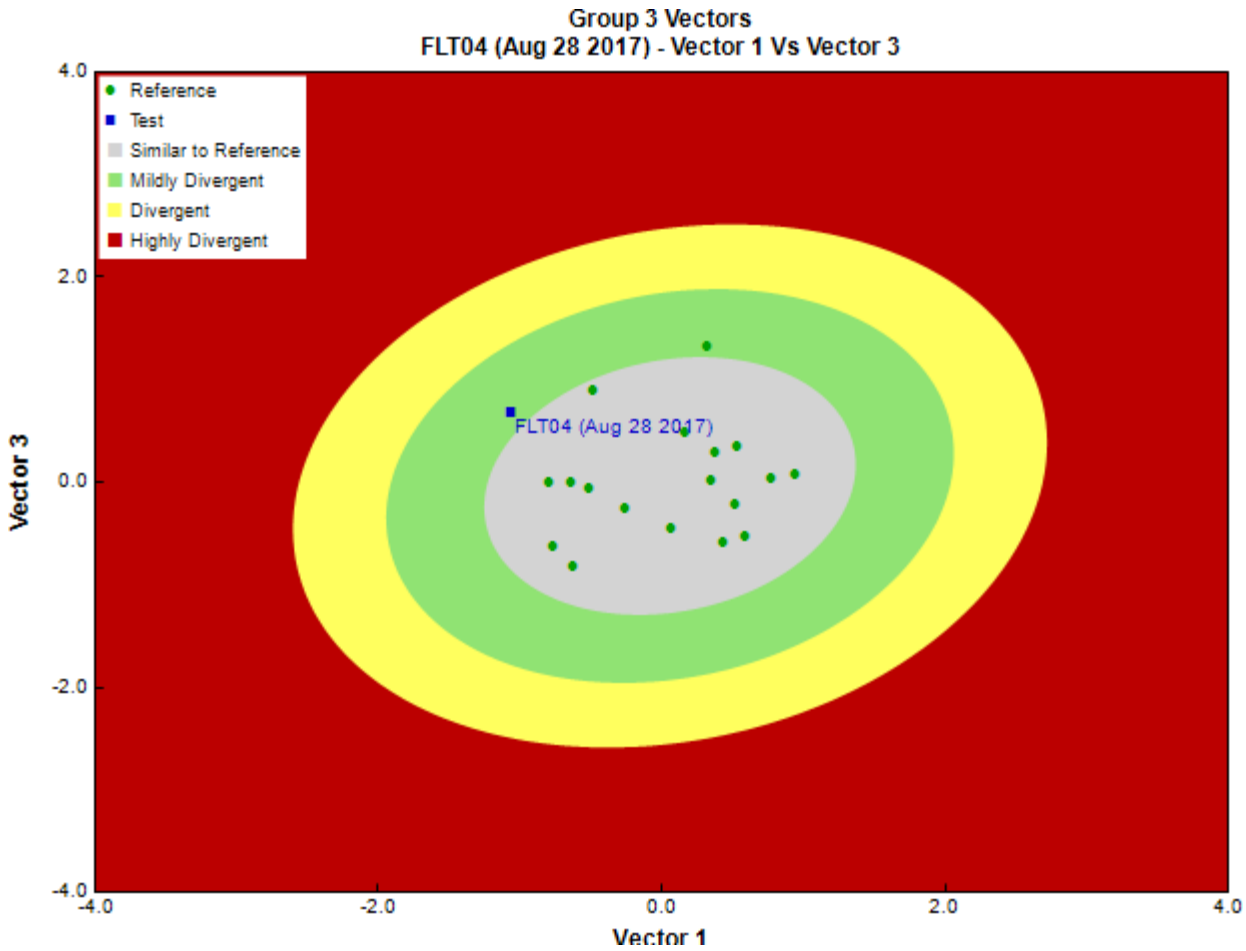


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 28, 2018
	Marchant Box
Sub-Sample Proportion	8/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	2	25.0
Arthropoda	Arachnida	Trombidiformes		2	25.0
			Aturidae	1	12.5
			Hydryphantidae	2	25.0
			Hygrobatidae	4	50.0
			Lebertiidae	1	12.5
			Sperchontidae	6	75.0

			Torrenticolidae	19	237.5
	Insecta	Coleoptera	Elmidae	21	262.5
		Diptera	Ceratopogonidae	1	12.5
			Chironomidae	157	1,962.5
			Psychodidae	8	100.0
			Tipulidae	17	212.5
		Ephemeroptera	Baetidae	34	425.0
			Ephemerellidae	13	162.5

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Heptageniidae	30	375.0
			Leptophlebiidae	1	12.5
		Plecoptera	Chloroperlidae	4	50.0
			Nemouridae	14	175.0
			Perlidae	4	50.0
			Perlodidae	4	50.0
		Trichoptera		1	12.5
			Apataniidae	3	37.5
			Brachycentridae	9	112.5
			Hydropsychidae	4	50.0
			Hydroptilidae	1	12.5
			Rhyacophilidae	8	100.0
			Uenoidae	1	12.5
			Total	372	4,650.0

Metrics

Name	FLT04	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.62	0.4 ± 0.2
Number Of Individuals		
% Chironomidae	42.5	6.9 ± 11.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.24
Apataniidae	22%	24%	28%	25%	3%	0.28
Athericidae	0%	2%	0%	17%	0%	0.01
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.03
Capniidae	78%	55%	50%	92%	68%	0.52
Ceratopogonidae	0%	55%	28%	42%	5%	0.29
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.51
Empididae	67%	55%	50%	67%	57%	0.51
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00

Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.79
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.01
Lebertiidae	78%	65%	39%	58%	5%	0.40
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.56
Limnephilidae	22%	31%	6%	25%	41%	0.07

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.17
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.37
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.06
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.37
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.01
Pisidiidae	0%	6%	0%	8%	0%	0.00
Planariidae	0%	8%	67%	17%	3%	0.64
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.91
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.39
Sperchontidae	78%	63%	50%	42%	65%	0.50
Stygothrombidiidae	0%	4%	0%	17%	0%	0.01
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.30
Torrenticolidae	11%	86%	11%	17%	11%	0.13
Uenoidae	22%	37%	17%	25%	46%	0.17
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.73
RIVPACS : Observed taxa P>0.50	12.00
RIVPACS : O:E (p > 0.5)	0.87
RIVPACS : Expected taxa P>0.70	10.51
RIVPACS : Observed taxa P>0.70	10.00
RIVPACS : O:E (p > 0.7)	0.95

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	16.7	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	18.00	67.33 ± 71.65
Depth-Max (cm)	25.0	32.9 ± 17.9
Macrophyte (PercentRange)	1	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80

Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0030000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.63	0.50 ± 0.25
Velocity-Max (m/s)	0.89	0.75 ± 0.28
Width-Bankfull (m)	15.0	15.6 ± 12.8
Width-Wetted (m)	9.4	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0

Habitat Description

Variable	FLT04	Predicted Group Reference Mean ±SD
%Boulder (%)	5	6 ± 7
%Cobble (%)	72	61 ± 27
%Gravel (%)	4	1 ± 2
%Pebble (%)	19	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	9.00	79.45 ± 47.98
Dg (cm)	8.7	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	4	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	63.11378	27.92073 ± 14.83033
SlopeLT30% (%)	63.11378	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	9.0	8.0 ± 0.6
General-SpCond (µS/cm)	192.7000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	29.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	16.1000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.5000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT06
Sampling Date	Oct 03 2013
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.08647 N, 114.52936 W
Altitude	1291
Local Basin Name	Howell Creek
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.5%	86.6%	12.5%	0.4%
CABIN Assessment of FLT06 on Oct 03, 2013	Similar to Reference				

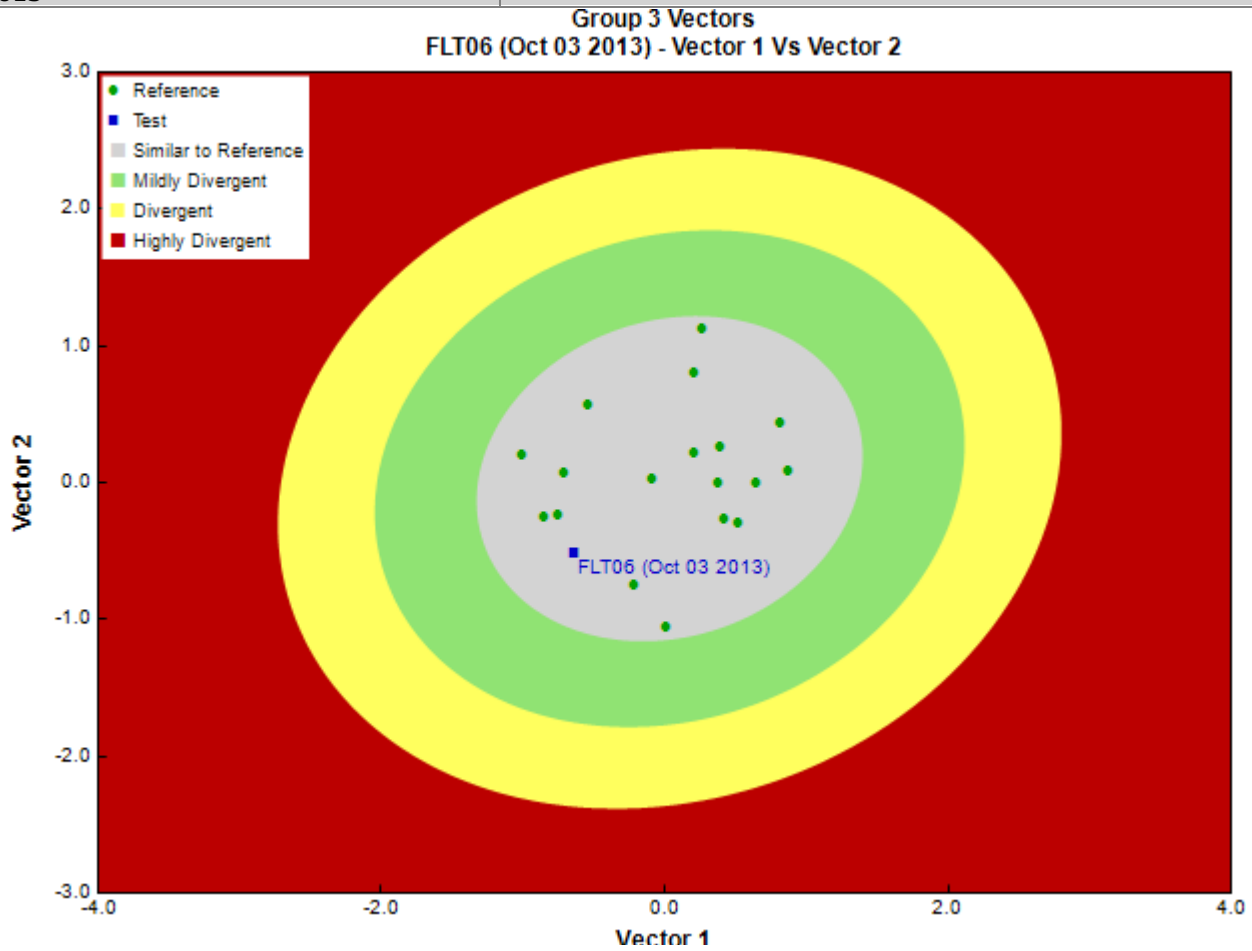


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	12/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	1	8.3
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	2	16.7
			Sperchontidae	1	8.3
			Torrenticolidae	1	8.3
	Insecta	Coleoptera	Elmidae	9	75.0
		Diptera	Chironomidae	20	166.7
			Psychodidae	10	83.3
			Tipulidae	4	33.3
		Ephemeroptera	Ameletidae	5	41.7
			Baetidae	78	650.0
			Ephemerellidae	24	200.0
			Heptageniidae	35	291.7
			Leptophlebiidae	1	8.3
		Plecoptera	Capniidae	4	33.3
			Chloroperlidae	4	33.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Nemouridae	15	125.0
			Perlidae	3	25.0
			Perlodidae	3	25.0
			Taeniopterygidae	79	658.3
		Trichoptera	Apataniidae	6	50.0
			Glossosomatidae	6	50.0
			Hydropsychidae	1	8.3
			Rhyacophilidae	5	41.7
			Uenoidae	2	16.7
			Total	319	2,658.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52

Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.34
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.60

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.83
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.20
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	0.98
RIVPACS : Expected taxa P>0.70	10.46
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	26.5	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	56.00	67.33 ± 71.65
Depth-Max (cm)	41.0	32.9 ± 17.9
Discharge (m^3/s)	0.293	0.000 ± 0.000
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.71	0.50 ± 0.25
Velocity-Max (m/s)	0.94	0.75 ± 0.28
Width-Bankfull (m)	18.8	15.6 ± 12.8
Width-Wetted (m)	15.2	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	7	6 ± 7
%Cobble (%)	62	61 ± 27
%Gravel (%)	1	1 ± 2
%Pebble (%)	30	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	8.80	79.45 ± 47.98
Dg (cm)	8.8	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	42.50562	27.92073 ± 14.83033
SlopeLT30% (%)	42.50562	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.2	8.0 ± 0.6
General-SpCond (µS/cm)	257.4000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	6.3	10.5 ± 4.2
General-TempWater (Degrees Celsius)	5.3000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	1.1400000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT06
Sampling Date	Sep 15 2014
Know Your Watershed Basin	Flathead

Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.08642 N, 114.53000 W
Altitude	391
Local Basin Name	Howell Creek
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.5%	86.8%	12.3%	0.4%
CABIN Assessment of FLT06 on Sep 15, 2014	Similar to Reference				

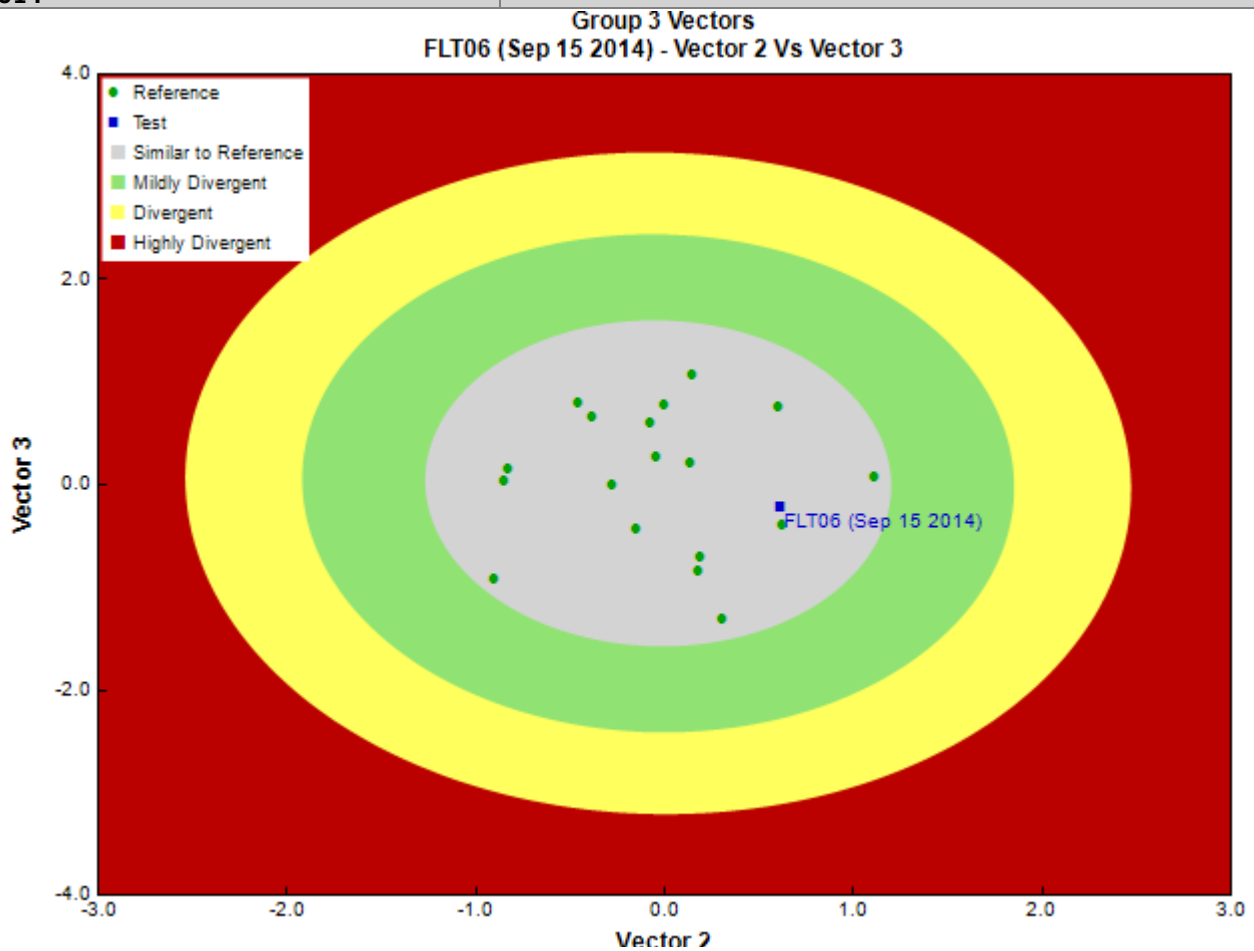


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 31, 2015
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	1	16.7
			Lebertiidae	2	33.3
	Insecta	Coleoptera	Elmidae	21	350.0
		Diptera	Chironomidae	66	1,100.0
			Psychodidae	32	533.3
			Simuliidae	2	33.3
			Tipulidae	1	16.7
		Ephemeroptera	Ameletidae	4	66.7
			Baetidae	44	733.3
			Ephemerellidae	25	416.7
			Heptageniidae	50	833.4
		Plecoptera	Capniidae	7	116.7
			Chloroperlidae	7	116.7
			Leuctridae	1	16.7
			Nemouridae	6	99.9

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Perlidae	5	83.4
			Perlodidae	3	50.0
			Taeniopterygidae	16	266.7
		Trichoptera		1	16.7
			Apataniidae	13	216.7
			Brachycentridae	1	16.7
			Glossosomatidae	3	50.0
			Hydropsychidae	3	50.0
			Rhyacophilidae	6	100.0
			Total	320	5,333.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.05
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30

Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.34
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.60

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.83
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.20
RIVPACS : Observed taxa P>0.50	14.00

RIVPACS : O:E (p > 0.5)	1.06
RIVPACS : Expected taxa P>0.70	10.46
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	23.2	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	63.50	67.33 ± 71.65
Depth-Max (cm)	32.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	1	3 ± 1
Reach-Pools (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.75	0.50 ± 0.25
Velocity-Max (m/s)	1.04	0.75 ± 0.28
Width-Bankfull (m)	24.4	15.6 ± 12.8
Width-Wetted (m)	15.7	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	13	6 ± 7
%Cobble (%)	70	61 ± 27
%Gravel (%)	1	1 ± 2
%Pebble (%)	16	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	11.85	79.45 ± 47.98
Dg (cm)	11.3	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	42.50562	27.92073 ± 14.83033
SlopeLT30% (%)	42.50562	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.2	8.0 ± 0.6
General-SpCond (µS/cm)	267.7000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	17.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	8.0000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.8700000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT06
Sampling Date	Sep 15 2015
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.08639 N, 114.52994 W
Altitude	1278
Local Basin Name	Howell Creek
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.4%	86.3%	12.8%	0.4%
CABIN Assessment of FLT06 on Sep 15, 2015	Similar to Reference				

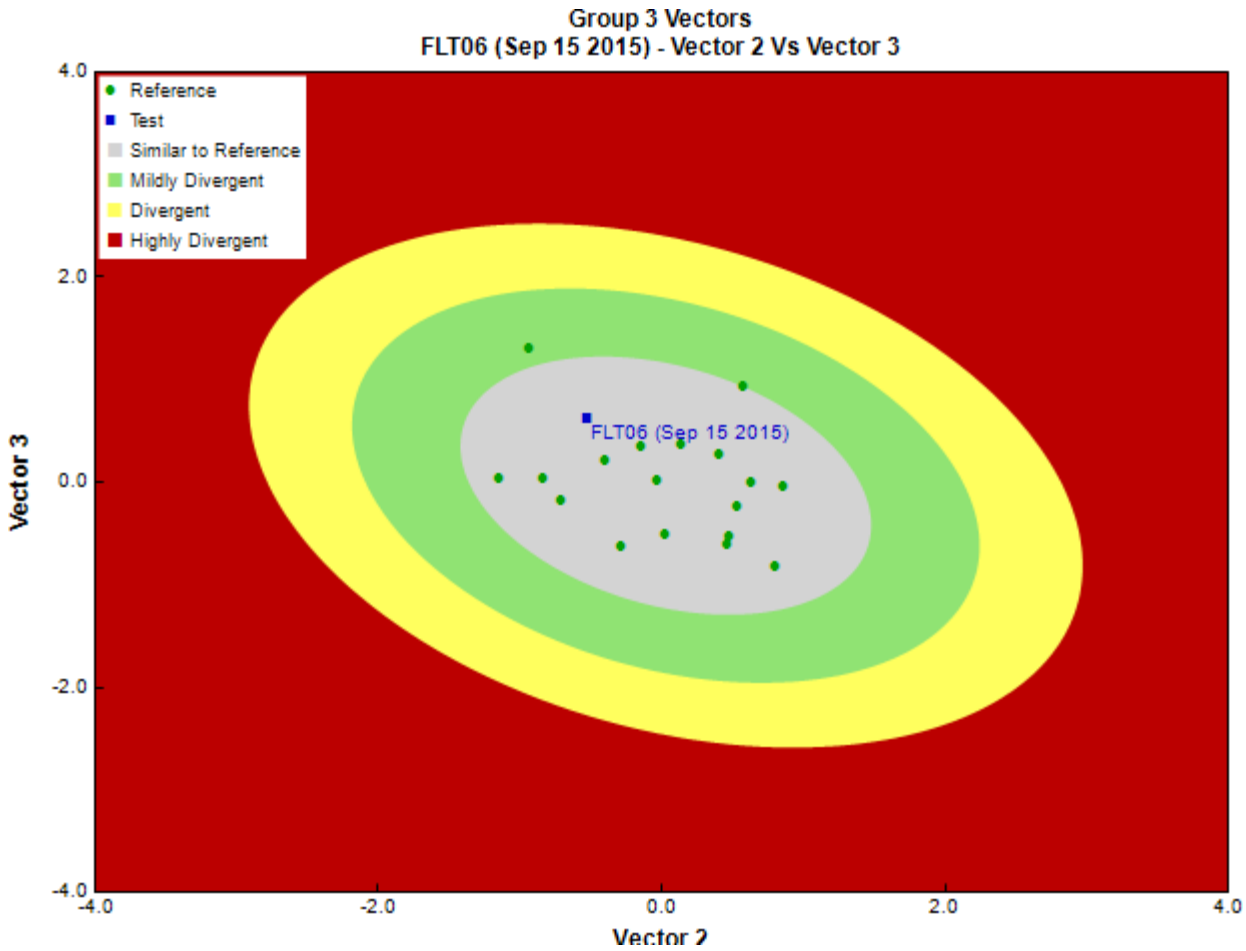


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Insecta	Coleoptera	Elmidae	13	260.0
		Diptera	Ceratopogonidae	1	20.0
			Chironomidae	38	760.0
			Pelecorhynchidae	1	20.0
			Psychodidae	29	580.0
			Tipulidae	14	280.0
		Ephemeroptera	Ameletidae	2	40.0

			Baetidae	112	2,240.0
			Ephemerellidae	42	840.0
			Heptageniidae	42	840.0
			Leptophlebiidae	1	20.0
		Plecoptera	Chloroperlidae	4	80.0
			Nemouridae	10	200.0
			Perlidae	4	80.0
			Perlodidae	16	320.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Taeniopterygidae	5	100.0
		Trichoptera	Apataniidae	9	180.0
			Brachycentridae	3	60.0
			Glossosomatidae	34	680.0
			Hydropsychidae	11	220.0
			Rhyacophilidae	4	80.0
			Total	395	7,900.0

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00

Naididae	0%	8%	39%	0%	3%	0.34
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.60
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.83
Pteronarcyidae	0%	12%	6%	0%	3%	0.05

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.70
RIVPACS : Observed taxa P>0.50	11.00
RIVPACS : O:E (p > 0.5)	0.87
RIVPACS : Expected taxa P>0.70	10.45
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	30.2	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	52.00	67.33 ± 71.65
Depth-Max (cm)	43.5	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.59	0.50 ± 0.25
Velocity-Max (m/s)	0.70	0.75 ± 0.28
Width-Bankfull (m)	20.6	15.6 ± 12.8
Width-Wetted (m)	14.1	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		

%Bedrock (%)	0	0 ± 0
%Boulder (%)	4	6 ± 7
%Cobble (%)	59	61 ± 27
%Gravel (%)	5	1 ± 2
%Pebble (%)	31	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	1	0 ± 1
D50 (cm)	9.50	79.45 ± 47.98
Dg (cm)	7.1	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	3	2 ± 1
SurroundingMaterial (Category(0-9))	4	3 ± 1
Topography		
Reg-SlopeLT30% (%)	42.50562	27.92073 ± 14.83033
SlopeLT30% (%)	42.50562	29.33739 ± 12.62448

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Water Chemistry		
General-DO (mg/L)	8.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.5	8.0 ± 0.6
General-SpCond (µS/cm)	273.4000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	11.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	7.1000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	1.2000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT06
Sampling Date	Sep 15 2016
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.08639 N, 114.52994 W
Altitude	1278
Local Basin Name	Howell Creek
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.4%	86.3%	12.9%	0.4%
CABIN Assessment of FLT06 on Sep 15, 2016	Mildly Divergent				

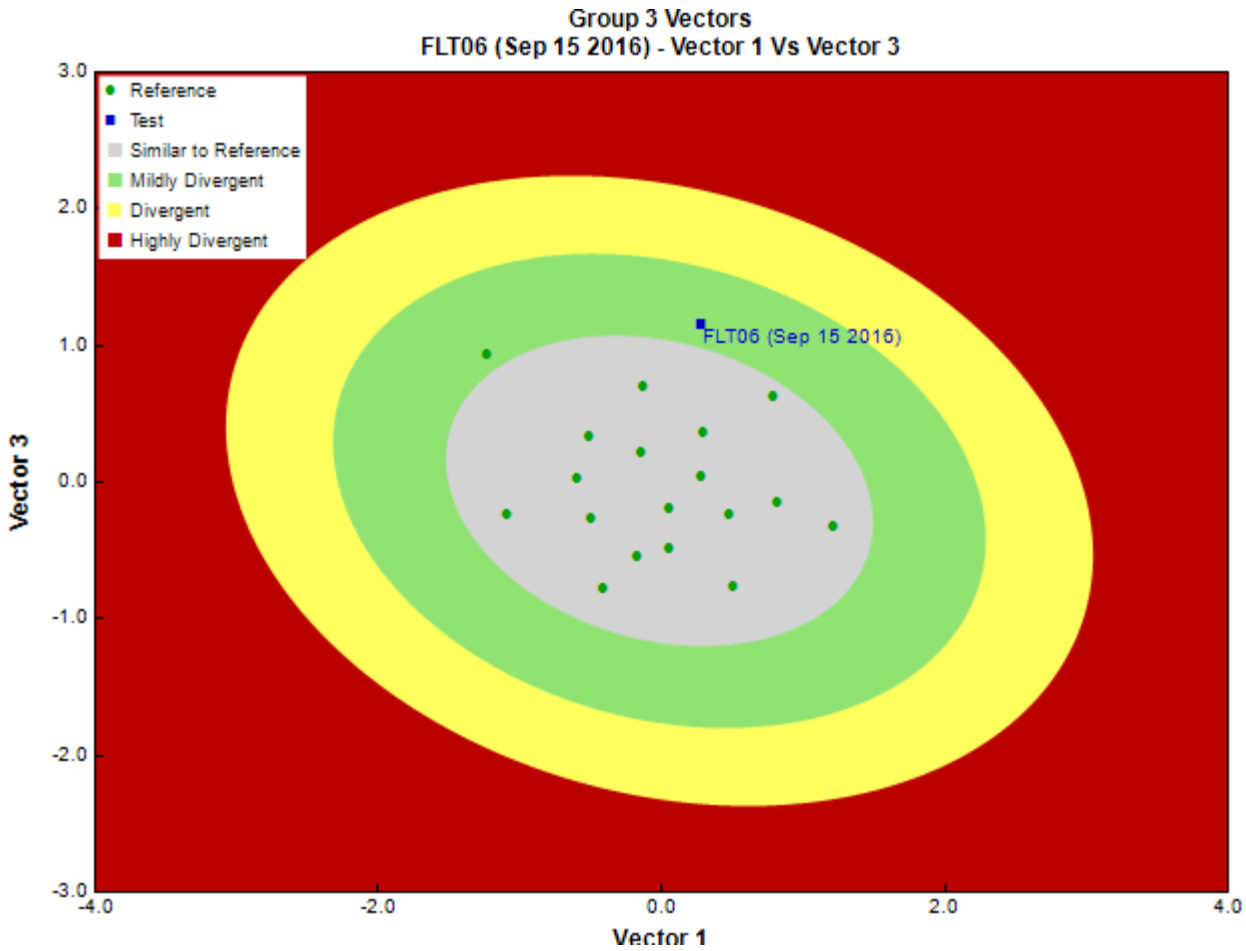


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	February 12, 2017
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	1	16.7
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	5	83.3
			Sperchontidae	4	66.7
			Torrenticolidae	1	16.7
	Insecta	Coleoptera	Elmidae	19	316.7
		Diptera	Chironomidae	57	950.0
			Pelecorhynchidae	1	16.7

			Psychodidae	9	150.0
			Simuliidae	2	33.4
			Tipulidae	15	250.0
		Ephemeroptera	Ameletidae	2	33.3
			Baetidae	52	866.7
			Ephemerellidae	22	366.6
			Heptageniidae	25	416.7
		Plecoptera	Capniidae	1	16.7

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Chloroperlidae	1	16.7
			Leuctridae	1	16.7
			Nemouridae	4	66.7
			Perlidae	2	33.3
			Perlodidae	6	100.0
			Taeniopterygidae	6	100.0
		Trichoptera		3	50.0
			Apataniidae	9	150.0
			Brachycentridae	11	183.3
			Glossosomatidae	55	916.7
			Hydropsychidae	1	16.7
			Lepidostomatidae	1	16.7
			Rhyacophilidae	2	33.3
			Uenoidae	11	183.3
			Total	329	5,483.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00

Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.34
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.60
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.83
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.70
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	1.02
RIVPACS : Expected taxa P>0.70	10.45
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	31.0	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	14.35	67.33 ± 71.65
Depth-Max (cm)	37.4	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0

Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.58	0.50 ± 0.25
Velocity-Max (m/s)	0.84	0.75 ± 0.28
Width-Bankfull (m)	20.3	15.6 ± 12.8
Width-Wetted (m)	143.5	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	8	6 ± 7
%Cobble (%)	66	61 ± 27
%Gravel (%)	2	1 ± 2
%Pebble (%)	23	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	1	0 ± 1
D50 (cm)	9.15	79.45 ± 47.98
Dg (cm)	8.8	73.9 ± 48.0

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	42.50562	27.92073 ± 14.83033
SlopeLT30% (%)	42.50562	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	11.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.8	8.0 ± 0.6
General-SpCond (µS/cm)	279.3000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	11.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	5.5000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.5000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT06
Sampling Date	Aug 30 2017
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.08636 N, 114.52994 W
Altitude	1278
Local Basin Name	Howell Creek
	Flathead River
Stream Order	5

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 28, 2019

Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.4%	86.2%	13.0%	0.4%
CABIN Assessment of FLT06 on Aug 30, 2017	Similar to Reference				

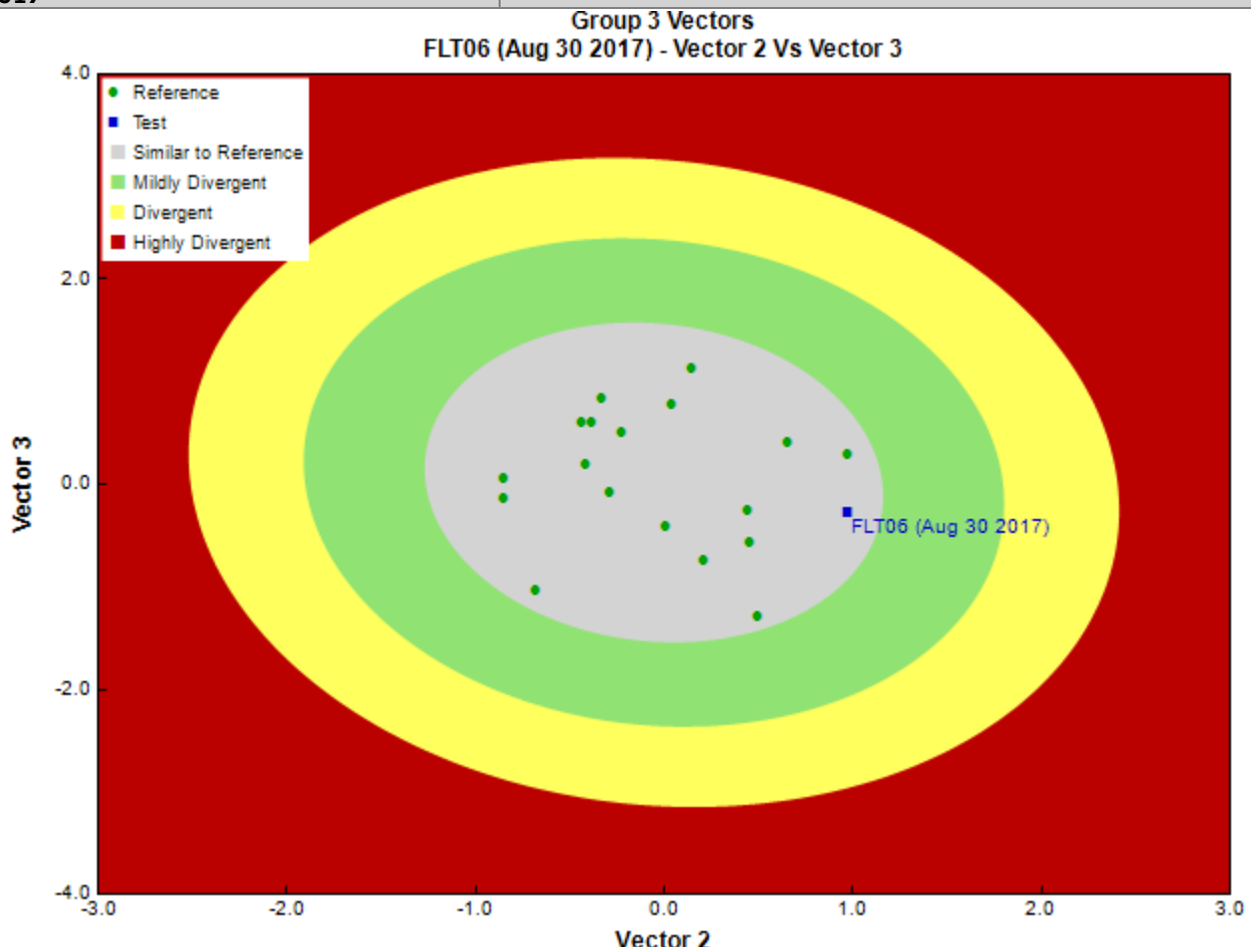


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 14, 2018

	Marchant Box
Sub-Sample Proportion	7/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	1	14.3
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	1	14.3
			Lebertiidae	5	71.4
			Sperchontidae	1	14.3
			Torrenticolidae	1	14.3
	Insecta	Coleoptera	Elmidae	26	371.4
		Diptera	Chironomidae	90	1,285.7
			Empididae	1	14.3
			Psychodidae	26	371.4
		Ephemeroptera	Ameletidae	4	57.1
			Baetidae	83	1,185.7
			Ephemerellidae	21	300.1
			Heptageniidae	32	457.1
		Plecoptera	Capniidae	13	185.7
			Chloroperlidae	5	71.5

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Nemouridae	8	114.3
			Perlidae	4	57.1
			Perlodidae	3	42.9
			Taeniopterygidae	2	28.6
		Trichoptera	Apataniidae	14	200.0
			Brachycentridae	6	85.7
			Glossosomatidae	17	242.9
			Hydropsychidae	3	42.9
			Rhyacophilidae	2	28.6
			Uenoidae	1	14.3
			Total	370	5,285.9

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39

Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.34
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT06
	Group 1	Group 2	Group 3	Group 4	Group 5	
Planariidae	0%	8%	67%	17%	3%	0.60
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.83
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.70
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	1.02
RIVPACS : Expected taxa P>0.70	10.45
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	31.7	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	36.00	67.33 ± 71.65
Depth-Max (cm)	44.0	32.9 ± 17.9

Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.69	0.50 ± 0.25
Velocity-Max (m/s)	0.83	0.75 ± 0.28
Width-Bankfull (m)	19.0	15.6 ± 12.8
Width-Wetted (m)	15.1	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	8	6 ± 7
%Cobble (%)	78	61 ± 27
%Gravel (%)	1	1 ± 2
%Pebble (%)	13	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	11.50	79.45 ± 47.98
Dg (cm)	11.3	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2

Habitat Description

Variable	FLT06	Predicted Group Reference Mean ±SD
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	4	3 ± 1
Topography		
Reg-SlopeLT30% (%)	42.50562	27.92073 ± 14.83033
SlopeLT30% (%)	42.50562	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	9.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.6	8.0 ± 0.6
General-SpCond (µS/cm)	267.0000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	22.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	9.2000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.7000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT07
Sampling Date	Oct 03 2013
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.36733 N, 114.68569 W
Altitude	1384
Local Basin Name	Cate Creek

	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	November 12, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.1%	74.8%	23.4%	1.7%
CABIN Assessment of FLT07 on Oct 03, 2013	Similar to Reference				

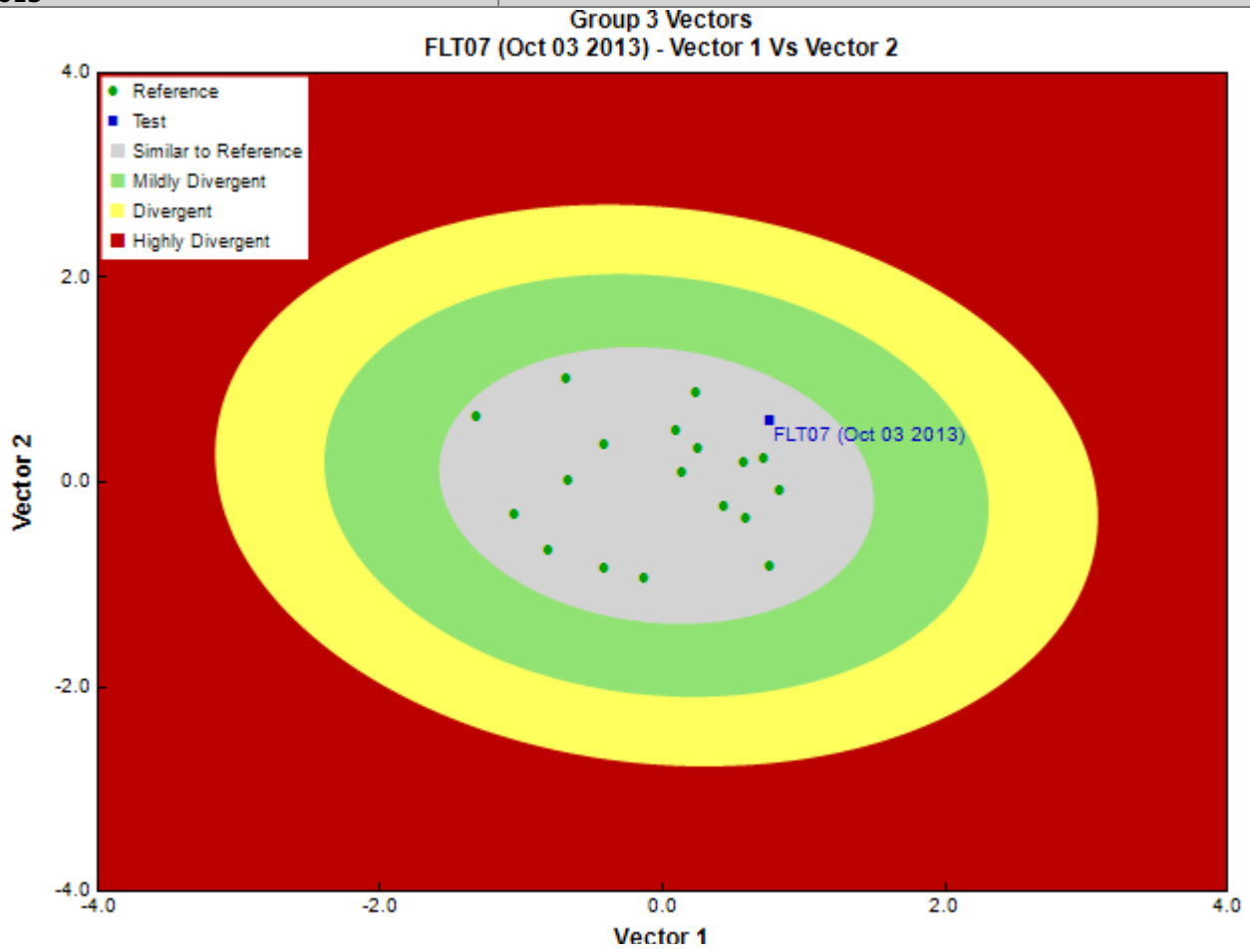


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	12/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Insecta	Diptera	Ceratopogonidae	1	8.3
			Chironomidae	3	25.0
			Psychodidae	1	8.3
			Tipulidae	1	8.3
		Ephemeroptera	Ameletidae	5	41.7
			Baetidae	3	25.0
			Ephemerellidae	6	50.0
			Heptageniidae	115	958.3
		Plecoptera	Capniidae	1	8.3
			Chloroperlidae	5	41.7
			Leuctridae	2	16.7
			Nemouridae	11	91.6
			Peltoperlidae	2	16.7
			Perlodidae	3	25.0
			Taeniopterygidae	181	1,508.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Trichoptera	Apataniidae	2	16.7
			Glossosomatidae	1	8.3
			Hydropsychidae	1	8.3
			Rhyacophilidae	1	8.3
			Total	345	2,874.8

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT07
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.30
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.04
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.10
Capniidae	78%	55%	50%	92%	68%	0.60
Ceratopogonidae	0%	55%	28%	42%	5%	0.31
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.96
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.04
Elmidae	0%	86%	50%	50%	5%	0.49
Empididae	67%	55%	50%	67%	57%	0.54
Enchytraeidae	11%	14%	0%	8%	0%	0.02

Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.81
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.10
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.43
Lepidostomatidae	0%	53%	6%	17%	8%	0.08
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.16
Leuctridae	22%	43%	56%	67%	54%	0.58
Limnephilidae	22%	31%	6%	25%	41%	0.11
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.29
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.04
Peltoperlidae	22%	12%	6%	8%	41%	0.07
Perlidae	11%	84%	33%	100%	3%	0.49
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.02
Planariidae	0%	8%	67%	17%	3%	0.54
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.73
Pteronarcyidae	0%	12%	6%	0%	3%	0.04
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.37

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT07
	Group 1	Group 2	Group 3	Group 4	Group 5	
Sperchontidae	78%	63%	50%	42%	65%	0.48
Stygothrombidiidae	0%	4%	0%	17%	0%	0.04
Taeniopterygidae	89%	49%	100%	92%	97%	0.98
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.37
Torrenticolidae	11%	86%	11%	17%	11%	0.13
Uenoidae	22%	37%	17%	25%	46%	0.19
Valvatidae	0%	2%	6%	0%	0%	0.04

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.63
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	1.03
RIVPACS : Expected taxa P>0.70	10.37
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.06

Habitat Description

Variable	FLT07	Predicted Group Reference Mean ±SD

Channel		
Depth-Avg (cm)	20.1	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	75.90	67.33 ± 71.65
Depth-Max (cm)	28.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	4	3 ± 1
Reach-Rapids (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.82	0.50 ± 0.25
Velocity-Max (m/s)	1.33	0.75 ± 0.28
Width-Bankfull (m)	11.8	15.6 ± 12.8
Width-Wetted (m)	7.3	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	2	6 ± 7
%Cobble (%)	39	61 ± 27
%Gravel (%)	6	1 ± 2
%Pebble (%)	49	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	4	0 ± 1
D50 (cm)	5.50	79.45 ± 47.98
Dg (cm)	4.6	73.9 ± 48.0
Dominant-1st (Category(0-9))	5	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	26.33417	27.92073 ± 14.83033
SlopeLT30% (%)	26.33417	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	9.0000000	10.4922222 ± 0.8833463

Habitat Description

Variable	FLT07	Predicted Group Reference Mean ±SD
General-pH (pH)	7.9	8.0 ± 0.6
General-SpCond (µS/cm)	253.8000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	5.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	6.7000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.4100000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT07
Sampling Date	Sep 16 2014
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.24878 N, 114.54672 W
Altitude	1382

Local Basin Name	Cate Creek
	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	November 12, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.1%	76.5%	22.1%	1.3%
CABIN Assessment of FLT07 on Sep 16, 2014	Similar to Reference				

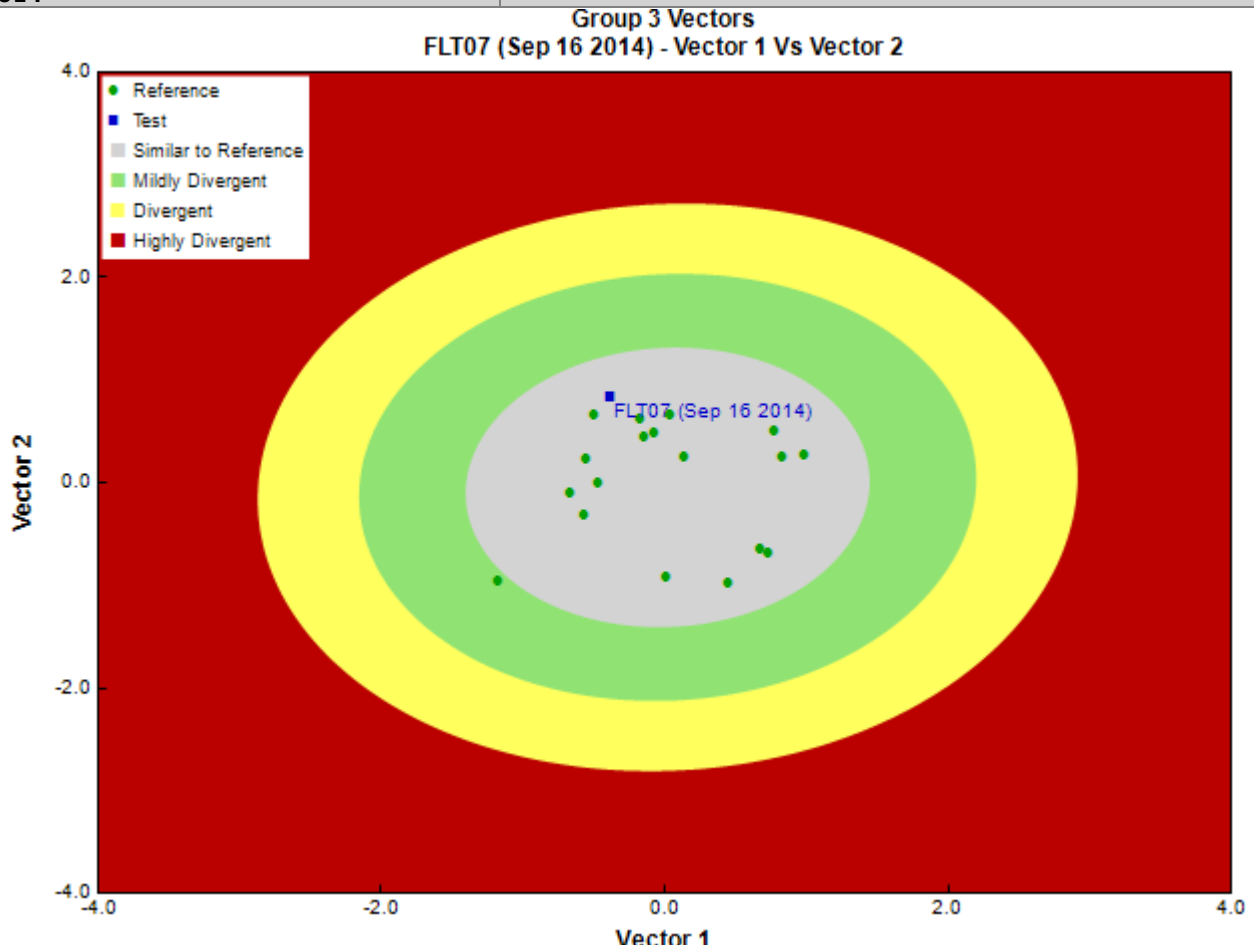


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	February 03, 2015
	Marchant Box
Sub-Sample Proportion	10/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	1	10.0
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	1	10.0
			Sperchontidae	2	20.0
	Insecta	Diptera	Chironomidae	18	180.0
			Empididae	2	20.0
			Psychodidae	4	40.0
			Tipulidae	1	10.0
		Ephemeroptera	Ameletidae	7	70.0
			Baetidae	19	190.0
			Ephemerellidae	4	40.0
			Heptageniidae	141	1,410.0
		Plecoptera	Capniidae	7	70.0
			Chloroperlidae	13	130.0
			Nemouridae	5	50.0
			Perlodidae	4	40.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Taeniopterygidae	129	1,290.0
		Trichoptera	Apataniidae	1	10.0
			Hydropsychidae	3	30.0
			Rhyacophilidae	1	10.0
			Total	363	3,630.0

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT07
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.29
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.04
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.09
Capniidae	78%	55%	50%	92%	68%	0.59
Ceratopogonidae	0%	55%	28%	42%	5%	0.31
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.96
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.04
Elmidae	0%	86%	50%	50%	5%	0.49
Empididae	67%	55%	50%	67%	57%	0.54
Enchytraeidae	11%	14%	0%	8%	0%	0.02

Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.81
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.10
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.43
Lepidostomatidae	0%	53%	6%	17%	8%	0.08
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.16
Leuctridae	22%	43%	56%	67%	54%	0.58
Limnephilidae	22%	31%	6%	25%	41%	0.10
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.30
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.04
Peltoperlidae	22%	12%	6%	8%	41%	0.07
Perlidae	11%	84%	33%	100%	3%	0.48
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.02
Planariidae	0%	8%	67%	17%	3%	0.55
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.74
Pteronarcyidae	0%	12%	6%	0%	3%	0.04
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.37

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT07
	Group 1	Group 2	Group 3	Group 4	Group 5	
Sperchontidae	78%	63%	50%	42%	65%	0.48
Stygothrombidiidae	0%	4%	0%	17%	0%	0.04
Taeniopterygidae	89%	49%	100%	92%	97%	0.98
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.37
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.19
Valvatidae	0%	2%	6%	0%	0%	0.04

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.64
RIVPACS : Observed taxa P>0.50	0.00
RIVPACS : O:E (p > 0.5)	0.00
RIVPACS : Expected taxa P>0.70	10.38
RIVPACS : Observed taxa P>0.70	0.00
RIVPACS : O:E (p > 0.7)	0.00

Habitat Description

Variable	FLT07	Predicted Group Reference Mean ±SD
Channel		

Depth-Avg (cm)	14.4	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	125.00	67.33 ± 71.65
Depth-Max (cm)	21.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	3	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.44	0.50 ± 0.25
Velocity-Max (m/s)	0.54	0.75 ± 0.28
Width-Bankfull (m)	36.4	15.6 ± 12.8
Width-Wetted (m)	4.6	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	2	6 ± 7
%Cobble (%)	51	61 ± 27
%Gravel (%)	1	1 ± 2
%Pebble (%)	44	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	2	0 ± 1
D50 (cm)	6.50	79.45 ± 47.98
Dg (cm)	5.9	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 2
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	2	3 ± 1
Topography		
Reg-SlopeLT30% (%)	26.33417	27.92073 ± 14.83033
SlopeLT30% (%)	26.33417	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	9.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.0	8.0 ± 0.6

Habitat Description

Variable	FLT07	Predicted Group Reference Mean ±SD
General-SpCond (µS/cm)	263.7000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	20.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	9.0000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.6900000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT07
Sampling Date	Sep 14 2015
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.24906 N, 114.54614 W
Altitude	1380

Local Basin Name	Cate Creek
	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	November 12, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.2%	77.1%	21.5%	1.3%
CABIN Assessment of FLT07 on Sep 14, 2015	Similar to Reference				

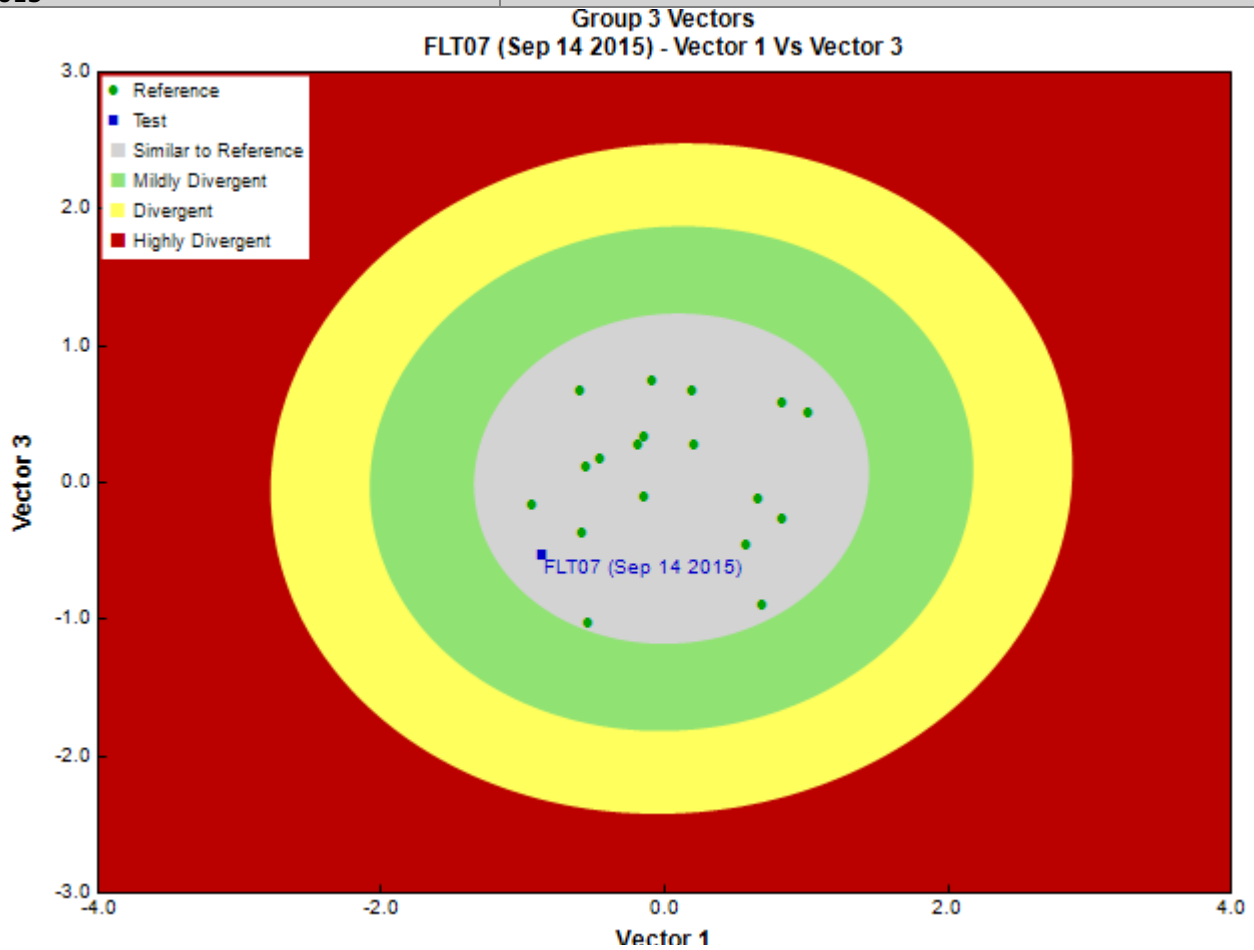


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Insecta	Diptera	Chironomidae	5	100.0
		Ephemeroptera	Ameletidae	17	340.0
			Baetidae	21	420.0
			Ephemerellidae	5	100.0
			Heptageniidae	151	3,020.0
		Plecoptera	Capniidae	1	20.0
			Chloroperlidae	9	180.0
			Nemouridae	17	340.0
			Perlodidae	2	40.0
			Taeniopterygidae	157	3,140.0
		Trichoptera		2	40.0
			Apataniidae	1	20.0
			Hydropsychidae	5	100.0
			Rhyacophilidae	3	60.0
			Total	396	7,920.0

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT07
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.29
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.04
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.09
Capniidae	78%	55%	50%	92%	68%	0.59
Ceratopogonidae	0%	55%	28%	42%	5%	0.31
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.96
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.04
Elmidae	0%	86%	50%	50%	5%	0.49
Empididae	67%	55%	50%	67%	57%	0.54
Enchytraeidae	11%	14%	0%	8%	0%	0.02
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.81
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15

Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.43
Lepidostomatidae	0%	53%	6%	17%	8%	0.08
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.16
Leuctridae	22%	43%	56%	67%	54%	0.58
Limnephilidae	22%	31%	6%	25%	41%	0.10
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.30
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.04
Peltoperlidae	22%	12%	6%	8%	41%	0.07
Perlidae	11%	84%	33%	100%	3%	0.47
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.02
Planariidae	0%	8%	67%	17%	3%	0.55
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.75
Pteronarcyidae	0%	12%	6%	0%	3%	0.04
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.37
Sperchontidae	78%	63%	50%	42%	65%	0.48
Stygothrombidiidae	0%	4%	0%	17%	0%	0.04
Taeniopterygidae	89%	49%	100%	92%	97%	0.98
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.36
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.19
Valvatidae	0%	2%	6%	0%	0%	0.04

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.64
RIVPACS : Observed taxa P>0.50	0.00
RIVPACS : O:E (p > 0.5)	0.00
RIVPACS : Expected taxa P>0.70	10.39
RIVPACS : Observed taxa P>0.70	0.00
RIVPACS : O:E (p > 0.7)	0.00

Habitat Description

Variable	FLT07	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	10.1	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	58.00	67.33 ± 71.65
Depth-Max (cm)	11.5	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	4	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.36	0.50 ± 0.25
Velocity-Max (m/s)	0.44	0.75 ± 0.28
Width-Bankfull (m)	6.2	15.6 ± 12.8

Width-Wetted (m)	2.0	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	6 ± 7
%Cobble (%)	40	61 ± 27
%Gravel (%)	3	1 ± 2
%Pebble (%)	57	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	5.00	79.45 ± 47.98
Dg (cm)	5.5	73.9 ± 48.0
Dominant-1st (Category(0-9))	5	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	26.33417	27.92073 ± 14.83033
SlopeLT30% (%)	26.33417	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.4	8.0 ± 0.6
General-SpCond (µS/cm)	285.8000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	10.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	8.2000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	1.9500000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT07
Sampling Date	Sep 14 2016
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.24883 N, 114.54694 W
Altitude	1383
Local Basin Name	Cate Creek
	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	November 12, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%

Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.2%	77.4%	21.1%	1.3%
CABIN Assessment of FLT07 on Sep 14, 2016	Similar to Reference				

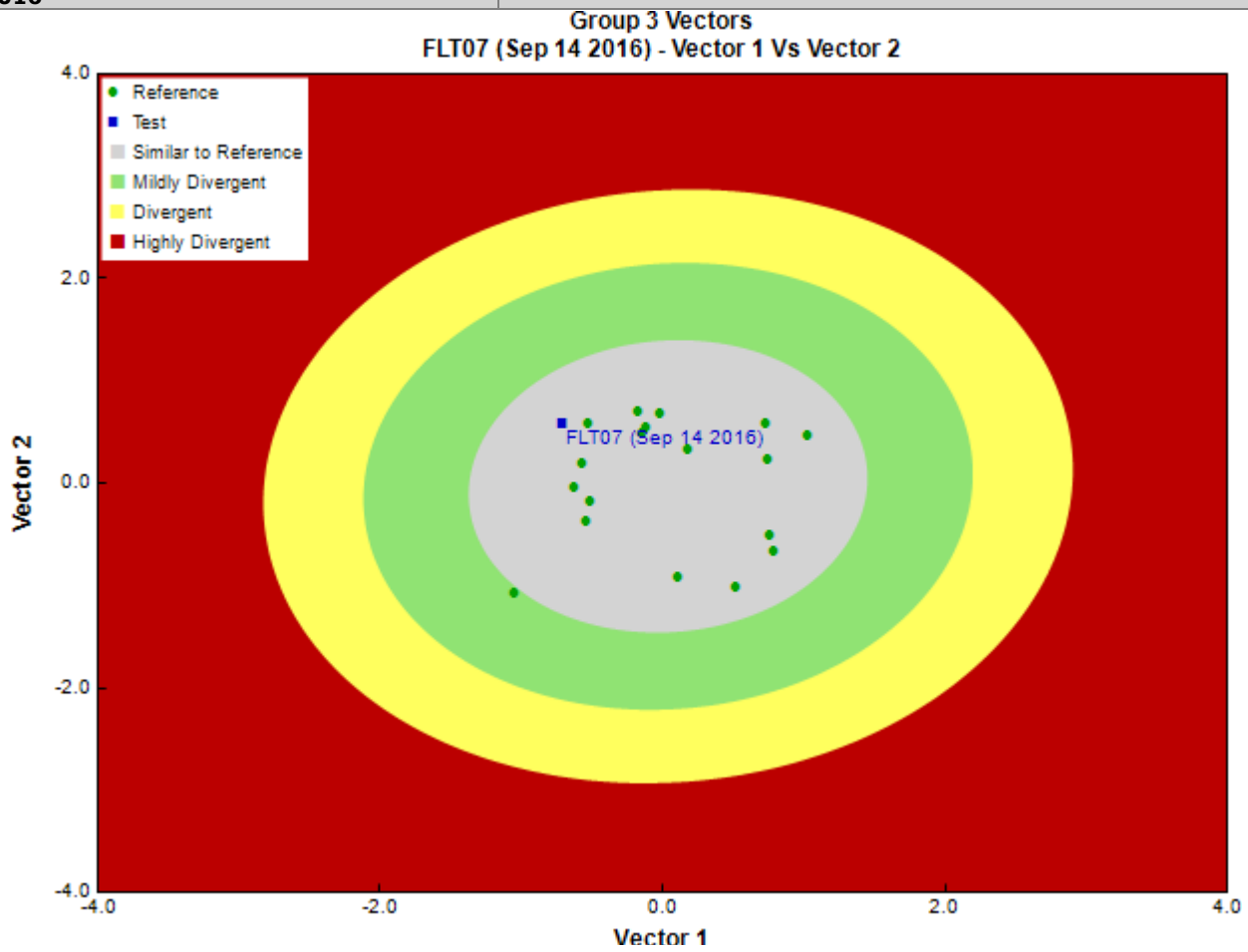


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	February 09, 2017
	Marchant Box
Sub-Sample Proportion	8/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	1	12.5
Arthropoda	Insecta	Coleoptera	Elmidae	1	12.5
		Diptera	Chironomidae	3	37.5

			Simuliidae	3	37.5
			Tipulidae	1	12.5
		Ephemeroptera	Ameletidae	5	62.5
			Baetidae	20	250.0
			Ephemerellidae	7	87.5
			Heptageniidae	197	2,462.5
		Plecoptera	Capniidae	2	25.0
			Chloroperlidae	4	50.0
			Leuctridae	1	12.5
			Nemouridae	13	162.5
			Perlodidae	5	62.5
			Taeniopterygidae	102	1,275.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Trichoptera	Apataniidae	3	37.5
			Glossosomatidae	3	37.5
			Hydropsychidae	9	112.5
			Rhyacophilidae	3	37.5
			Total	383	4,787.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT07
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.29
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.04
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.09
Capniidae	78%	55%	50%	92%	68%	0.59
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.96
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.04
Elmidae	0%	86%	50%	50%	5%	0.49
Empididae	67%	55%	50%	67%	57%	0.54
Enchytraeidae	11%	14%	0%	8%	0%	0.02
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.81
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.43
Lepidostomatidae	0%	53%	6%	17%	8%	0.08
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.16
Leuctridae	22%	43%	56%	67%	54%	0.58
Limnephilidae	22%	31%	6%	25%	41%	0.10
Limnesiidae	0%	2%	0%	0%	0%	0.00

Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.30
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.04
Peltoperlidae	22%	12%	6%	8%	41%	0.07
Perlidae	11%	84%	33%	100%	3%	0.47
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.02
Planariidae	0%	8%	67%	17%	3%	0.55
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.75
Pteronarcyidae	0%	12%	6%	0%	3%	0.04
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.37

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT07
	Group 1	Group 2	Group 3	Group 4	Group 5	
Sperchontidae	78%	63%	50%	42%	65%	0.48
Stygothrombidiidae	0%	4%	0%	17%	0%	0.04
Taeniopterygidae	89%	49%	100%	92%	97%	0.98
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.36
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.19
Valvatidae	0%	2%	6%	0%	0%	0.04

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.65
RIVPACS : Observed taxa P>0.50	0.00
RIVPACS : O:E (p > 0.5)	0.00
RIVPACS : Expected taxa P>0.70	10.39
RIVPACS : Observed taxa P>0.70	0.00
RIVPACS : O:E (p > 0.7)	0.00

Habitat Description

Variable	FLT07	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	7.0	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	80.00	67.33 ± 71.65
Depth-Max (cm)	11.5	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	4	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.17	0.50 ± 0.25
Velocity-Max (m/s)	0.31	0.75 ± 0.28
Width-Bankfull (m)	45.0	15.6 ± 12.8
Width-Wetted (m)	4.1	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785

Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	2	6 ± 7
%Cobble (%)	41	61 ± 27
%Gravel (%)	7	1 ± 2
%Pebble (%)	50	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	5.80	79.45 ± 47.98
Dg (cm)	5.6	73.9 ± 48.0
Dominant-1st (Category(0-9))	5	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 2
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	26.33417	27.92073 ± 14.83033
SlopeLT30% (%)	26.33417	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	11.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.4	8.0 ± 0.6

Habitat Description

Variable	FLT07	Predicted Group Reference Mean ±SD
General-SpCond (µS/cm)	273.0000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	10.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	9.0000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.4000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT07
Sampling Date	Aug 29 2017
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.24872 N, 114.54703 W
Altitude	1382
Local Basin Name	Cate Creek
	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	November 12, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	1	2	3	4	5
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%

Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.2%	77.5%	21.0%	1.3%
CABIN Assessment of FLT07 on Aug 29, 2017	Mildly Divergent				

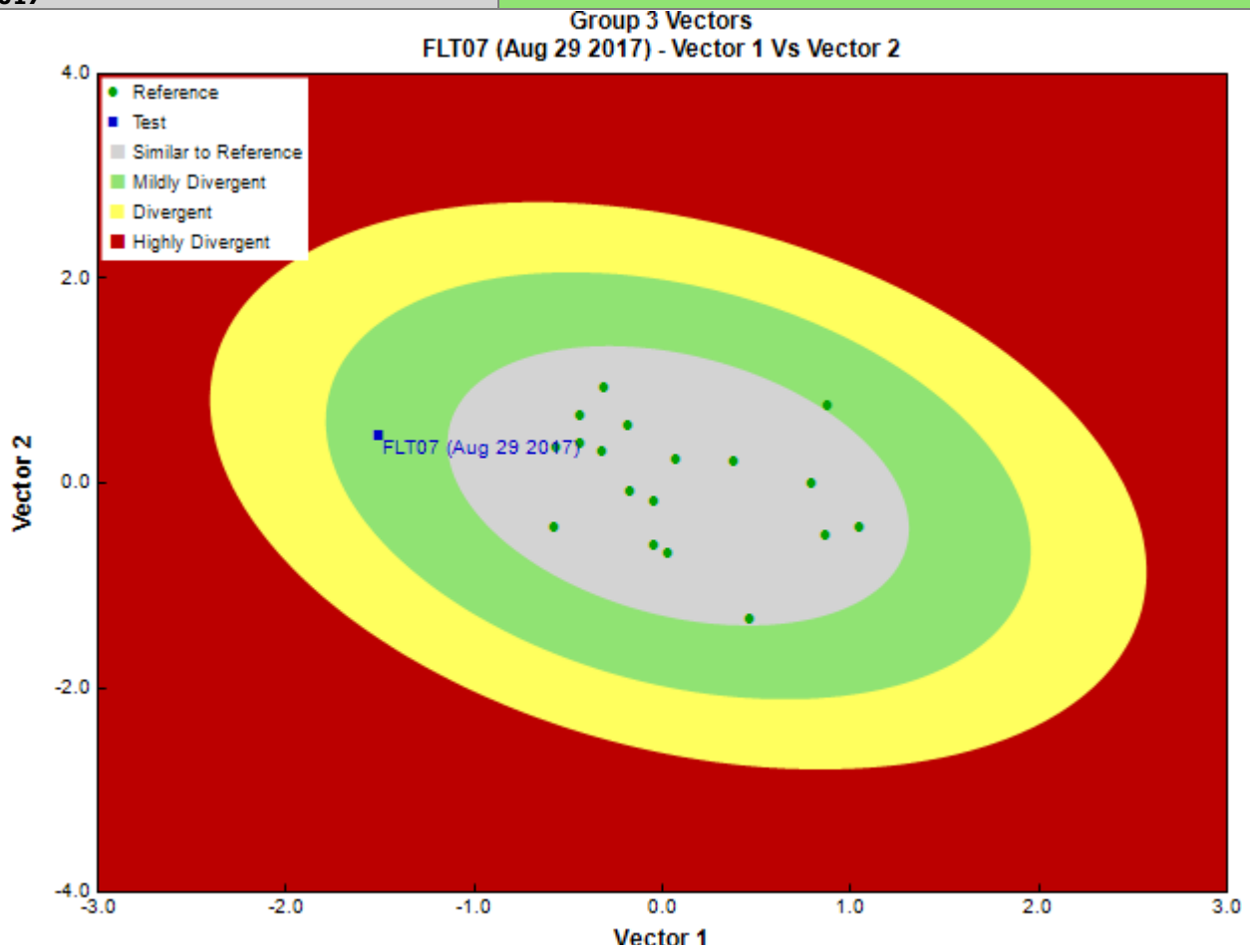


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 02, 2018
	Marchant Box
Sub-Sample Proportion	28/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	1	3.6
	Insecta	Diptera	Chironomidae	5	17.9
		Ephemeroptera	Ameletidae	44	157.1

			Baetidae	3	10.7
			Ephemerellidae	8	28.6
			Heptageniidae	246	878.6
		Plecoptera	Capniidae	5	17.9
			Chloroperlidae	11	39.3
			Leuctridae	1	3.6
			Nemouridae	3	10.8
			Perlodidae	2	7.2
			Taeniopterygidae	8	28.6
		Trichoptera	Apataniidae	3	10.7
			Hydropsychidae	1	3.6
			Total	341	1,218.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT07
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.29
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.04
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.09
Capniidae	78%	55%	50%	92%	68%	0.59
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.96
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.04
Elmidae	0%	86%	50%	50%	5%	0.49
Empididae	67%	55%	50%	67%	57%	0.54
Enchytraeidae	11%	14%	0%	8%	0%	0.02
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.81
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.43
Lepidostomatidae	0%	53%	6%	17%	8%	0.08
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.16
Leuctridae	22%	43%	56%	67%	54%	0.58
Limnephilidae	22%	31%	6%	25%	41%	0.10
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.30
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.04
Peltoperlidae	22%	12%	6%	8%	41%	0.07
Perlidae	11%	84%	33%	100%	3%	0.47
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.02

Planariidae	0%	8%	67%	17%	3%	0.55
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.75
Pteronarcyidae	0%	12%	6%	0%	3%	0.04
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.37
Sperchontidae	78%	63%	50%	42%	65%	0.48
Stygothrombidiidae	0%	4%	0%	17%	0%	0.04
Taeniopterygidae	89%	49%	100%	92%	97%	0.98
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.36
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.19
Valvatidae	0%	2%	6%	0%	0%	0.04

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.65
RIVPACS : Observed taxa P>0.50	0.00
RIVPACS : O:E (p > 0.5)	0.00
RIVPACS : Expected taxa P>0.70	10.39
RIVPACS : Observed taxa P>0.70	0.00
RIVPACS : O:E (p > 0.7)	0.00

Habitat Description

Variable	FLT07	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	5.7	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	85.00	67.33 ± 71.65
Depth-Max (cm)	7.5	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	4	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0140000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.24	0.50 ± 0.25
Velocity-Max (m/s)	0.40	0.75 ± 0.28
Width-Bankfull (m)	43.0	15.6 ± 12.8
Width-Wetted (m)	3.0	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	1	6 ± 7
%Cobble (%)	47	61 ± 27
%Gravel (%)	10	1 ± 2
%Pebble (%)	42	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	6.00	79.45 ± 47.98
Dg (cm)	5.1	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	1	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		

Reg-SlopeLT30% (%)	26.33417	27.92073 ± 14.83033
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.6	8.0 ± 0.6
General-SpCond (µS/cm)	270.0000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	19.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	12.5000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.2500000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT08
Sampling Date	Oct 04 2013
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.04072 N, 114.53475 W
Altitude	1300
Local Basin Name	Cauldry Creek
	Flathead River
Stream Order	4

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 29, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.6%	86.4%	12.7%	0.3%
CABIN Assessment of FLT08 on Oct 04, 2013	Similar to Reference				

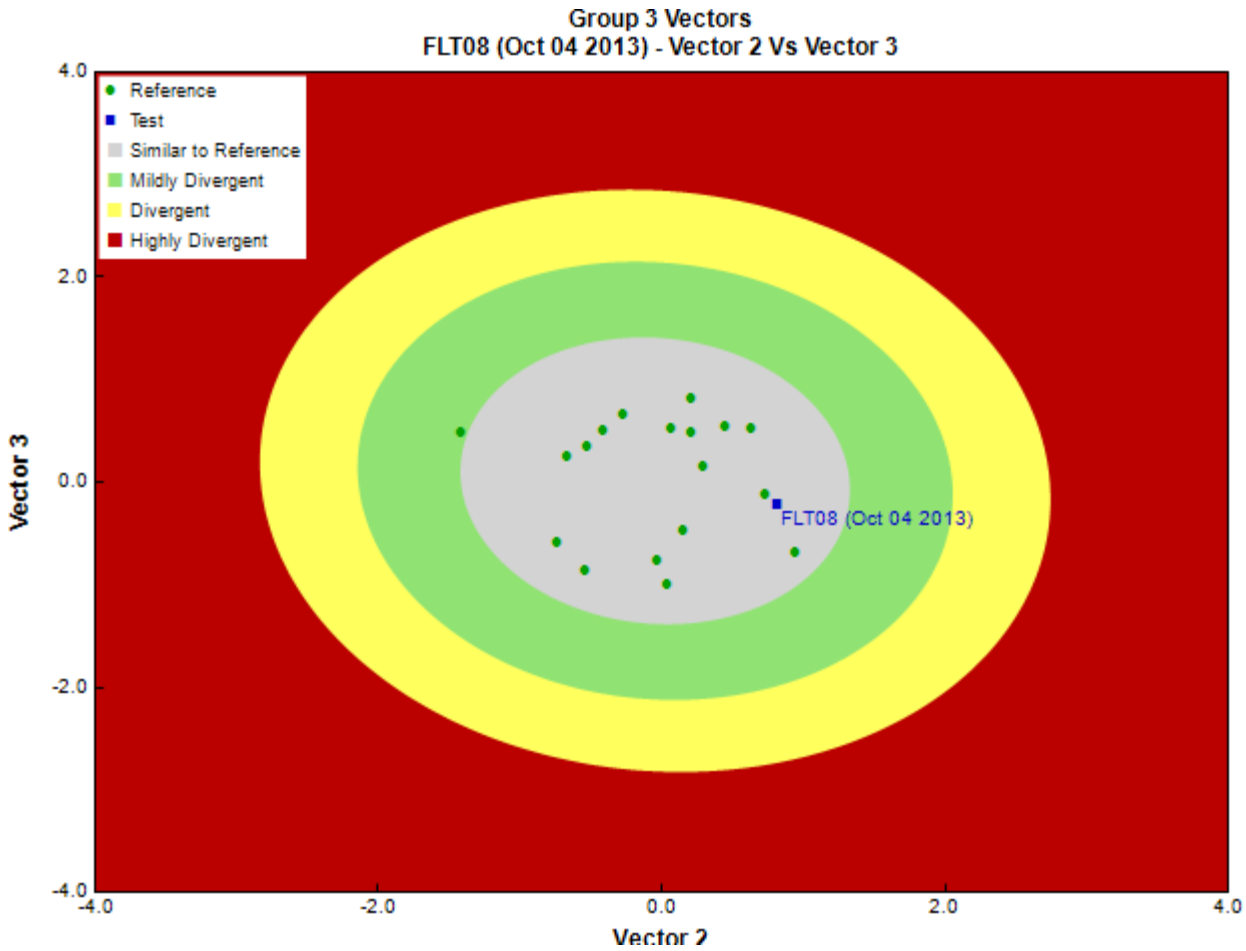


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	12/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	1	8.3
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	1	8.3
	Insecta	Coleoptera	Elmidae	4	33.3
		Diptera	Chironomidae	10	83.3
			Psychodidae	2	16.7
		Ephemeroptera	Ameletidae	3	25.0
			Baetidae	51	425.0

			Ephemerellidae	16	133.3
			Heptageniidae	59	491.6
		Plecoptera	Capniidae	2	16.7
			Chloroperlidae	2	16.6
			Nemouridae	16	133.3
			Perlidae	1	8.3
			Perlodidae	4	33.3
			Taeniopterygidae	140	1,166.7

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Trichoptera	Brachycentridae	1	8.3
			Glossosomatidae	3	25.0
			Hydropsychidae	1	8.3
			Rhyacophilidae	15	125.0
			Uenoidae	5	41.7
			Total	337	2,808.0

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.34

Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.60
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.83
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.20
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	0.98
RIVPACS : Expected taxa P>0.70	10.46
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	23.1	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	30.40	67.33 ± 71.65
Depth-Max (cm)	29.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0115000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.77	0.50 ± 0.25
Velocity-Max (m/s)	1.13	0.75 ± 0.28
Width-Bankfull (m)	12.0	15.6 ± 12.8
Width-Wetted (m)	10.4	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0

%Boulder (%)	4	6 ± 7
%Cobble (%)	61	61 ± 27
%Gravel (%)	2	1 ± 2
%Pebble (%)	30	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	3	0 ± 1
D50 (cm)	9.10	79.45 ± 47.98
Dg (cm)	7.5	73.9 ± 48.0
Dominant-1st (Category(0-9))	7	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	4	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	42.69989	27.92073 ± 14.83033
SlopeLT30% (%)	42.69989	29.33739 ± 12.62448
Water Chemistry		

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	7.9	8.0 ± 0.6
General-SpCond (µS/cm)	1885.0000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	4.5	10.5 ± 4.2
General-TempWater (Degrees Celsius)	5.6000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.5900000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT08
Sampling Date	Sep 15 2014
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.04083 N, 114.53456 W
Altitude	1269
Local Basin Name	Cauldry Creek
	Flathead River
Stream Order	4

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 29, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	1	2	3	4	5
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				

Probability of Group Membership	0.0%	0.6%	86.5%	12.5%	0.3%
CABIN Assessment of FLT08 on Sep 15, 2014	Similar to Reference				

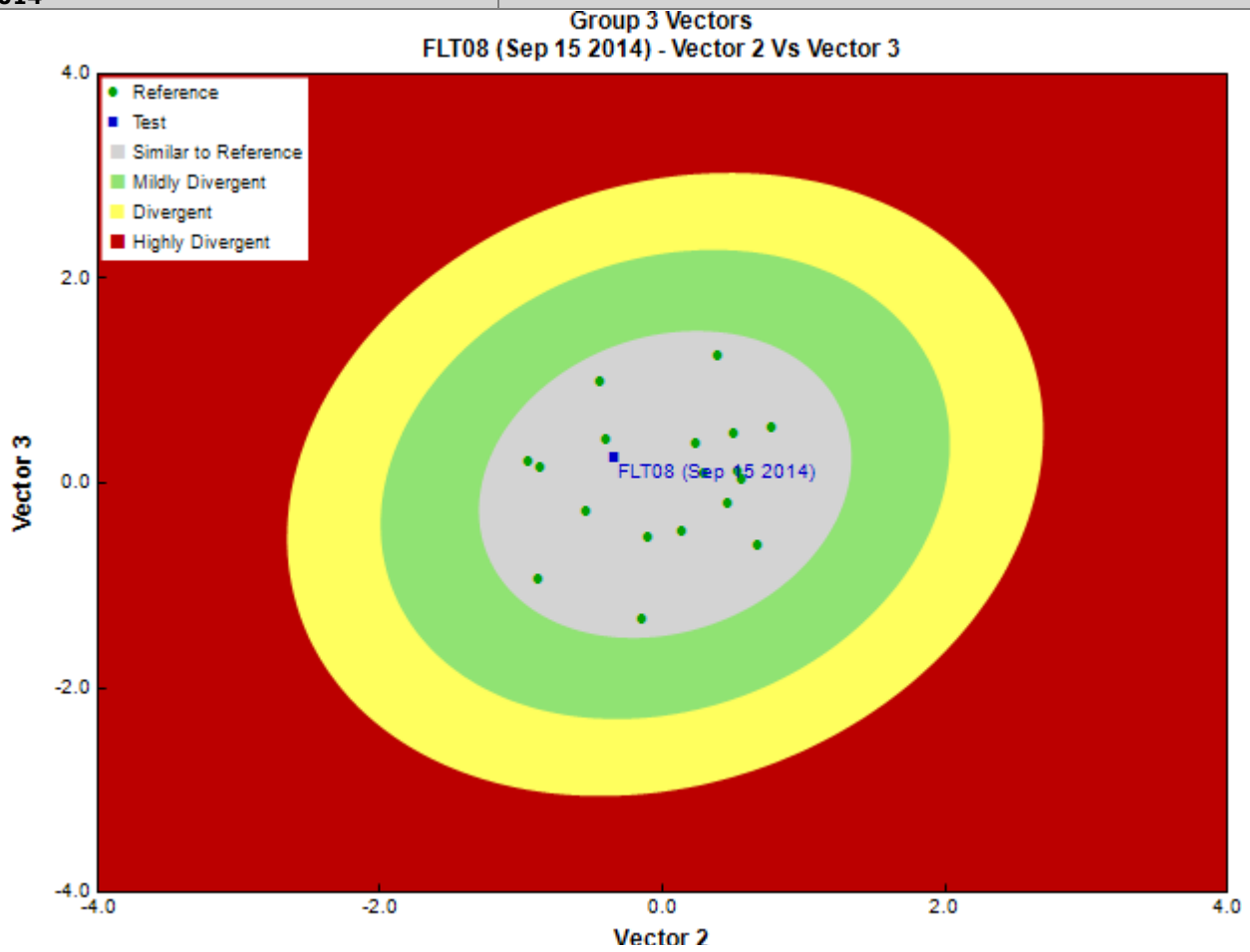


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	February 05, 2015
	Marchant Box
Sub-Sample Proportion	7/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata		Enchytraeidae	1	14.3
Arthropoda	Arachnida	Trombidiformes	Aturidae	1	14.3
			Hydryphantidae	1	14.3
			Hygrobatidae	1	14.3

			Lebertiidae	2	28.6
	Insecta	Coleoptera	Elmidae	17	242.9
		Diptera	Chironomidae	21	300.0
			Empididae	1	14.3
			Psychodidae	13	185.7
			Tipulidae	1	14.3
		Ephemeroptera	Ameletidae	4	57.1
			Baetidae	67	957.1
			Ephemerellidae	21	300.0
			Heptageniidae	67	957.1
		Plecoptera	Chloroperlidae	5	71.4

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Nemouridae	7	100.1
			Perlidae	1	14.3
			Perlodidae	6	85.7
			Taeniopterygidae	83	1,185.7
		Trichoptera		3	42.9
			Apataniidae	3	42.9
			Glossosomatidae	9	128.6
			Hydropsychidae	1	14.3
			Rhyacophilidae	21	300.0
			Uenoidae	1	14.3
			Total	358	5,114.5

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07

Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.34
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Planariidae	0%	8%	67%	17%	3%	0.60
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.83
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.20
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	0.98
RIVPACS : Expected taxa P>0.70	10.46
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	21.3	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	35.00	67.33 ± 71.65
Depth-Max (cm)	31.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0115000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0

Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.72	0.50 ± 0.25
Velocity-Max (m/s)	0.99	0.75 ± 0.28
Width-Bankfull (m)	12.6	15.6 ± 12.8
Width-Wetted (m)	10.2	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	8	6 ± 7
%Cobble (%)	64	61 ± 27
%Gravel (%)	2	1 ± 2
%Pebble (%)	25	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	1	0 ± 1
D50 (cm)	10.25	79.45 ± 47.98
Dg (cm)	9.5	73.9 ± 48.0
Dominant-1st (Category(0-9))	7	6 ± 1
Dominant-2nd (Category(0-9))	6	6 ± 2

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	42.69989	27.92073 ± 14.83033
SlopeLT30% (%)	42.69989	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.0	8.0 ± 0.6
General-SpCond (µS/cm)	187.2000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	20.5	10.5 ± 4.2
General-TempWater (Degrees Celsius)	9.5000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.6800000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT08
Sampling Date	Sep 15 2015
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.04083 N, 114.61789 W
Altitude	1262
Local Basin Name	Cauldry Creek
	Flathead River
Stream Order	4

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010

Analysis Date	October 29, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.7%	85.4%	13.5%	0.4%
CABIN Assessment of FLT08 on Sep 15, 2015	Similar to Reference				

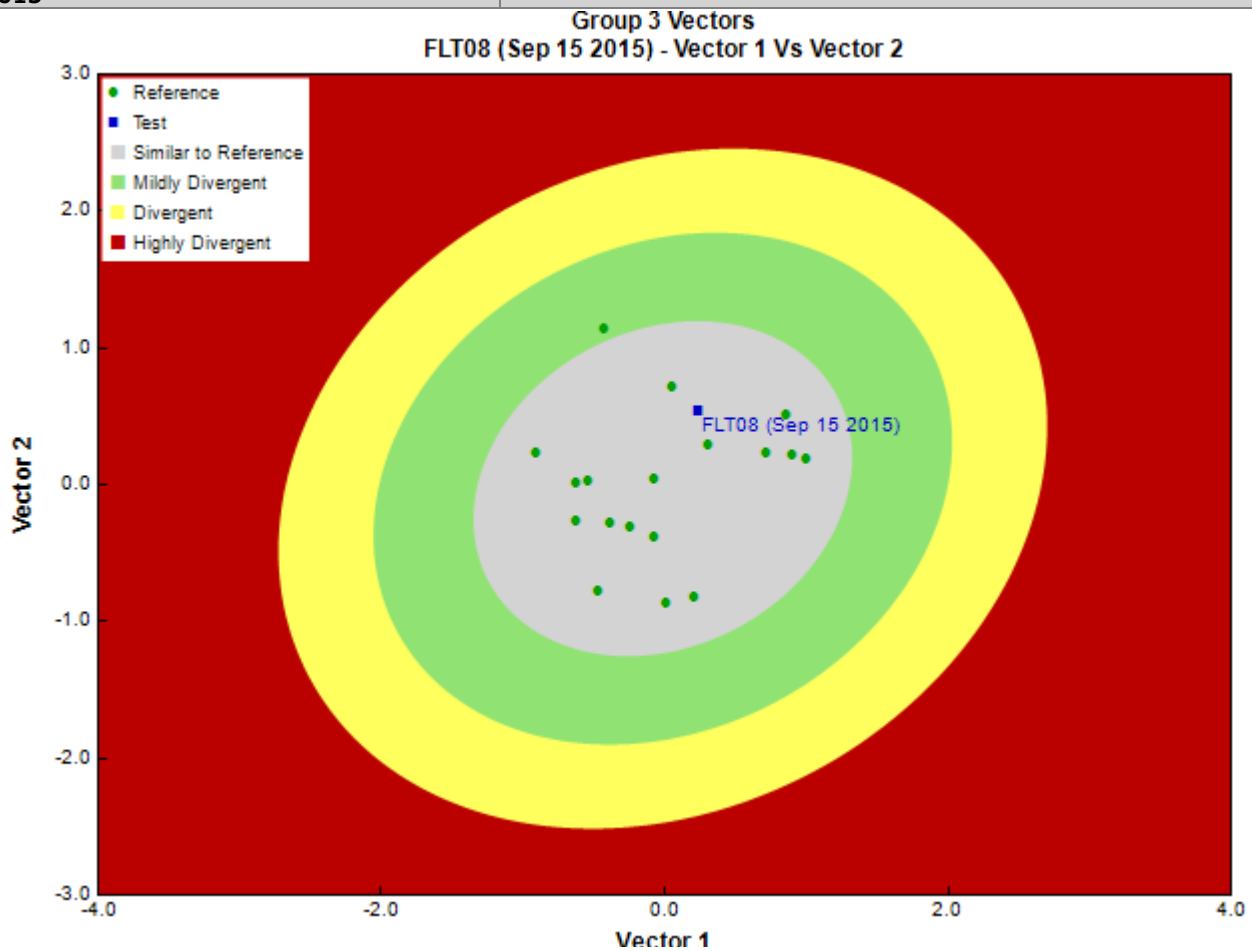


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant

Date Taxonomy Completed	January 26, 2016
	Marchant Box
Sub-Sample Proportion	7/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Lumbriculida	Lumbriculidae	1	14.3
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	1	14.3
	Insecta	Coleoptera	Elmidae	8	114.3
		Diptera	Chironomidae	13	185.7
			Psychodidae	8	114.3
			Simuliidae	1	14.3
			Tipulidae	3	42.9
		Ephemeroptera	Ameletidae	5	71.4
			Baetidae	84	1,200.0
			Ephemerellidae	12	171.4
			Heptageniidae	59	842.8
		Plecoptera	Chloroperlidae	4	57.2
			Nemouridae	13	185.8
			Perlodidae	7	100.0
			Taeniopterygidae	34	485.7

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Trichoptera	Apataniidae	2	28.6
			Glossosomatidae	63	900.0
			Rhyacophilidae	12	171.4
			Uenoidae	3	42.9
			Total	333	4,757.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.56
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00

Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.42
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.15
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.33
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.43
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.59
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.82
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.19
RIVPACS : Observed taxa P>0.50	11.00
RIVPACS : O:E (p > 0.5)	0.83
RIVPACS : Expected taxa P>0.70	10.45
RIVPACS : Observed taxa P>0.70	10.00
RIVPACS : O:E (p > 0.7)	0.96

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	20.7	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	36.00	67.33 ± 71.65
Depth-Max (cm)	28.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Slope (m/m)	0.0115000	0.0235102 ± 0.0284557

Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.57	0.50 ± 0.25
Velocity-Max (m/s)	0.99	0.75 ± 0.28
Width-Bankfull (m)	12.5	15.6 ± 12.8
Width-Wetted (m)	9.9	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	7	6 ± 7
%Cobble (%)	56	61 ± 27
%Gravel (%)	4	1 ± 2
%Pebble (%)	33	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	9.00	79.45 ± 47.98
Dg (cm)	8.1	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	42.69990	27.92073 ± 14.83033
SlopeAvg (%)	42.69990	48.68089 ± 8.41381
SlopeLT30% (%)	42.69990	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
General-pH (pH)	8.1	8.0 ± 0.6
General-SpCond (µS/cm)	200.6000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	10.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	7.2000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	1.0800000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT08
Sampling Date	Sep 15 2016
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.04094 N, 114.53453 W
Altitude	1264
Local Basin Name	Cauldry Creek
	Flathead River
Stream Order	4

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 29, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.6%	86.5%	12.6%	0.3%
CABIN Assessment of FLT08 on Sep 15, 2016	Similar to Reference				

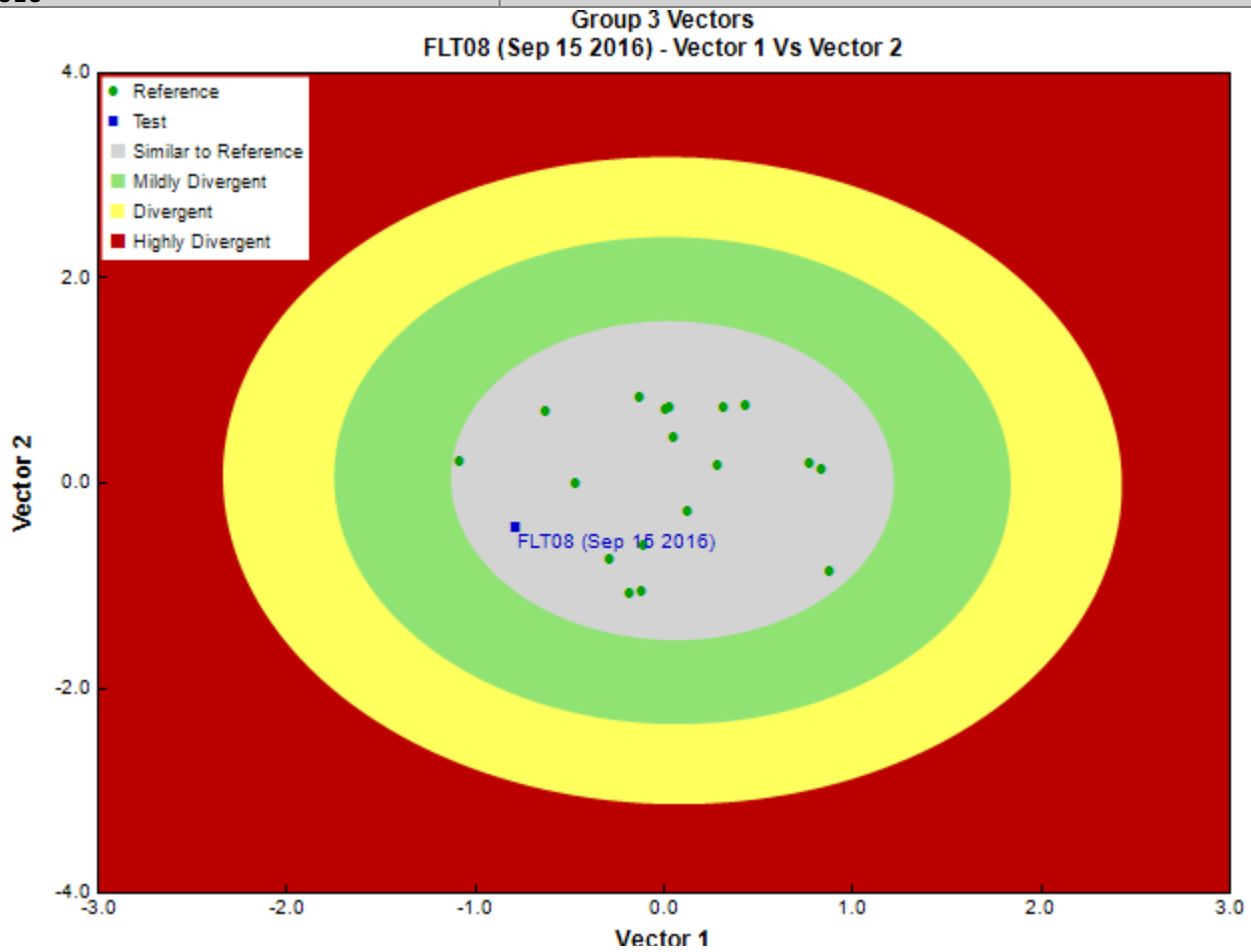


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400

Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	February 07, 2017
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	6	100.0
	Insecta	Coleoptera	Elmidae	12	200.0
		Diptera	Chironomidae	8	133.3
			Psychodidae	12	200.0
			Simuliidae	54	900.0
			Tipulidae	5	83.3
		Ephemeroptera	Ameletidae	3	50.0
			Baetidae	102	1,700.0
			Ephemerellidae	33	550.1
			Heptageniidae	55	916.6
		Plecoptera	Chloroperlidae	2	33.3
			Leuctridae	1	16.7
			Nemouridae	9	150.0
			Peltoperlidae	1	16.7
			Perlidae	1	16.7

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Perlodidae	4	66.7
			Taeniopterygidae	24	400.0
		Trichoptera	Apataniidae	2	33.4
			Brachycentridae	2	33.3
			Glossosomatidae	81	1,350.0
			Hydropsychidae	1	16.7
			Rhyacophilidae	3	50.0
			Uenoidae	5	83.4
			Total	426	7,100.2

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00

Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.34
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.60
Planorbidae	0%	0%	0%	0%	3%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Psychodidae	22%	65%	94%	8%	11%	0.83
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.20
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	0.98
RIVPACS : Expected taxa P>0.70	10.46
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	22.2	22.5 ± 10.5

Depth-BankfullMinusWetted (cm)	40.00	67.33 ± 71.65
Depth-Max (cm)	32.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0115000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.64	0.50 ± 0.25
Velocity-Max (m/s)	0.96	0.75 ± 0.28
Width-Bankfull (m)	12.0	15.6 ± 12.8
Width-Wetted (m)	8.2	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	0	6 ± 7
%Cobble (%)	64	61 ± 27
%Gravel (%)	2	1 ± 2
%Pebble (%)	31	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	3	0 ± 1
D50 (cm)	9.00	79.45 ± 47.98
Dg (cm)	7.0	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2
Embeddedness (Category(1-5))	4	4 ± 1
PeriphytonCoverage (Category(1-5))	3	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
Topography		
Reg-SlopeLT30% (%)	42.69990	27.92073 ± 14.83033
SlopeLT30% (%)	42.69990	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	11.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.6	8.0 ± 0.6
General-SpCond (µS/cm)	230.0000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	22.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	8.6000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.5000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT08
Sampling Date	Aug 30 2017
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.04094 N, 114.53456 W
Altitude	1266

Local Basin Name	Cauldry Creek
	Flathead River
Stream Order	4

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 29, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.5%	86.4%	12.7%	0.3%
CABIN Assessment of FLT08 on Aug 30, 2017	Similar to Reference				

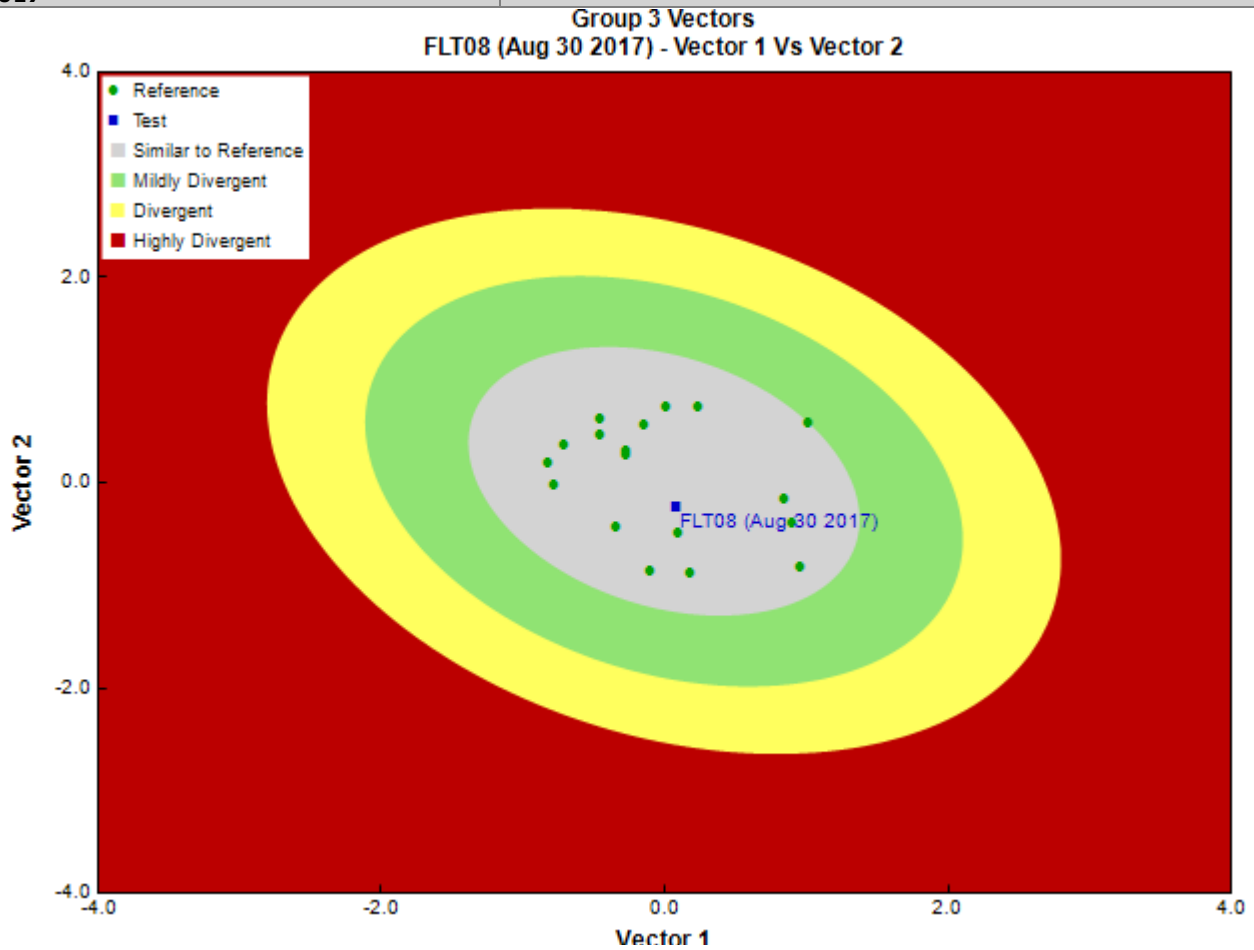


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 26, 2018
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes		1	16.7
			Lebertiidae	5	83.3
			Sperchontidae	3	50.0
	Insecta	Coleoptera	Elmidae	11	183.3
		Diptera		1	16.7
			Chironomidae	44	733.3
			Psychodidae	13	216.7
			Simuliidae	2	33.4
			Tipulidae	1	16.7
		Ephemeroptera	Baetidae	68	1,133.3
			Ephemerellidae	30	500.0
			Heptageniidae	87	1,449.9
		Plecoptera	Chloroperlidae	2	33.3
			Nemouridae	16	266.7
			Perlodidae	7	116.7

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Taeniopterygidae	41	683.3
		Trichoptera	Apataniidae	2	33.3
			Brachycentridae	1	16.7
			Glossosomatidae	34	566.7
			Hydropsychidae	1	16.7
			Rhyacophilidae	11	183.3
			Uenoidae	9	150.0
			Total	390	6,500.0

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.26
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.55
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05

Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.16
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.41
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.14
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.08
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.34
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.42
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.60
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.83

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT08
	Group 1	Group 2	Group 3	Group 4	Group 5	
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.33
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	13.20
RIVPACS : Observed taxa P>0.50	12.00
RIVPACS : O:E (p > 0.5)	0.91
RIVPACS : Expected taxa P>0.70	10.46
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	23.5	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	20.50	67.33 ± 71.65
Depth-Max (cm)	30.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0115000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.90	0.50 ± 0.25
Velocity-Max (m/s)	1.08	0.75 ± 0.28
Width-Bankfull (m)	11.8	15.6 ± 12.8
Width-Wetted (m)	8.4	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	7	6 ± 7
%Cobble (%)	71	61 ± 27
%Gravel (%)	0	1 ± 2
%Pebble (%)	22	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	0	0 ± 1
D50 (cm)	10.10	79.45 ± 47.98
Dg (cm)	10.2	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	7	6 ± 2
Embeddedness (Category(1-5))	3	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1

Habitat Description

Variable	FLT08	Predicted Group Reference Mean ±SD
Reg-SlopeLT30% (%)	42.69990	27.92073 ± 14.83033
SlopeLT30% (%)	42.69990	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	8.5000000	10.4922222 ± 0.8833463
General-pH (pH)	8.5	8.0 ± 0.6
General-SpCond (µS/cm)	235.0000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	13.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	8.9000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.5000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT09
Sampling Date	Sep 15 2014
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia

Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.09594 N, 114.45647 W
Altitude	1283
Local Basin Name	Sage Creek
	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 31, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.3%	84.5%	14.7%	0.5%
CABIN Assessment of FLT09 on Sep 15, 2014	Similar to Reference				

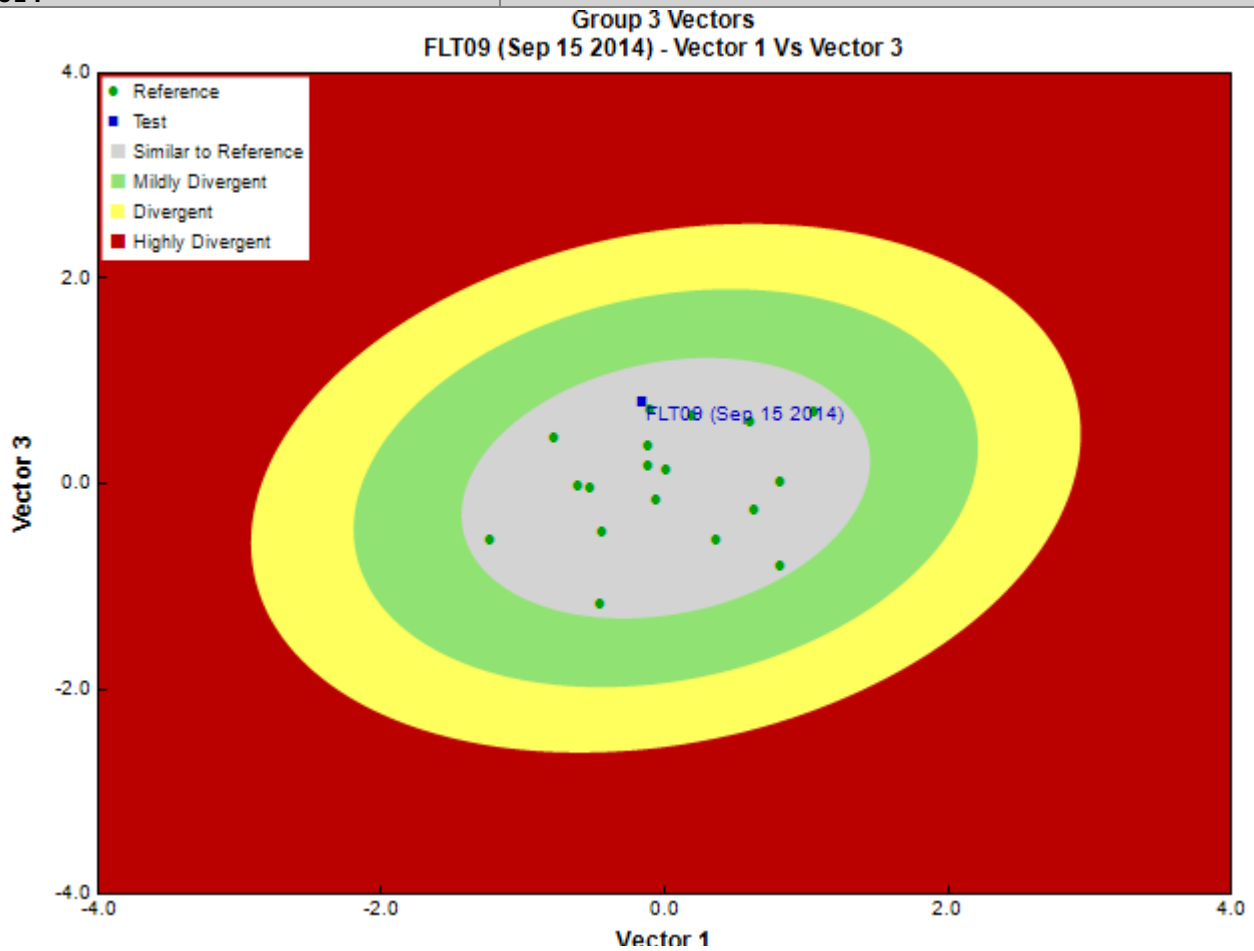


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis

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	Pina Viola, Consultant
Date Taxonomy Completed	February 20, 2015
	Marchant Box
Sub-Sample Proportion	12/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydryphantidae	3	25.0
			Hygrobatidae	1	8.3
			Lebertiidae	1	8.3
			Sperchontidae	1	8.3
			Torrenticolidae	9	75.0
	Insecta	Coleoptera	Elmidae	15	125.0
		Diptera	Ceratopogonidae	1	8.3
			Chironomidae	26	216.7
			Psychodidae	15	125.0
			Tipulidae	2	16.7
		Ephemeroptera	Ameletidae	4	33.3
			Baetidae	44	366.7
			Ephemerellidae	39	325.0
			Heptageniidae	160	1,333.3
			Leptophlebiidae	10	83.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera	Capniidae	6	50.0
			Chloroperlidae	15	125.0
			Nemouridae	2	16.6
			Perlidae	5	41.6
			Perlodidae	3	25.0
			Taeniopterygidae	6	50.0
		Trichoptera		2	16.7
			Apataniidae	3	25.0
			Glossosomatidae	8	66.6
			Hydropsychidae	3	25.0
			Rhyacophilidae	1	8.3
			Total	385	3,208.0

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT09
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.27
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.56

Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.53
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.42
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.15
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.09
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.33
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.43
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT09
	Group 1	Group 2	Group 3	Group 4	Group 5	
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.59
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.81
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.34
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.69
RIVPACS : Observed taxa P>0.50	12.00

RIVPACS : O:E (p > 0.5)	0.95
RIVPACS : Expected taxa P>0.70	10.44
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT09	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	20.8	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	72.50	67.33 ± 71.65
Depth-Max (cm)	30.5	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0120000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.46	0.50 ± 0.25
Velocity-Max (m/s)	0.67	0.75 ± 0.28
Width-Bankfull (m)	22.7	15.6 ± 12.8
Width-Wetted (m)	16.7	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	5	6 ± 7
%Cobble (%)	51	61 ± 27
%Gravel (%)	5	1 ± 2
%Pebble (%)	38	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	1	0 ± 1
D50 (cm)	7.00	79.45 ± 47.98
Dg (cm)	6.4	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 2
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1

Habitat Description

Variable	FLT09	Predicted Group Reference Mean ±SD
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	36.89166	27.92073 ± 14.83033
SlopeLT30% (%)	36.89166	29.33739 ± 12.62448
Water Chemistry		
General-DO (mg/L)	11.0000000	10.4922222 ± 0.8833463
General-pH (pH)	7.6	8.0 ± 0.6
General-SpCond (µS/cm)	148.5000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	11.5	10.5 ± 4.2
General-TempWater (Degrees Celsius)	6.8000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.5700000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT09
Sampling Date	Sep 15 2015
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.09594 N, 114.45647 W
Altitude	1283
Local Basin Name	Sage Creek
	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 31, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.3%	84.4%	14.8%	0.5%
CABIN Assessment of FLT09 on Sep 15, 2015	Mildly Divergent				

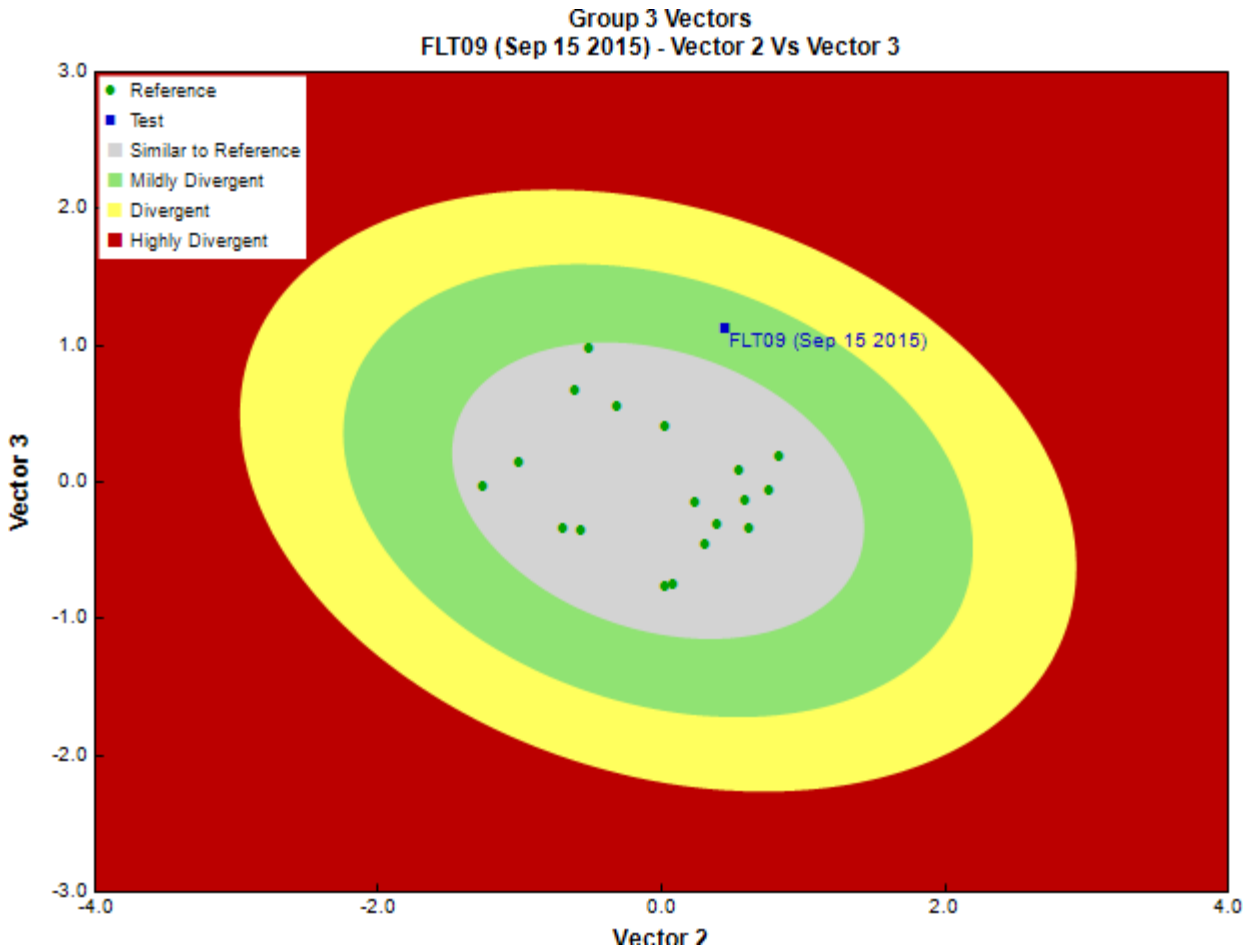


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 26, 2016
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydryphantidae	1	16.7
			Hygrobatidae	2	33.4
			Lebertiidae	2	33.3
	Insecta	Coleoptera	Elmidae	9	150.0
		Diptera	Chironomidae	94	1,566.7
			Empididae	1	16.7
			Pelecorhynchidae	1	16.7

			Psychodidae	10	166.7
			Tipulidae	2	33.3
		Ephemeroptera	Baetidae	6	100.1
			Ephemerellidae	52	866.7
			Heptageniidae	56	933.3
			Leptophlebiidae	15	250.0
		Plecoptera	Capniidae	1	16.7
			Chloroperlidae	11	183.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Nemouridae	4	66.6
			Perlidae	1	16.7
			Perlodidae	1	16.7
			Taeniopterygidae	2	33.3
		Trichoptera	Apataniidae	7	116.7
			Brachycentridae	1	16.7
			Glossosomatidae	59	983.3
			Hydropsychidae	5	83.3
			Lepidostomatidae	1	16.7
			Rhyacophilidae	2	33.3
			Uenoidae	1	16.7
			Total	347	5,783.6

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT09
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.27
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.56
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.53
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.42
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.15

Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.09
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.33
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.43
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT09
	Group 1	Group 2	Group 3	Group 4	Group 5	
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.59
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.81
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.34
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.69
RIVPACS : Observed taxa P>0.50	13.00
RIVPACS : O:E (p > 0.5)	1.02
RIVPACS : Expected taxa P>0.70	10.44
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT09	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	21.4	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	44.50	67.33 ± 71.65
Depth-Max (cm)	27.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0120000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.57	0.50 ± 0.25

Velocity-Max (m/s)	0.77	0.75 ± 0.28
Width-Bankfull (m)	21.4	15.6 ± 12.8
Width-Wetted (m)	15.4	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	4	6 ± 7
%Cobble (%)	55	61 ± 27
%Gravel (%)	2	1 ± 2
%Pebble (%)	37	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	2	0 ± 1
D50 (cm)	7.45	79.45 ± 47.98
Dg (cm)	6.4	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 2

Habitat Description

Variable	FLT09	Predicted Group Reference Mean ±SD
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	4	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	36.89166	27.92073 ± 14.83033
Water Chemistry		
General-DO (mg/L)	10.6000000	10.4922222 ± 0.8833463
General-pH (pH)	8.1	8.0 ± 0.6
General-SpCond (µS/cm)	170.9000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	14.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	10.0000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	1.0600000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT09
Sampling Date	Sep 14 2016
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.09542 N, 114.45642 W
Altitude	1284
Local Basin Name	Sage Creek
	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 31, 2019
Taxonomic Level	Family

Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.3%	84.3%	14.9%	0.5%
CABIN Assessment of FLT09 on Sep 14, 2016	Similar to Reference				

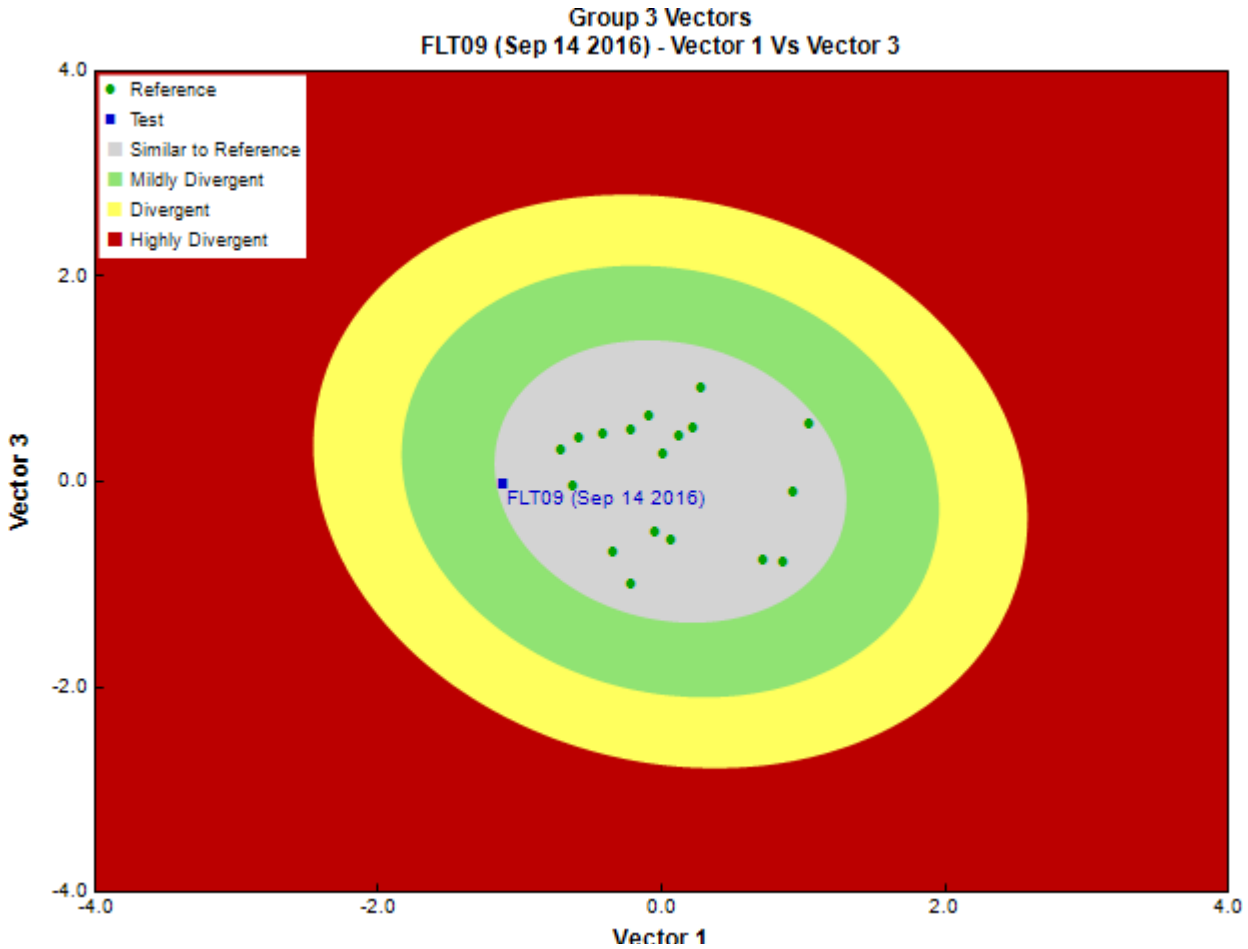


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant

Date Taxonomy Completed	February 18, 2017
	Marchant Box
Sub-Sample Proportion	10/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Hirudinida	Piscicolidae	1	10.0
Arthropoda	Arachnida	Trombidiformes	Hydryphantidae	2	20.0
			Lebertiidae	6	60.0
			Sperchontidae	4	40.0
			Torrenticolidae	18	180.0
	Insecta	Coleoptera	Elmidae	11	110.0
		Diptera	Ceratopogonidae	1	10.0
			Chironomidae	20	200.0
			Pelecorhynchidae	1	10.0
			Psychodidae	7	70.0
			Tipulidae	1	10.0
		Ephemeroptera	Ameletidae	3	30.0
			Baetidae	7	70.0
			Ephemerellidae	57	570.0
			Heptageniidae	109	1,090.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Leptophlebiidae	10	100.0
		Plecoptera	Chloroperlidae	14	140.0
			Nemouridae	3	30.0
			Perlidae	3	30.0
			Perlodidae	4	40.0
			Taeniopterygidae	2	20.0
		Trichoptera		9	90.0
			Apataniidae	7	70.0
			Brachycentridae	3	30.0
			Glossosomatidae	74	740.0
			Hydropsychidae	6	60.0
			Lepidostomatidae	1	10.0
			Rhyacophilidae	3	30.0
			Total	387	3,870.0

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT09
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.27
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06
Capniidae	78%	55%	50%	92%	68%	0.56
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.53

Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.42
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.15
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.09
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.33
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.43

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT09
	Group 1	Group 2	Group 3	Group 4	Group 5	
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.59
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.81
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.34
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.69
RIVPACS : Observed taxa P>0.50	11.00
RIVPACS : O:E (p > 0.5)	0.87
RIVPACS : Expected taxa P>0.70	10.44
RIVPACS : Observed taxa P>0.70	11.00
RIVPACS : O:E (p > 0.7)	1.05

Habitat Description

Variable	FLT09	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	22.7	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	29.50	67.33 ± 71.65
Depth-Max (cm)	26.5	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0120000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.45	0.50 ± 0.25
Velocity-Max (m/s)	0.64	0.75 ± 0.28
Width-Bankfull (m)	19.1	15.6 ± 12.8
Width-Wetted (m)	14.9	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	1	6 ± 7
%Cobble (%)	50	61 ± 27
%Gravel (%)	5	1 ± 2
%Pebble (%)	43	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	1	0 ± 1
D50 (cm)	6.50	79.45 ± 47.98

Habitat Description

Variable	FLT09	Predicted Group Reference Mean ±SD
Dg (cm)	5.9	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1
Dominant-2nd (Category(0-9))	5	6 ± 2
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	36.89166	27.92073 ± 14.83033
Water Chemistry		
General-DO (mg/L)	10.5000000	10.4922222 ± 0.8833463
General-pH (pH)	8.4	8.0 ± 0.6
General-SpCond (µS/cm)	162.3000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	25.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	11.4000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.3000000	0.0000000 ± 0.0000000

Site Description

Study Name	BC NGO-Flathead River-Wildsight
Site	FLT09
Sampling Date	Aug 29 2017
Know Your Watershed Basin	Flathead
Province / Territory	British Columbia

Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.09586 N, 114.45647 W
Altitude	1284
Local Basin Name	Sage Creek
	Flathead River
Stream Order	3

Cabin Assessment Results

Reference Model Summary	
Model	Columbia-Okanagan Preliminary March 2010
Analysis Date	October 31, 2019
Taxonomic Level	Family
Predictive Model Variables	Depth-Avg Latitude Longitude Reg-Ice Reg-SlopeLT30%

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	9	43	17	12	33
Group Error Rate	22.2%	24.5%	22.2%	25.0%	32.4%
Overall Model Error Rate	26.4%				
Probability of Group Membership	0.0%	0.3%	84.7%	14.5%	0.5%
CABIN Assessment of FLT09 on Aug 29, 2017	Similar to Reference				

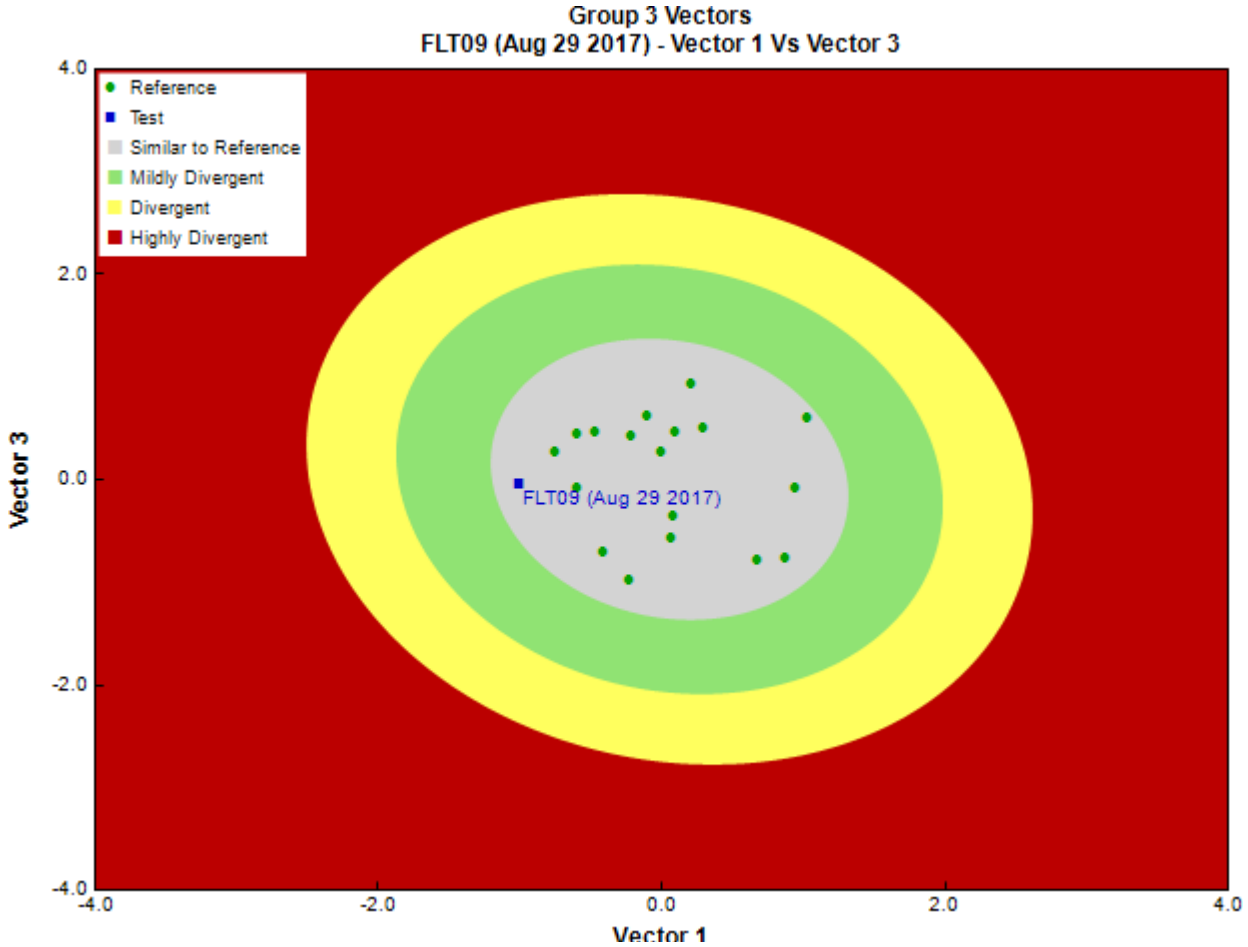


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
Date Taxonomy Completed	January 05, 2018
	Marchant Box
Sub-Sample Proportion	10/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydryphantidae	7	70.0
			Hygrobatidae	5	50.0
			Lebertiidae	6	60.0
			Sperchontidae	2	20.0
			Torrenticolidae	26	260.0
	Insecta	Coleoptera	Elmidae	14	140.0
		Diptera	Ceratopogonidae	2	20.0
			Chironomidae	14	140.0
			Psychodidae	5	50.0
			Tipulidae	2	20.0
		Ephemeroptera	Ameletidae	3	30.0
			Baetidae	25	250.0
			Ephemerellidae	44	440.0
			Heptageniidae	117	1,170.0
			Leptophlebiidae	9	90.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera	Capniidae	2	20.0
			Chloroperlidae	18	180.0
			Nemouridae	4	40.0
			Perlidae	3	30.0
			Perlodidae	3	30.0
		Trichoptera	Apataniidae	16	160.0
			Brachycentridae	3	30.0
			Glossosomatidae	40	400.0
			Hydropsychidae	4	40.0
			Lepidostomatidae	1	10.0
			Rhyacophilidae	3	30.0
			Total	378	3,780.0

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT09
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ameletidae	56%	53%	22%	50%	68%	0.27
Apataniidae	22%	24%	28%	25%	3%	0.27
Athericidae	0%	2%	0%	17%	0%	0.02
Aturidae	0%	8%	0%	0%	0%	0.00
Baetidae	100%	100%	100%	100%	97%	1.00
Blephariceridae	0%	0%	0%	0%	5%	0.00
Brachycentridae	11%	69%	0%	42%	3%	0.06

Capniidae	78%	55%	50%	92%	68%	0.56
Ceratopogonidae	0%	55%	28%	42%	5%	0.30
Chironomidae	100%	100%	100%	100%	95%	1.00
Chloroperlidae	78%	88%	94%	100%	100%	0.95
Corixidae	11%	0%	0%	0%	0%	0.00
Curculionidae	0%	4%	0%	0%	0%	0.00
Deuterophlebiidae	0%	0%	0%	0%	3%	0.00
Dixidae	0%	10%	0%	0%	0%	0.00
Dytiscidae	0%	8%	6%	0%	0%	0.05
Elmidae	0%	86%	50%	50%	5%	0.50
Empididae	67%	55%	50%	67%	57%	0.52
Enchytraeidae	11%	14%	0%	8%	0%	0.01
Ephemerellidae	78%	100%	100%	100%	100%	1.00
Ephydridae	0%	2%	0%	0%	0%	0.00
Glossosomatidae	11%	49%	39%	42%	35%	0.39
Heptageniidae	100%	100%	100%	100%	100%	1.00
Hydraenidae	0%	4%	0%	0%	0%	0.00
Hydrophilidae	11%	2%	0%	0%	0%	0.00
Hydropsychidae	11%	92%	78%	92%	86%	0.80
Hydroptilidae	11%	8%	0%	0%	0%	0.00
Hydrozetidae	0%	10%	17%	8%	16%	0.15
Hydryphantidae	11%	31%	11%	8%	8%	0.11
Hygrobatidae	0%	29%	0%	0%	11%	0.00
Lebertiidae	78%	65%	39%	58%	5%	0.42
Lepidostomatidae	0%	53%	6%	17%	8%	0.07
Leptohyphidae	0%	2%	0%	0%	0%	0.00
Leptophlebiidae	0%	90%	11%	33%	3%	0.15
Leuctridae	22%	43%	56%	67%	54%	0.57
Limnephilidae	22%	31%	6%	25%	41%	0.09
Limnesiidae	0%	2%	0%	0%	0%	0.00
Lumbriculidae	0%	20%	17%	25%	3%	0.18
Mideopsidae	0%	2%	0%	0%	0%	0.00
Naididae	0%	8%	39%	0%	3%	0.33
Nemouridae	100%	100%	100%	100%	100%	1.00
Pelecorhynchidae	0%	22%	6%	0%	0%	0.05
Peltoperlidae	22%	12%	6%	8%	41%	0.06
Perlidae	11%	84%	33%	100%	3%	0.43
Perlodidae	78%	78%	89%	92%	81%	0.89
Philopotamidae	0%	31%	0%	0%	3%	0.00

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at FLT09
	Group 1	Group 2	Group 3	Group 4	Group 5	
Pisidiidae	0%	6%	0%	8%	0%	0.01
Planariidae	0%	8%	67%	17%	3%	0.59
Planorbidae	0%	0%	0%	0%	3%	0.00
Psychodidae	22%	65%	94%	8%	11%	0.81
Pteronarcyidae	0%	12%	6%	0%	3%	0.05
Rhyacophilidae	100%	92%	100%	100%	95%	1.00
Simuliidae	33%	49%	39%	33%	16%	0.38
Sperchontidae	78%	63%	50%	42%	65%	0.49
Stygothrombidiidae	0%	4%	0%	17%	0%	0.02
Taeniopterygidae	89%	49%	100%	92%	97%	0.99
Thaumaleidae	11%	4%	0%	0%	0%	0.00
Tipulidae	56%	55%	28%	67%	43%	0.34
Torrenticolidae	11%	86%	11%	17%	11%	0.12
Uenoidae	22%	37%	17%	25%	46%	0.18
Valvatidae	0%	2%	6%	0%	0%	0.05

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	12.69
RIVPACS : Observed taxa P>0.50	11.00
RIVPACS : O:E (p > 0.5)	0.87
RIVPACS : Expected taxa P>0.70	10.44
RIVPACS : Observed taxa P>0.70	10.00
RIVPACS : O:E (p > 0.7)	0.96

Habitat Description

Variable	FLT09	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	18.3	22.5 ± 10.5
Depth-BankfullMinusWetted (cm)	35.00	67.33 ± 71.65
Depth-Max (cm)	21.0	32.9 ± 17.9
Macrophyte (PercentRange)	0	0 ± 0
Reach-%CanopyCoverage (PercentRange)	1.00	0.94 ± 0.80
Reach-DomStreamsideVeg (Category(1-4))	2	3 ± 1
Reach-Pools (Binary)	1	0 ± 1
Reach-Riffles (Binary)	1	1 ± 0
Reach-StraightRun (Binary)	1	1 ± 0
Slope (m/m)	0.0120000	0.0235102 ± 0.0284557
Veg-Coniferous (Binary)	1	1 ± 0
Veg-Deciduous (Binary)	1	1 ± 0
Veg-GrassesFerns (Binary)	1	1 ± 0
Veg-Shrubs (Binary)	1	1 ± 0
Velocity-Avg (m/s)	0.66	0.50 ± 0.25
Velocity-Max (m/s)	0.70	0.75 ± 0.28
Width-Bankfull (m)	20.0	15.6 ± 12.8
Width-Wetted (m)	15.2	10.2 ± 7.0
XSEC-VelMethod (Category(1-3))	1	2 ± 1
Landcover		
Reg-Ice (%)	0.00000	0.46949 ± 1.15785
Substrate Data		
%Bedrock (%)	0	0 ± 0
%Boulder (%)	4	6 ± 7
%Cobble (%)	47	61 ± 27
%Gravel (%)	4	1 ± 2
%Pebble (%)	41	31 ± 28
%Sand (%)	0	0 ± 0
%Silt+Clay (%)	3	0 ± 1
D50 (cm)	6.50	79.45 ± 47.98
Dg (cm)	5.4	73.9 ± 48.0
Dominant-1st (Category(0-9))	6	6 ± 1

Habitat Description

Variable	FLT09	Predicted Group Reference Mean ±SD
Dominant-2nd (Category(0-9))	5	6 ± 2
Embeddedness (Category(1-5))	5	4 ± 1
PeriphytonCoverage (Category(1-5))	2	2 ± 1
SurroundingMaterial (Category(0-9))	3	3 ± 1
Topography		
Reg-SlopeLT30% (%)	36.89166	27.92073 ± 14.83033
Water Chemistry		
General-DO (mg/L)	10.0000000	10.4922222 ± 0.8833463
General-pH (pH)	8.4	8.0 ± 0.6
General-SpCond (µS/cm)	157.0000000	214.2437500 ± 77.1891440
General-TempAir (Degrees Celsius)	32.0	10.5 ± 4.2
General-TempWater (Degrees Celsius)	15.0000000	6.6716667 ± 2.0277755
General-Turbidity (NTU)	0.6000000	0.0000000 ± 0.0000000

Appendix C- Map Resources

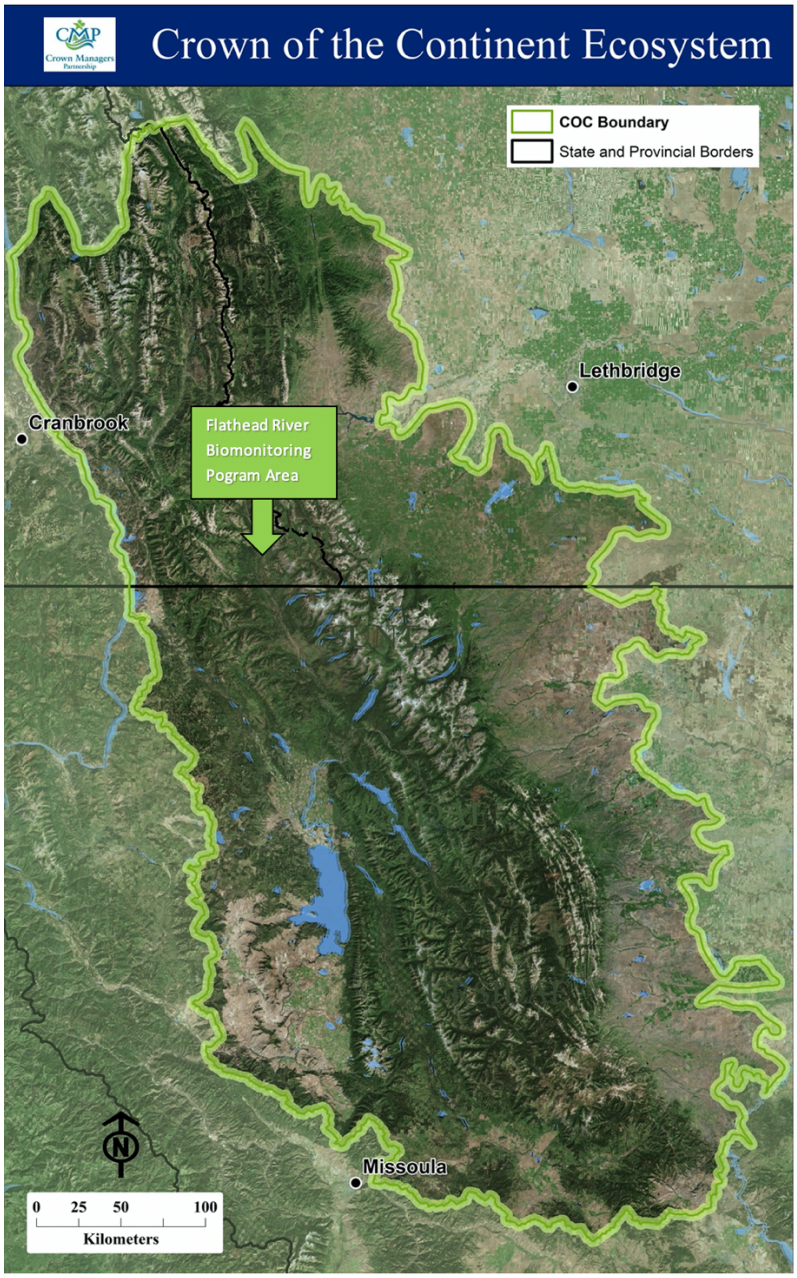
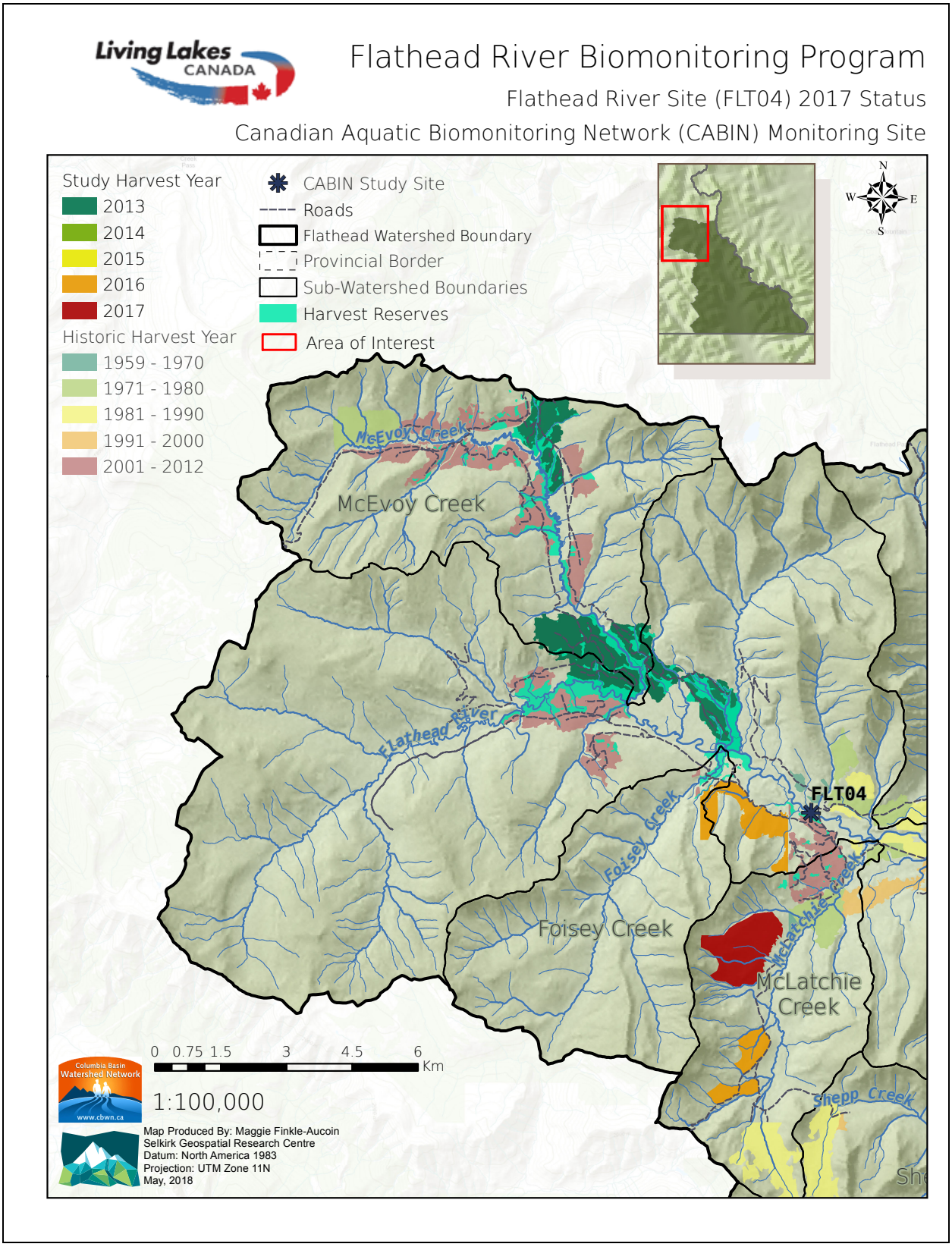


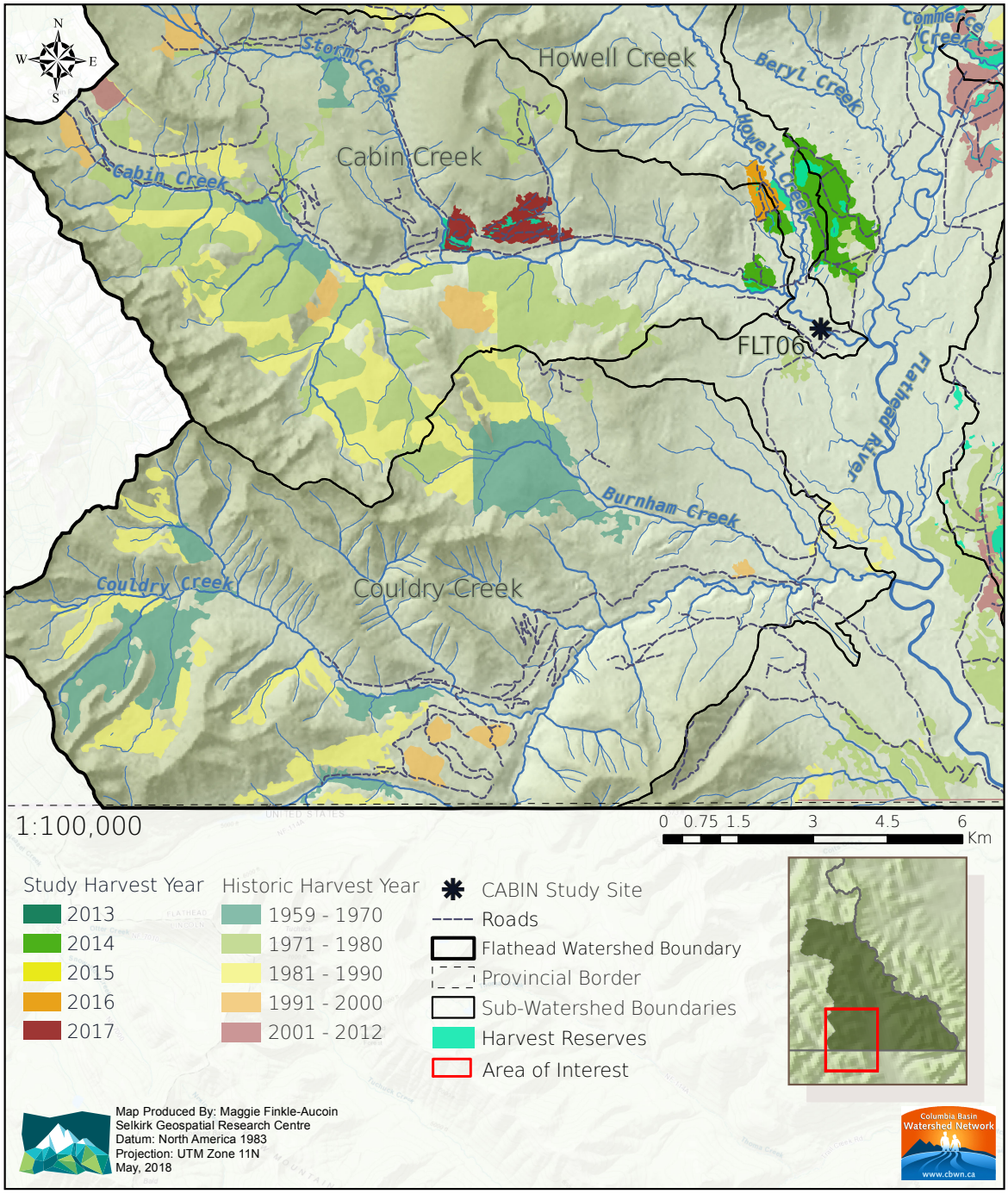
Figure C-1- Map indicating entirety of the Crown of the Continent Ecosystem along with approximate area where Biomonitoring program occurred. Map adopted from USGS online source [Accessed Mar 11, 2020. https://www.sciencebase.gov/catalog/item/51102e04e4b048b5cead853b


Living Lakes CANADA
Flathead River Biomonitoring Program
Flathead River Site (FLT04) 2017 Status
Canadian Aquatic Biomonitoring Network (CABIN) Monitoring Site
Study Harvest Year
2013
2014
2015
2016
2017
Historic Harvest Year
1959 - 1970
1971 - 1980
1981 - 1990
1991 - 2000
2001 - 2012
CABIN Study Site
Roads
Flathead Watershed Boundary
Provincial Border
Sub-Watershed Boundaries
Harvest Reserves
Area of Interest
N
W
E
S
McEvoy Creek
McEvoy Creek
Flathead River
FLT04
Foisey Creek
Foisey Creek
McLatchie Creek
McLatchie Creek
Shepp Creek
0 0.75 1.5 3 4.5 6
Km
1:100,000
Columbia Basin Watershed Network
www.cbwn.ca
Map Produced By: Maggie Finkle-Aucoin
Selkirk Geospatial Research Centre
Datum: North America 1983
Projection: UTM Zone 11N
May, 2018

Flathead River Biomonitoring Program

Howell Creek Site (FLT06) 2017 Status

Canadian Aquatic Biomonitoring Network (CABIN) Monitoring Site

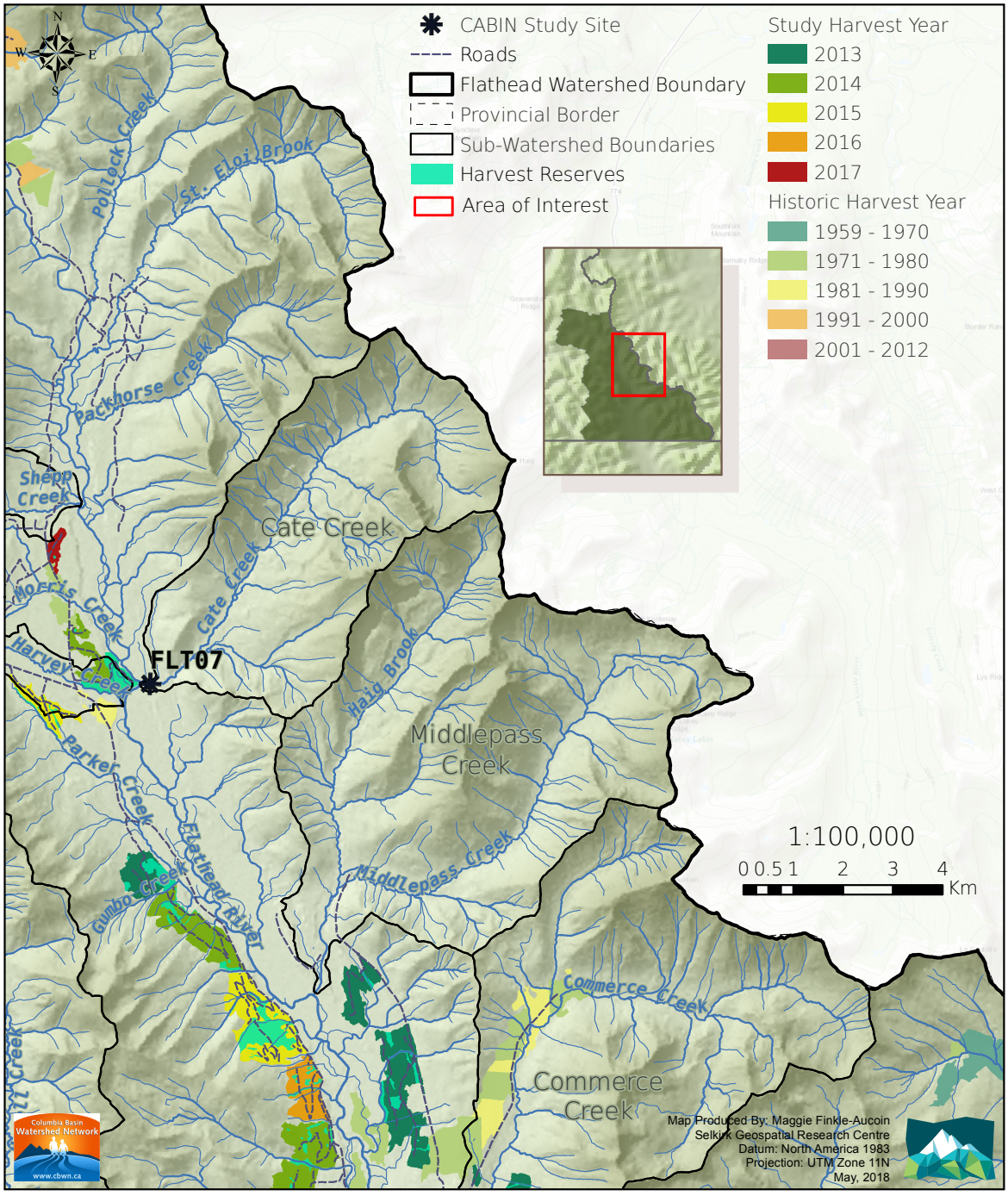


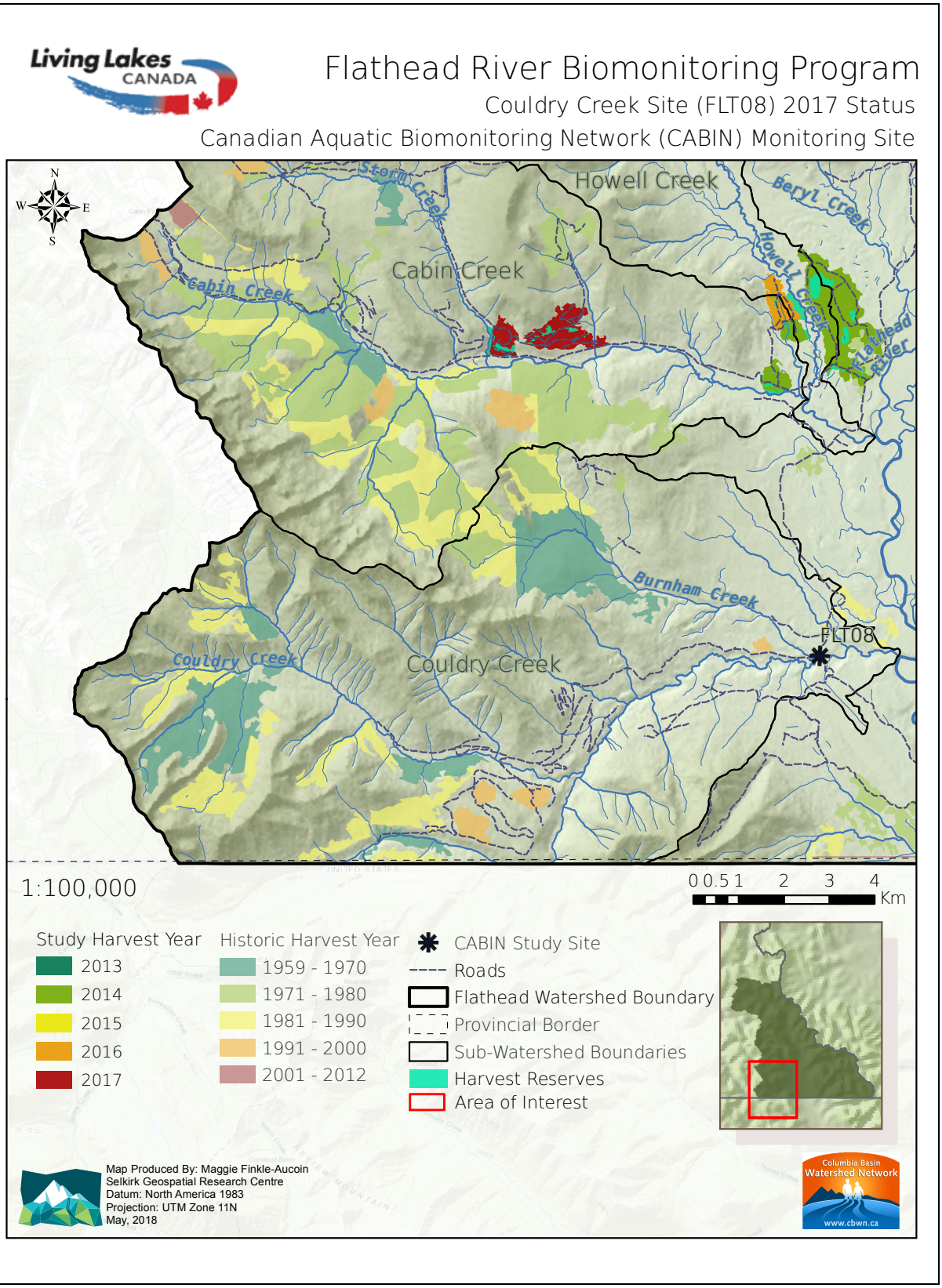
Living Lakes CANADA

Flathead River Biomonitoring Program

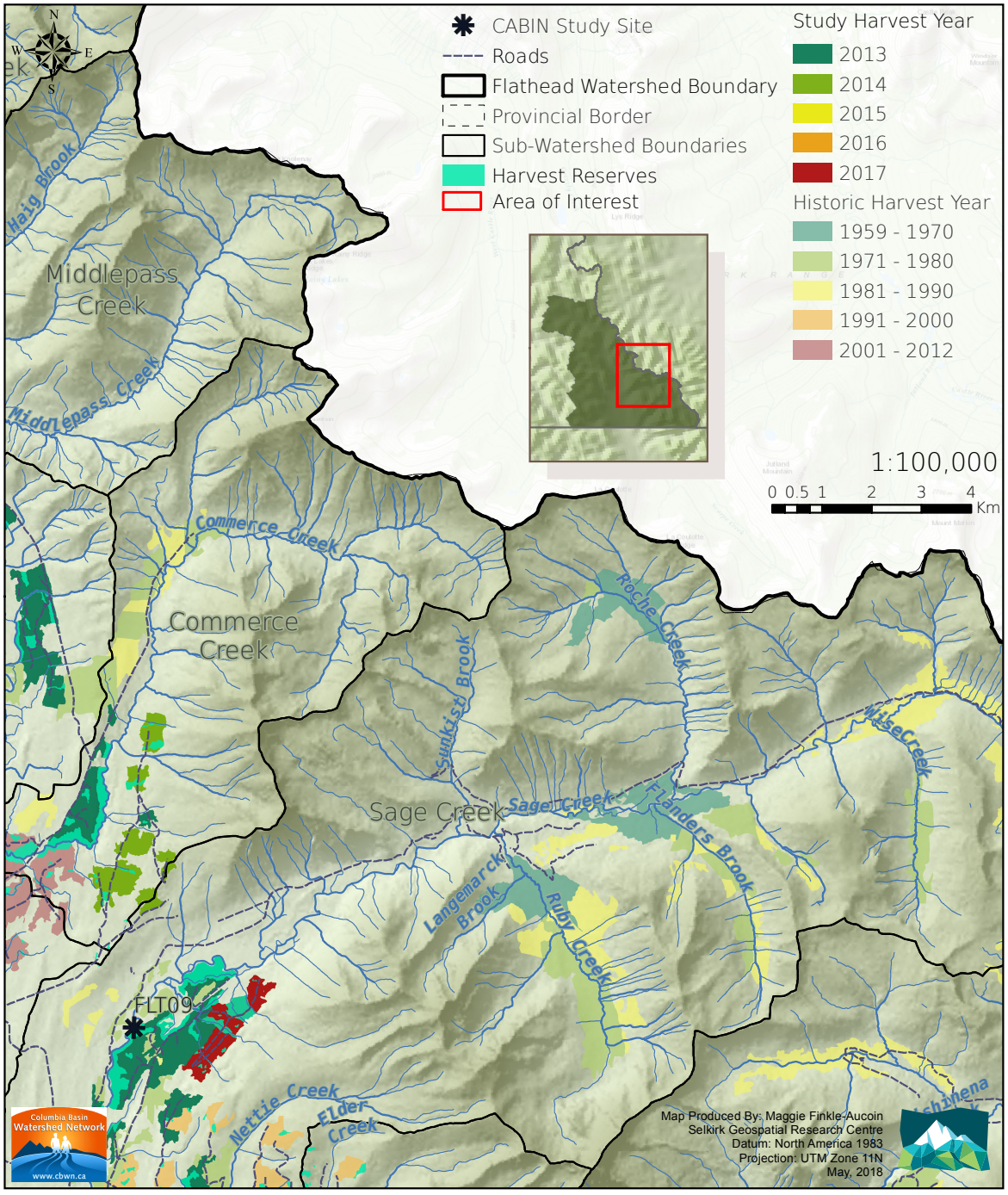
Cate Creek Site (FLT07) 2017 Status

Canadian Aquatic Biomonitoring Network (CABIN) Monitoring Site




Living Lakes CANADA
Flathead River Biomonitoring Program
Couldry Creek Site (FLT08) 2017 Status
Canadian Aquatic Biomonitoring Network (CABIN) Monitoring Site
N
W
E
S
Howell Creek
Storm Creek
Beryl Creek
Howell Creek
Cabin Creek
Cabin Creek
Flathead River
Burnham Creek
FLT08
Couldry Creek
Couldry Creek
1:100,000
0 0.5 1 2 3 4 Km
Study Harvest Year
2013
2014
2015
2016
2017
Historic Harvest Year
1959 - 1970
1971 - 1980
1981 - 1990
1991 - 2000
2001 - 2012
CABIN Study Site
Roads
Flathead Watershed Boundary
Provincial Border
Sub-Watershed Boundaries
Harvest Reserves
Area of Interest
Map Produced By: Maggie Finkle-Aucoin
Selkirk Geospatial Research Centre
Datum: North America 1983
Projection: UTM Zone 11N
May, 2018
Columbia Basin Watershed Network
www.cbwn.ca

Flathead River Biomonitoring Program

Sage Creek Site (FLT09) 2017 Status

Canadian Aquatic Biomonitoring Network (CABIN) Monitoring Site