Slocan River Monitoring and Assessment

Report 2008 – 2009

Section I

Report Prepared For:

The Columbia Kootenay Fisheries Renewal Partnership
Columbia Power Corporation and
The Columbia Basin Trust

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Contents

Overview and Summary

This report documents the sixth year of a multi-year ecological assessment and educational outreach in the Slocan Valley conducted by the Slocan River Streamkeepers.
Activities occurred from April, 2008 through January, 2009 and can be divided into three areas:

1. monitoring and assessments
2. outreach and education
3. restoration

Parameters monitored were: water temperature, habitat conditions, benthic invertebrates, coliform bacteria, and index site fish counts. The locations of the Streamkeeper's monitoring stations are given on the map on page 8.

Regarding 2008 river water temperatures, the number of days temperatures rose above 19°C ranged from 7 (Slocan Valhalla) to 12 (Crescent Valley). This was the lowest number of days where water temperatures rose above 19°C seen in 5 years of study. At 22.9°C, the maximum water temperature observed was near that seen in 2007. All Stations were close in temperature. Slocan Valhalla showed slightly greater variation in temperatures.

Stream habitat indicators and water chemistry were close to values reported in 2007.
Regarding coliforms as a reflection of drinking water quality, the geometric mean for total coliforms for 2008 was mid range while fecal coliforms were the second highest seen in 6 years of study. One count at Winlaw exceeded the recommended guideline for recreational use water. The high counts likely reflect high rainfall during the sampling period as sample collection is targeted to occur during or after rainfall events.

Regarding rainbow trout, in 2008, a reduction in the overall number of trout, returning to population levels experienced pre 2006 were observed. It would appear that the importance of the Lemon index site can not be understated and is responsible for much of the productivity of rainbow trout in the Slocan River.

Population trends for trout followed trends for key invertebrate species including Mayflies, Stoneflies and Caddisflies and water temperature.

Acknowledgements 2008

Members and friends of the Slocan River Streamkeepers initiated and carried out this project. Streamkeepers Judy Laret, Jen Yeow, Shanoon Bennett and Verena Shaw helped collect benthic invertebrate specimens and worked with students. Tyson Elders worked under the direction of Pete Corbett of Mirkwood Ecology to conduct the fish counts, Judy Laret, Aram Yeow and Jen Yeow placed and retrieved the data loggers in the field.

Verena Shaw, Shanoon Bennett, Liz Clow and Jennifer Yeow receive credit and thanks for their work sorting and identifying benthic invertebrates. Thank you, Passmore Laboratory Ltd. for giving space and equipment for this work. Mt. Sentinel High School and Selkirk College have lent microscopes and we are thankful for their generosity.

We have had the honor of working with the following teachers and their students: Kathy Knapik and the Mt Sentinel Biology 11 class, Linda Hoffman and her 4th grade class at Brent Kennedy Elementary, Lois Warthe and Gail McGee and students at the Blewett Elemantary School, Sasha Skalabise and he W.E. Graham Environmental Leadership Class and Rick Bardati at Lucerne High School in New Denver. Thank you, Nelson Junior Naturalists Club for asking us to join you on your yearly field outing and especially the Columbia Basin Watershed Network for supporting our invertebrate work.

Thank you Don Paul, and the Valhalla Fire Camp for allowing us to use your river front land for assessments and data collection. We are grateful to Gregoire Lamoureux and crew for their efforts at restoring problematic riverside sites.

Also, we are grateful to Jo Brown who did a great job on our website and Tom Bradley, our Streamkeeper Chairperson, for supplying maps. Jennifer Yeow wrote this report with contributions and help from Pete Corbett and Eva Johansson edited the final report.

Finally, we are very grateful to the Columbia Kootenay Fisheries Renewal Partnership, the Columbia Basin Trust, and Columbia Power Corporation for funding our work.

Project Objectives: Monitoring, Assessment and School Outreach

Streamkeepers are aware of the need to characterize baseline conditions to understand river ecology, evaluate the efficacy of long-term restoration projects and give guidance to future restoration work.

The objectives of the Slocan River Assessment and Restoration for Year 6 are:

- Continue to document rainbow trout populations by counting spawning fish and population estimates throughout the river.
- Document water temperature, water quality and benthic invertebrate populations that characterize current conditions in the Slocan River and Slocan Watershed tributary streams.
- Raise community awareness about aquatic issues thorough individual involvement and provide a learning experience that includes hands-on data collection, interpretation and presentation.
- Carry out restorative projects that will enhance aquatic habitat, protect river banks and give residents an opportunity to create positive change along their section of river

It is recognized that the above objectives require a long-term commitment and we will endeavor to work in increments that are realistic for the time frame and funding available.

Introduction

The Slocan River Streamkeepers was formed in 2003 as a member group of the Pacific Streamkeepers Federation. We came together out of concern for the Slocan River, and to learn about our river resource, help maintain it and restore aquatic habitat.

Our mission statement is:
"To work with the local community to promote awareness of the aquatic environment and engage in restorative and monitoring activities that benefit the Slocan River".

Our partnership with the Columbia Basin Trust enables us carry out an outreach program at local schools and involve youth in restoration projects. Our partnership with Columbia Power Corporation enables us to carry out restorative projects on private land and address the issue of riparian conservation throughout the valley.

Residents and local groups have long expressed concern about the health of the Slocan River. Issues such as channel in-filling, bank erosion, lack of trout habitat, decline in riparian vegetation and changes in water quality have been cited. In addition, as livestock range management, agriculture and recreation use increases, residents are concerned about environmental degradation and pollution from human/animal activities.

Regarding the sports fishery, rainbow trout of large size class decreased dramatically in the 1970's. During the early 1990's stocking program were attempted with limited success. Trout numbers continued to decline and the river has been closed to fishing since 1994.

Recent surveys have shown some resurgence of fish numbers, especially in the upper river, but overall numbers remain low and size/age class distributions are skewed in some index sites (Oliver, 2001). However, these surveys only reflect trends in the last 10 years. There is a need for continued studies to determine the factors affecting populations

The Slocan and Little Slocan Rivers also support a wide range of lesser-known fishes. Northern squawfish (*Ptychocheilus oregonenis*), longnose suckers (*Catostomus catostomus*) and mountain whitefish (*Prosopium williamsoni*) are abundant in the slower reaches. Sculpins (*Cottidae spp*) occur throughout the mainstem and the Shorthead Sculpin, *Cottus confusus*, an endangered species, also occurs. The rare/endangered (red listed) Umatilla dace is reported in the lower portion of the main river. Bull trout (*Salvelinus confluentus*) are known to spawn in Lemon Creek. A resident bull trout population also exists in Hoder Creek, a tributary to the Little Slocan Lake. Sturgeon (*Acipenser transmontanus*) have been reported in Slocan Lake and we know of one sighting of a sturgeon near the mouth of the Slocan River.

Factors that have been cited for the decline of fish numbers include:

Lack of nutrients

A study done by Oliver (1998) examined the possibility of nutrient limitation throughout the mainstem. Although findings indicated low nutrients levels, a healthy macroinvertebrate population was observed. The study investigated and proposed the possibility of fertilization. However, local residents were not supportive of this option.
Geologically, the Slocan River Watershed lies in the Nelson Batholith. Bedrock formations are mainly granitic. Silica is the predominant mineral and it has low solubility in water. Hence, many of the Slocan River tributary streams have low conductivity/mineral hardness.
With a range of 40 to 70mg/l as CaCO3, the Slocan River itself also has relatively low hardness.

Temperature

In many sections, the Slocan River is shallow and/or slow flowing. This is especially true above Lemon Creek (see below). This fact, coupled with warm, lake fed water makes the Slocan warmer than other rivers in the region. Temperatures up to 24 °C have been reported and historic data indicates mainstem temperatures are well above optimum rearing values for juvenile trout (Arndt, 2000).

Habitat Alteration

Timber harvesting, road building and crown land development have likely increased sedimentation of the river. Features such as train corridors, highways and roads, culverts on tributaries and B.C. Hydro corridors have also reduced habitat.
One of the main factors regarding habitat alteration is the diverted channel at Lemon Creek. The diversion which was done in the mid 1940's to protect CPR's rail line from washouts has resulted in water back up above the diversion, farmland flooding, river sedimentation, fish habitat degradation and higher river temperatures. It can't be overstated as a factor in the decline of fish. .

Most of the Slocan riparian land is privately owned and, as development continues the critical riverfront land experiences constant pressure. Logging, domestic animal grazing, septic field leaching, and home construction all contribute to environmental degradation

Historic over-fishing

Although, a limited "Catch and Release" fishery is now open from June to September, excessive catches in the early 1900's up to 1970's likely had a negative impact on fish populations that persist today. In addition, we are aware that violations of fishing regulations persist.

The Slocan River Streamkeepers support the concept of riparian restoration as a sustainable approach to helping fish stocks, improving drinking water quality and maintaining the aquatic environment. Stream bank re-vegetation, bank erosion control, where appropriate, and small scale in-stream structures to provide habitat and reduce channel in-filling have all been put forward as effective ways to promote river health. In addition, fences can be used to protect sensitive riverbanks from livestock impacts.

Table 1. Monitoring Sites and Parameters on the Slocan River for 2007

Site	UTM coordinates (Zone 11U) or Latitude & Longitude (Can. Geodetic Survey map)			Parameters Tested
	Easting	Northing	Altitude (m)	
Little Slocan River				Relative flow using a gauge
Carpenter Creek, @ Hwy 6 bridge, New Denver	Latitude: 49 55'25"	Longitude: 117 22' 15"	510	Benthic invertebrate survey, substrate, water chemistry
Slocan River below Slocan Village (Valhalla Camp)	465762	5512056	509.9	Benthic invertebrate survey, substrate, water chemistry, temp. data logger,
Slocan River, Slocan Village	Lower Bridge: redds observation, snorkel float between Upper and lower bridges			
Slocan River @ Winlaw	459064	5494303	496.9	Temperature data logger Total and Fecal Coliforms
Winlaw Creek @ gauge station	Latitude: 49°36'20"	Longitude: 117°32'25"	518	Temp. data logger, benthic invertebrates, water chemistry, substrate, EMS # E225508
Passmore Bridge	452683	5487859	482.7	Total and fecal coliforms
South Slocan (Don Paul's property)	460956	5475831	469.2	Benthic invertebrate survey, substrate, water chemistry, temp. data logger, coliforms
River Swim (including index sites)	Index sites established by G.G. Oliver and modified by P. Corbett			Snorkel floats – Rainbow Trout enumeration

Table 2. Monitoring Sites and Parameters on the Slocan River

Parameter	Collection frequency
Temperature using Temp. Pro data loggers	Hourly
Total and fecal Coliforms	5 over 30 days, beginning mid-summer
Water Chemistry (Hach kit)	Once during fall (low water)
Benthic invertebrates	Once in fall
Substrate analyses	Once in fall
Habitat survey	Once in fall
Rainbow trout spawning and redd's count	Visual from Lower Slocan Bridge: twice a week during March – April 2-3 snorkel surveys between Slocan bridges
Snorkel survey/index site study on Slocan R.	As weather permits during late summer – fall

Flow Summary

Little Slocan River

The Little Slocan River flows through a sub basin in the Slocan watershed. The watershed is home to Tree Farm License #3, one of the oldest Tree Farms in B.C. The watershed is 79,796 hectares and a number of smaller creeks including Koch, Grizzly, Boulder, Russell and Hoder flow into the Little Slocan. The River forms below the lower Little Slocan lake and flows for approximately 20 kilometers before merging with the Slocan River in Vallican. In 2005, a gauge to measure relative height was installed on the Little Slocan River at the location indicated on the map (page 8).

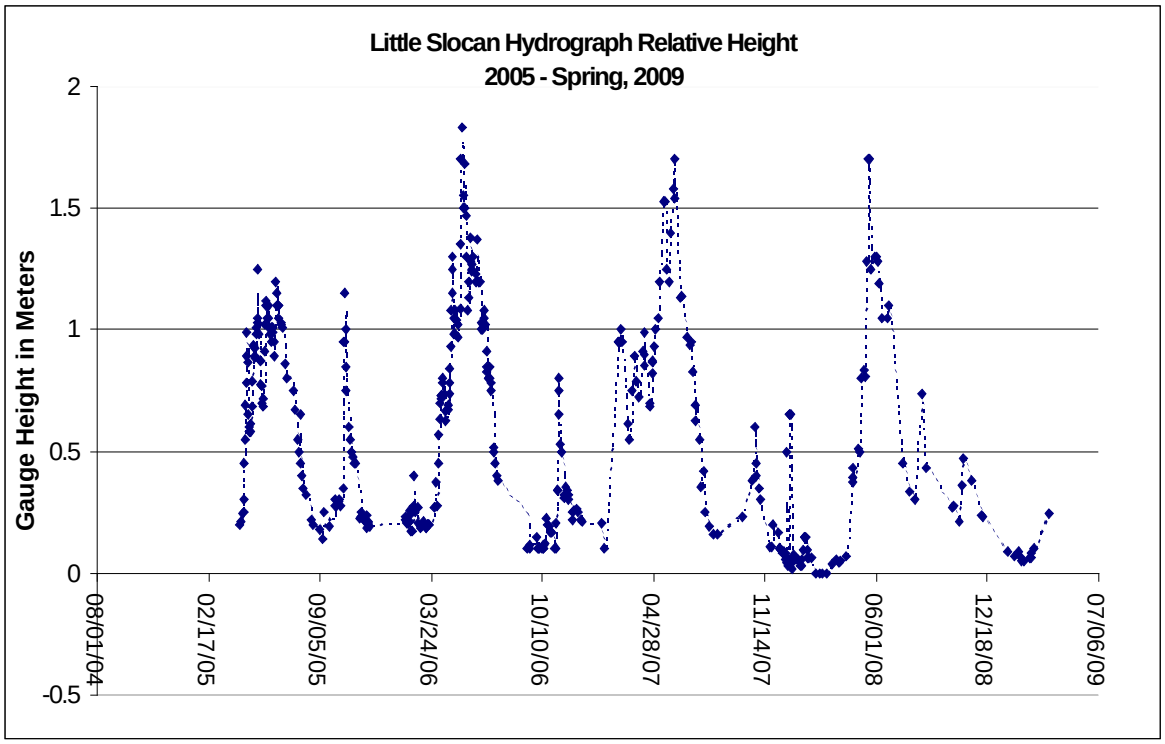


Chart 1. Gauge on the Little Slocan River

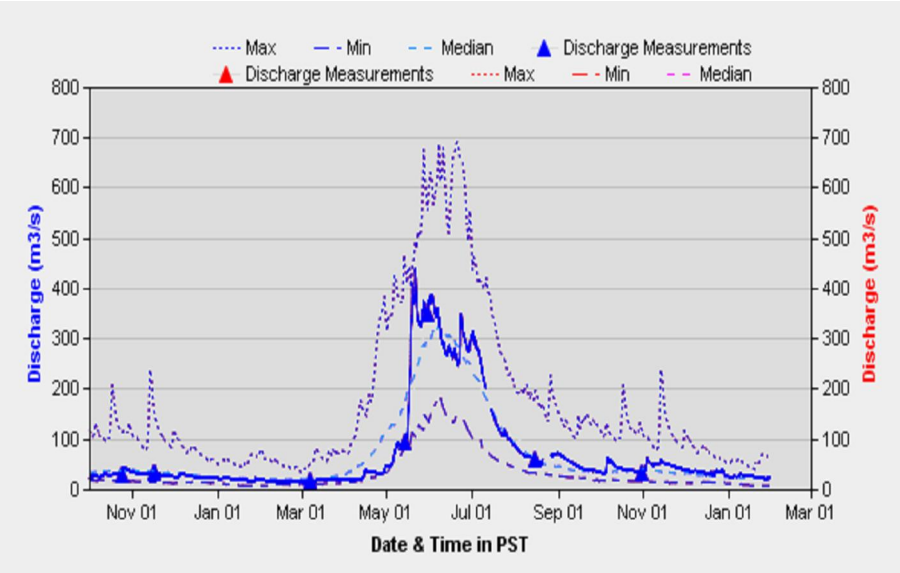
A review of relative gauge height shows that peak flow in spring, 2008 was very close to high levels in 2007 and slightly below 2006. High water occurred in mid May at approximately the same time as previous years. However, the length of time water stayed high overall was shorter than seen in 2007. Fall, 2007 and 2008 water levels were lower than seen in 2005 and 2006.

Historic Flow on the Slocan for 2008

Water Survey Canada has measured flow on the Slocan River since 1914 and the data is available on their website: www.wsc.ec.ca/hydat/H2O/index

A review of historic data for 2008 shows a rapid rise in water levels at the end of May. The levels dropped quickly when compared with historic high flows and low flows were slightly higher than normal seasonal trends. See Chart 2

Chart 2 Daily Discharge for 2008 for the Slocan River: (WSC Waterweb)



Temperature Summary

Methods

Three Hobo Water Temp Pro temperature loggers manufactured by Onset Technologies were installed at below locations. Each logger was mounted inside a large masonry brick. The bricks were secured with a cord and installed at locations described in Table 3 below. Manual temperature readings were taken at the time of installation and removal.

Table 3. Temperature Sensor Installation

Site	Date installed	Distance from bench full water line	Depth	Date removed	Manual temp.°C installed/ removed
Slocan (Valhalla Camp)	6/04/08	3 meters from east bank	1-2 meters	10/23/08	9.0/11.0
Winlaw	5/17/08	Attached to CPC habitat structure	2 meters	10/20/08	10.5/12.0
So. Slocan (Don Paul's)	6/21/08	4 meters from east bank	1-2 meters	10/16/08	12.1/3.5

Temperature readings were taken every hour, 24 hours daily. The sensors were removed in October, and the data was downloaded. Daily average and daily maximum were calculated from the downloaded data. Historic information referenced in Table 4 is based on data collected between 1998 and 2004 by S. Arndt of the Columbia Basin Fish and Wildlife Compensation Program (CBFWCP) and C. Beers of the Columbia Kootenay Fisheries Renewal Partnership (CKFRP).

Temperature Findings for 2008

Table 4 page 13 gives the number of days for means above 19°C and above 20°C. Both temperatures are given because there were days when the maximum temperature occurred between these two temperatures. Studies cited by Arndt (2000) indicate that 13° to 15°C are a desirable range for rearing trout, while maximum temperatures of 16 to 18°C are satisfactory.
Hence, temperatures above 19°C likely represent stressful conditions to fish.
The sensor at Valhalla Slocan became dewatered during early August and so, readings for that time period are questionable.
The data indicates that although the *maximum* temperatures were as high as previous years, the number of high water temperature days was relatively low. In fact, the number of days when the daily mean rose above 19°C was the lowest seen in six years of study.

Table 4. Water Temperature Comparisons for Sites in the Slocan and Little Slocan Rivers 1997 – 2008

Table 4. Station	**Year**	**Observed maximum (°C)**	**Number of days (estimate)**	
North to South			Daily mean > 20 °C	Daily mean > 19 °C
Slocan (Valhalla Camp)	2001**	20.6	4	14
	2003*	20.2	3	22
	2004***	23.1	22	32
	2005***	22.0	4	27
	2006***	23.3	23	38
	2007***	22.1	5	20
	2008***	22.8	4	7
North to South			Daily mean > 20 °C	Daily mean > 19 °C
Above Lemon Creek	1997*	21.5	2	
	1998*	24.4	39	
	2001**	20.9	4	18
Lemon Creek	1997*	17.5	0	
	1998*	18.9	0	
100 m below Lemon Creek	2003*	20.9	4	13
	2004*	22.4	14	26
Above Little Slocan confluence	1997*	21.3	23	

Table 4. Station	**Year**	**Observed maximum (°C)**	**Number of days (estimate)**	
	1998*	24	58	
Winlaw	2001**	20.2	3	13
	2003***	20.2	3	20
	2004***	22.8	23	30
	2005***	22.1	6	24
	2006***	23.5	35	52
	2007***	21.8	5	20
	2008***	22.3	6	11
Little Slocan	2001*	19.1	0	1
	2003***	19.9	0	1
	2004***	22.6	0	5
	2005***	18.1	0	0
	2006***	22.3	0	6
Crescent Valley	2001***	22.4	23	28
	2003*	21.2	11	22
	2004*	23.8	23	30
	2006***	23.6	13	31
	2007***	22.3	18	24
	2008***	22.9	7	12

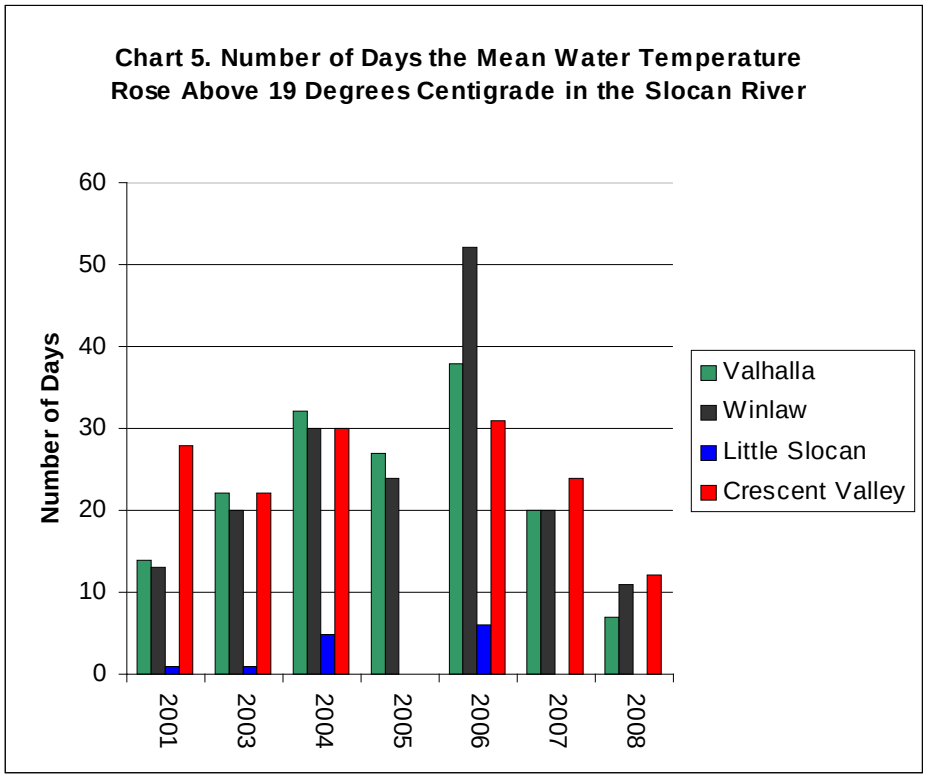
* CBFWCP, ** CKFRP, *** Slocan River Streamkeepers

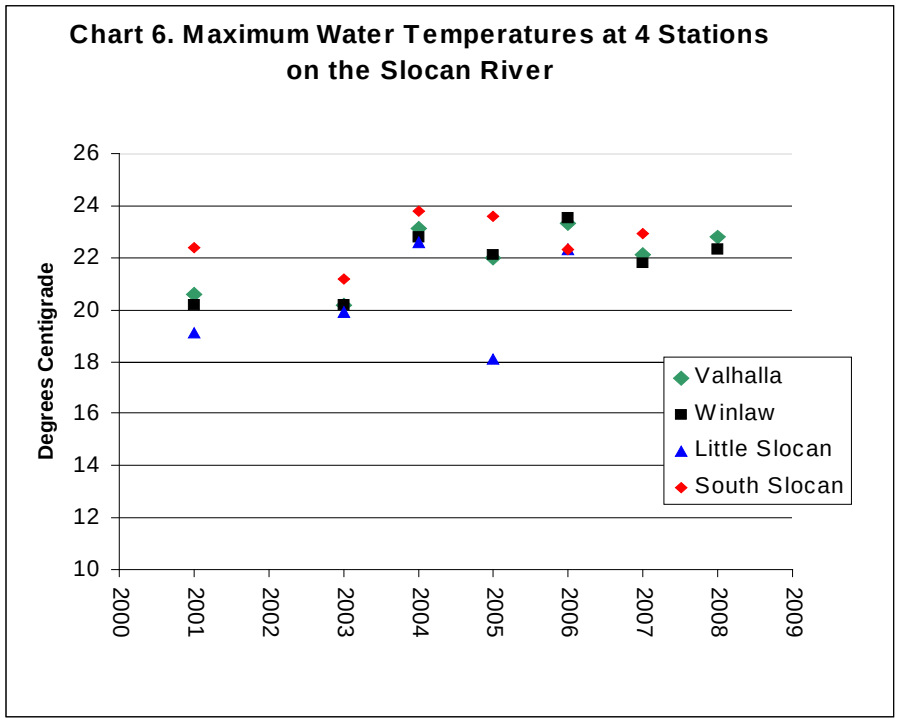
Time periods for measurements

1997: July 2 - Sept 30, 1998: July 1 - Sept 15, 2001: July – Oct, 2003: July – Oct , 2004: July – Oct, 2005: May – Oct, 2006: May – Oct, 2006: April – November, 2007: July – Oct, 2008: May – October

Chart 3. Slocan River Mean Daily Temperature at 3 Stations, 2008

Chart 4. Slocan River Maximum Daily Temperature at 3 Stations, 2008





As seen in Charts 5 and 6 above, the number of days that water temperature rose above 19 degrees centigrade dropped in 2007 and 2008, while the maximum temperatures remain at the same level or possibly increased slightly between 2001 and 2009. Note, the Little Slocan river is historically colder.

River Habitat Data

The field data collection methods are based on sampling protocol described in "The Canadian Aquatic Biomonitoring Network Program Field Manual" (Environment Canada, 2008).

Methods

- Diameter, width, length and average dimensions of 100 rocks were taken. Rocks were chosen using the "random walk" method.
- Percent embeddedness for 20 rocks were taken at random
- Water velocity was determined using a tennis ball, stopwatch and tape measure. Balls were dropped in the water and the float time across a known length was measured.
- The Water chemistry tests hardness, acidity, alkalinity, pH and oxygen were done using a Hach Kit model no. AL-36B or at Maxxam Laboratory Ltd. in Burnaby.
- Conductivity and Sediment were done at Passmore Laboratory Ltd. using methods outlined in Standard Methods for the Examination of Water and Wastewater, 17th edition, published by the American Public Health Association.
- Metals were performed at Maxxam Laboratory Ltd. in Burnaby

Table 5. Stream Habitat Data

	South Slocan	**Slocan Valhalla**	**Carpenter Creek**	**Koch Creek**
Date	9/30/08	10/23/08	10/15/08	9/15/08
Coordinates	460956E 5475831E	465762E 5512056N	49°58'00" Lat 117°28'00"Long	49°46'00" Lat 117°36'00"Long
Stream Order	5	5	5	3
Habitat Type	Riffle Straight run	Riffle, straight run	Riffle	Riffle
Habitat Sampled	Riffle	Riffle	Riffle	Riffle
Canopy coverage	0-25%	0-25%	51-74%	51-74%
Vegetation				
Ferns/grasses	present	Present	Present	Present
Shrubs	present	Present	Present	Present
Deciduous trees	present	Present	Present	Present
Coniferous trees	present	Present	Present	Present

Table 6. Stream Habitat and Water Chemistry Data

	South Slocan	**Slocan Valhalla**	**Carpenter Creek**	**Koch Creek**
Benthic Invertebrate Sample				
Operator:	Shanoon Bennett	Shanoon Bennett	Shanoon Bennett	V. Shaw
Sampling time	3 min	3 min	3 min	3 min
# of containers	1	1	1	1
Typical depth	45cm	53 cm	38cm	45cm
Substrate				
Predominant Particle Size (5 = 16 – 64mm) (6= 64 – 256mm)	6	6	6	7
2nd most predominant particle size	5	5	5	6
Size of matrix	1-2mm coarse sand	1-2mm coarse sand	2-16mm gravel	2-16mm gravel
Embeddedness Category	3	3	4	4
Average velocity m/sec	1.0	0.98	.67	.73
Maximum velocity m/sec	1.7	1.06	.91	.90
Av. Distance from shore m	16.1	4.5	15	2.5
Water temperature °C	13.5	16.2	3.0	7.5
Water Chemistry				
pH	7.4	7.7	Not done	7.6
Alkalinity mg/l	54.7	41.0	Not done	20.5
Acidity mg/l	2.3	5.7	Not done	4.6
Dissolved oxygen mg/l	10.5	10.0	10.0	11.0
Turbidity NTU's	0.65	0.35	0.45	0.2
Total suspended solids mg/l	2.1	Not done	Not done	Not done
Hardness mg/l	41.0	41.9	Not done	17.6
Conductivity mmhos/cm	73.1	85.8	191	39.5
Total nitrogen mg/l	0.04	0.03	0.08	0.02
Total phosphorus mg/l	<0.005	<0.005	<0.005	<0.005
Dissolved calcium mg/l	13.4	13.6	28.0	5.61
Dissolved magnesium mg/l	1.87	1.96	6.12	0.86

Benthic Invertebrate Survey

Background and Rational

Benthic macroinvertebrates are bottom dwelling spineless creatures that can be seen without the aid of a microscope. Many are the immature stage of common insects such as mayflies, stoneflies and caddis flies. Others include freshwater shrimps, mites and worms.

As an essential part of the aquatic food web, they feed on plants and, in turn, are eaten by other insects, fish, frogs, and other animals. According to Environment Canada's CABIN website, "the purpose of environmental assessment and management is ultimately the maintenance of biological integrity". Bioassessment methods use living organisms to provide insight into environmental conditions and benthic invertebrates are ideal for this purpose for a number of reasons:

- they are sedentary, and thus constantly exposed to the effects of pollution
- they are reasonably long-lived (1-3 years in north-temperate waters) so the effects of environmental stressors can be time-integrated; and
- they occur in high diversity, so many different species can potentially react to many different types of impacts.

Environment Canada has recommended that 5 years sampling is required to effectively characterize a site. In 2008 Environment Canada began sampling for their reference collection at sites throughout the Columbia. When complete, the reference collection will allow us to compare our sites with others of similar aspect, stream order water chemisty etc. Samples can be evaluated retroactively. For this reason, we have sampled 1 or 2 years on some creeks of interest to local communities.
Between 2005 and 2008 Slocan Streamkeepers collected according to CABIN protocol at the following Slocan Watershed sites: South Slocan (4 years) Slocan Valhalla (4 years), Little Slocan River (2006), Carpenter Creek (2006 & 2008), Bonanza Creek (2007) and Koch Creek (2008). In addition, in 2008 we sampled Harrop Creek in the Harrop/Proctor community outside the Slocan Valley.

Invertebrate Collection Methods for 2008

The methods used for invertebrate collection are outlined in Environments Canada's publication for the CABIN protocol entitled: "Canadian Aquatic Biomonitoring Network Program Field Manual" published by the Water Science and Technology Directorate.

A kick net with 400 μm mesh size and a collection time of three minutes was used.
The collector walked backward upstream kicking the substrate and brushing large boulders while the net was held downstream. The collector zigzaged over the stream bottom. A person trained in the CABIN Protocol was assigned to collect all samples for the study.

In Addition, students and other community members practiced using the kicknet and assisted in collecting habitat data and conducting stream velocity measurements.

All macroinvertebrate samples were preserved in 90% ethanol and taken to Passmore Laboratory Ltd. for initial sorting. Teams of Streamkeepers, members of the community and students from Selkirk College sorted specimens during November and December 2008. Specimens were shipped as per instructions from the Kootenay River Network to EcoAnalysts, Inc. in Moscow Idaho, U.S.A. Here, specimens were enumerated and identified. The following references were used to assist students and lab helpers:

- The Salmon River Rountable Benthic Invertebrate Key and Charts (1992)
- Aquatic Entomology by W. Patrick McCafferty (1981)
- Canadian Aquatic Biomonitoring Network's Key to Macroinvertebrates (CABIN) edited by Stephanie Sylvestre
- The Streamkeepers Handbook Module 4, Appendix 1 Field Identification and Keys (1995)
- Introduction to the Aquatic Insects of North America - Merritt and Cummins (1978) Interpretation

All animals are arranged into groups or taxonomic ranks, which include Phylum, Class, Order, Suborder, Family, Subfamily, Genus and Species. The benthic invertebrates with external skeletons are in phylum arthropoda, Class Insect. The common orders of interest in the Slocan River include ephemenoptera, pricoptera and plecoptera. Other names such as Baetidae, for example, refer to a Family under the Ephemenoptera or Mayfly Order.

Every attempt was made by EcoAnalysts to identify to the lowest taxa and, in most instances, this was Family. All data including habitat characteristics, water velocity, and taxonomic data from the 4 sampling sites was entered into Environment Canada's website: http://cabin.cciw.ca

The following statistical biometrics were calculated by the CABIN Program:

- Percent abundance by taxa which compares the relative abundance of all taxa.
- % EPT and number of EPT Taxa which is the total number of Ephemenoptera, Tricoptera and Plecoptera Orders and number of taxa from these groups.
- Total number of Taxa

Slocan River Invertebrate Findings for 2008

The site "Slocan Valhalla" represents an "above" location, e.g. near the beginning of the river while the site called "South Slocan" can be considered "below" because it is less than 1 kilometer from the confluence of the Slocan and Kootenay Rivers at the Brilliant reservoir.

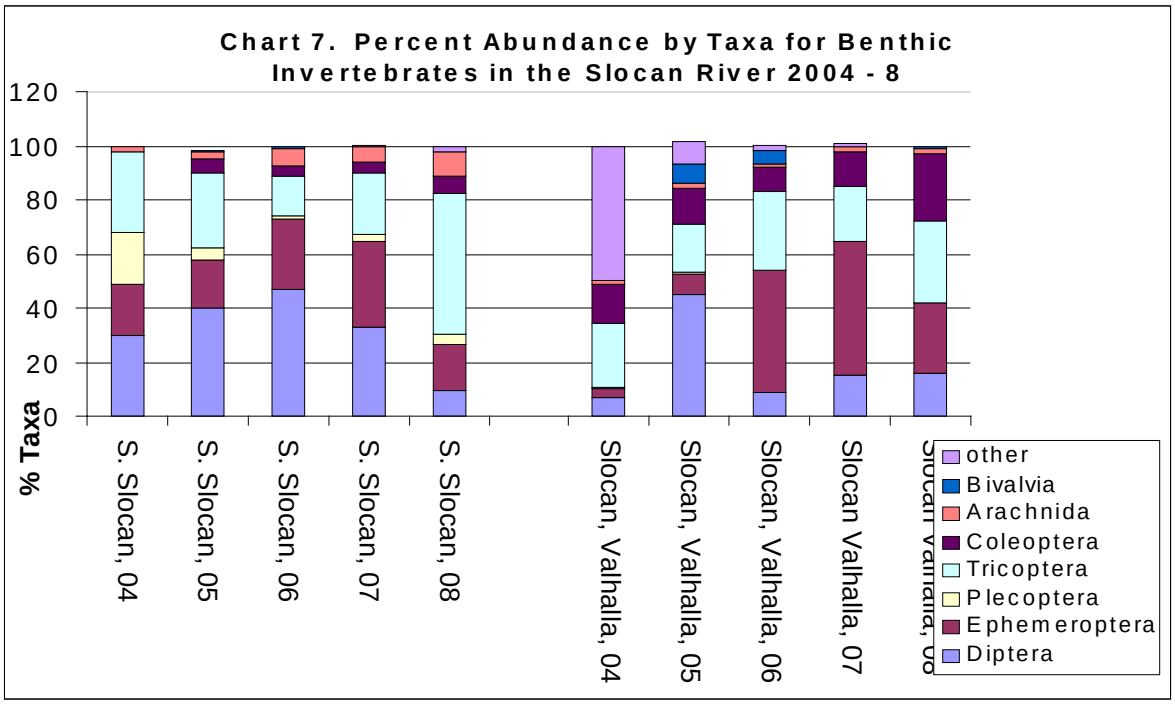
Chart 7 below shows percent abundance for benthic data in 2008. There are high numbers of the invertebrate groups that indicate good water quality and relatively diverse populations at both sites. The following trends are observed:

- An increase in the percentage abundance of Ephemeroptera (mayflies) was observed at both sites in 2006 and 2007. For 2006, this coincides with warmer water (See Chart 5) and an increase in catchable fish (See figure 2, Section II, Fish Population Assessment).

- When both Ephemeroptera and Tricoptera, are taken into account for years 2006 & 7, the Valhalla site correlates well with the trend seen for catchable fish above.

- Diptera (fly) larvae abundance at South Slocan correlates with fish counts for 2005 – 2008
- Arachinida (mites) are consistently higher at S. Slocan and families called "other" that include hydra are present at Valhalla Slocan and not S Slocan.

- Coleoptera (Beetles) are consistently higher at Valhalla Slocan.

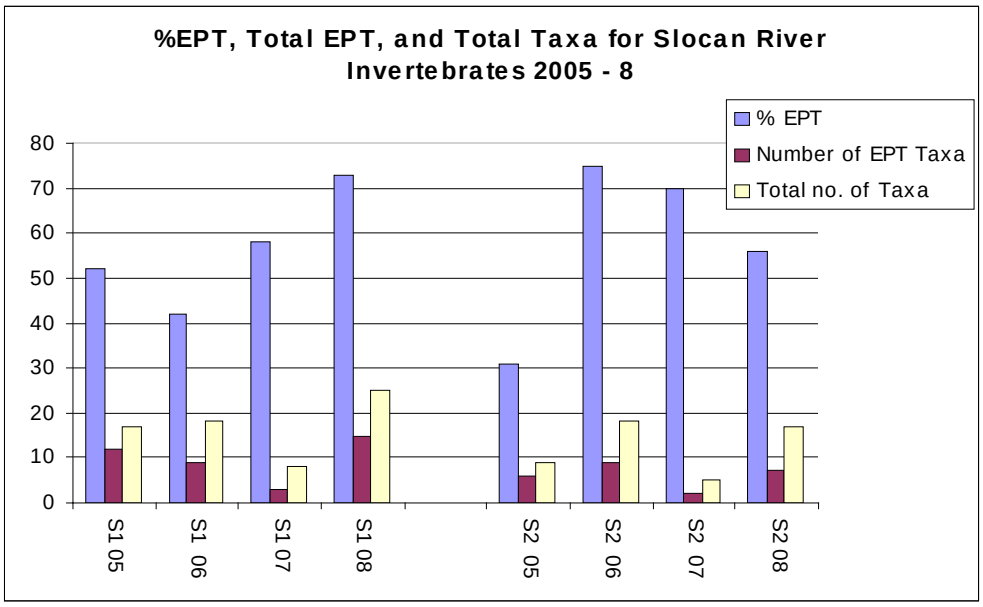


Other Invertebrate Biometrics

A review of the three important groups – Ephemeroptera, Tricoptera and Pleacoptera as a group called "EPT" shows:

- The percentage of EPT was highest in 2006 and dropped in 2007 and 2008 at Slocan Valhalla. It increased between 2006 and 2008 in South Slocan .
- The total number of EPT taxa decreased at both sites in 2007 and increased in 2008
- The total number of all taxa decreased in 2007 and increased in 2008 at both sites

Chart 8. Percent EPT, Total EPT and Total Taxa for Slocan River Invertebrates 2005 – 2008

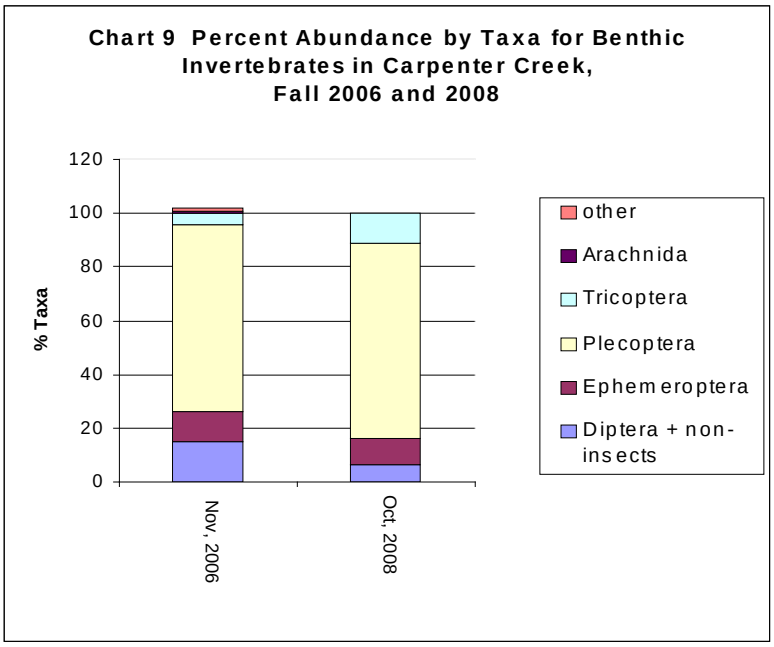


Carpenter Creek Findings for 2008

Carpenter Creek flows west through the town of Sandon and into the north end of Slocan Lake. Carpenter Creek Watershed has been heavily impacted by mining activity. While the claims are currently inactive, past mining has resulted in a mine's tailing pond beside the creek in downtown Sandon (on the south bank).

According to local biologist, Luce Paquin, Carpenter Creek likely has blue-listed species like "westslope cutthroat trout and a bull trout resident population". Kokanee trout use the lower reaches of the creek for spawning.

Carpenter Creek cont.



The type of insects, numbers and diversity of taxa in Carpenter Creek in found in 2008 were similar to those seen in 2006. The assemblage can be characterized as high in individuals that are sensitive to pollution. Other observations are:

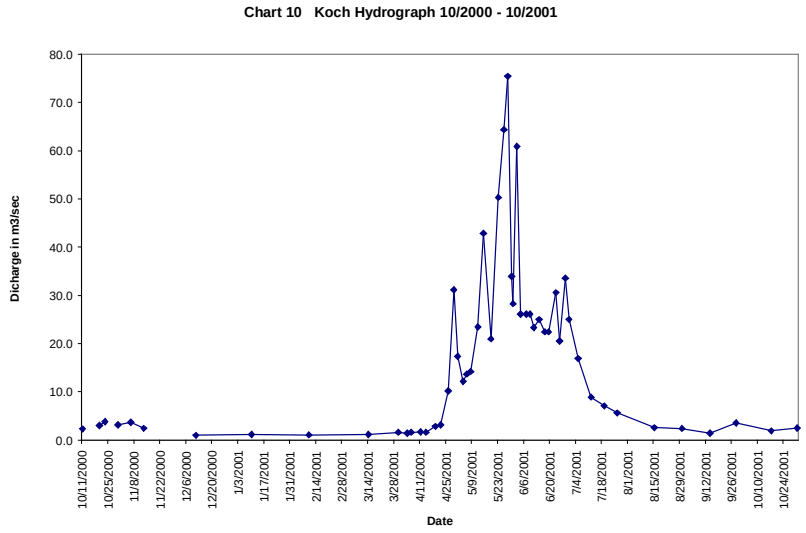
- The percentage of EPT (most sensitive) increased from 85% in 2006 to 94% in 2008.
- Plecoptera or stoneflies were the dominant taxa both years with Taeniopterygidae (winter stonefly) as the main family.
- As a percentage of the total, Tricoptera (caddisfly) gained from 4% in 2006 to 10% in 2008

Taeniopterygidae larvae

Adult

Koch Creek

Koch Creek enters the Little Slocan River approximately 2 kilometers west of Vallican. Due to its northern aspect, and deep canyons, water temperatures can be 3 to 4 degrees colder than the Little Slocan. Koch was selected for sampling because of its importance as a cold water input for the Slocan River and because a proposed hydroelectric project would have diverted a significant amount of the river's flow.



The hydrograph for Koch Creek , 2000 (Chart 10) shows the extreme nature of its snow dominated flow regime.

Invertebrate Findings for Koch Creek

- At 67% , the dominant taxa was Ephemeroptera with the majority of specimens in the Family Baetidae. The second most abundant taxa was Chironomidae.

- The important group collectively called EPT made up over 70 % of all taxa. This would indicate clean water containing organisms sensitive to pollution.

Regarding diversity and evenness measurements, all calculations show lower diversity and evenness metrics for Koch Creek when compared to the other 2008 creek/river study sites. This may be due to the low mineral (hardness and conductivity) content of the Koch creek and/or cool water temperature. See Table 6

See Appendix 3.

Total and Fecal Coliforms

Background

Total coliform bacteria have been used as indicators of water quality related to human health for over 80 years. As a group, total coliform bacteria include many genera that are associated with decaying plant material and are not of necessarily of human or animal origin. They can multiply on wood and ropes and can produce slime inside pipes. (APHA 1989). They are considered to be useful as broad indicators of water sanitation.

Because they are cultured at 44.5°C on selective media, the sub-group called "fecal (thermotolerant) coliform" bacteria are indicators of contamination due to warm blooded wildlife, domestic animals and/or human activity in a watershed and should be regarded as indicators of hazardous contamination (Environmental Health Directorate 1977). They are sensitive to water temperature and surface run-off (ibid).

Studies done between 1996 and 2003 on Slocan River tributaries show fecal coliform count rises as water temperature increases and, in summer, river water temperatures frequently rise above 20°C (SVWA 1996-2000). Fecal counts are low in winter when tributary volume and water temperature is low. In spring, coliform counts in tributaries have also been low despite an influx of water and turbid conditions. This is likely due to cool water temperatures (Winlaw Watershed Committee, 2001).

Total and fecal coliforms are included in our Streamkeeper assessment because many people obtain drinking water from surface sources and shallow wells next to the river. In fact, a survey conducted by Regional District H (which including the Slocan Valley) in 2004 found that 76% of respondents obtained water directly from surface sources or wells beside the river. Other surveys have found similar trends (conversation with RDCK employee). In addition, concern regarding drinking water quality has increased as recreation, development and livestock use has increased. The current standard for coliforms in raw drinking water is specific for *E. coli* and states no colony forming units per 100ml are permitted.

Methods

Three stations on the Slocan River were tested five times over 30 days during late summer and early fall. This is the time of year when water temperatures are high and fall rains can occur. The sampling regime is based on recommendations set out by the BC and Canadian Guidelines for Water Quality Monitoring (2000).

The test methodologies for total and fecal coliforms are based on procedures outlined in the "Standard Methods of Analysis for the Examination of Water and Wastewater, 17th edition published by the American Public Health Association, specifically, section 9222D called the Membrane Filtration Procedure.
Tests were performed at Passmore Laboratory which participates in on-going quality assurance testing through the Canadian Association for Laboratory Accreditation (CALA).

Findings

Total Coliforms

Total coliforms ranged from 6 to 300 cfu's per 100ml with readings as high as seen in 2004. See Table 7 and Chart 11.

Table 7. Geometric mean of five total coliform samples taken over 30 days. Samples taken on the Slocan River 2003 – 2008.

Site	2003	2004	2005	2006	2007	2008
South Slocan	9	71	28	10	29	22
Passmore	5.4	61	18	12	14	16
Winlaw	6	61	22	10	21	18

Fecal Coliforms

Fecal coliform counts ranged from 5 to 193 cfu's per 100ml with the highest readings seen to date. See Table 8 and Chart12.

Table 8. Geometric mean of five fecal coliform samples taken over 30 days. Samples taken on the Slocan River 2003 - 2008

Site	2003	2004	2005	2006	2007	2008
South Slocan	4.6	23.1	6.4	10	3.9	17
Passmore	5.1	21.7	10.2	9	3.9	14
Winlaw	3.4	25.7	9.4	10	5.1	17

The standard for *E. coli* in direct contact recreational water specifies that the geometric mean of 5 samples taken over 30 days not exceed 77 cfu's/100 ml. Since *E. coli* is a sub-group of the fecal coliforms, it is likely the guidelines were exceeded on one sampling day, August 21st , when counts ranged from 115 to 193 CFU's/100ml. Although high on that day, the geometric mean for 2008 was lower than 2004 because counts dropped quickly.

Observations

Between August 19th and 21st over 63mm of rain was recorded at the Passmore Weather Station. At 193 cfu/100ml, the highest fecal coliform count was observed at Winlaw on August 21st. By August 25 the count had dropped to 18cfu/100mls. This may indicate that during periods of high rain in late summer, fecal coliform counts rise early and drop quickly. Also, the total counts tend to be proportional to the volume of rain. E.g. more rain equals higher counts.
This was the highest count and highest rainfall in August we have seen in six years of study. In September, the highest fecal coliform count was 15 cfu/100ml. Although all the stations were close in geometric mean values, over the years, Winlaw was consistently in the higher range for fecal coliform counts and South Slocan high for total coliform counts. See Charts 11 and 12 below.

In summary, as in previous years, there does appear to be a correlation between coliform counts, rain and, possibly, water temperatures.

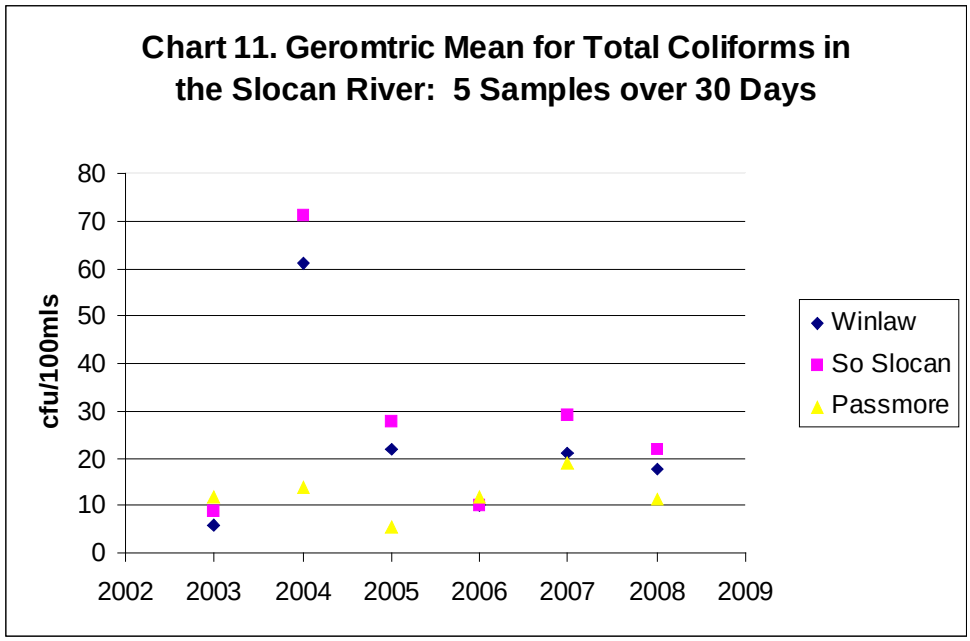


Chart 11. Geromtric Mean for Total Coliforms in the Slocan River: 5 Samples over 30 Days
cfu/100mls
80
70
60
50
40
30
20
10
0
2002
2003
2004
2005
2006
2007
2008
2009
Winlaw
So Slocan
Passmore

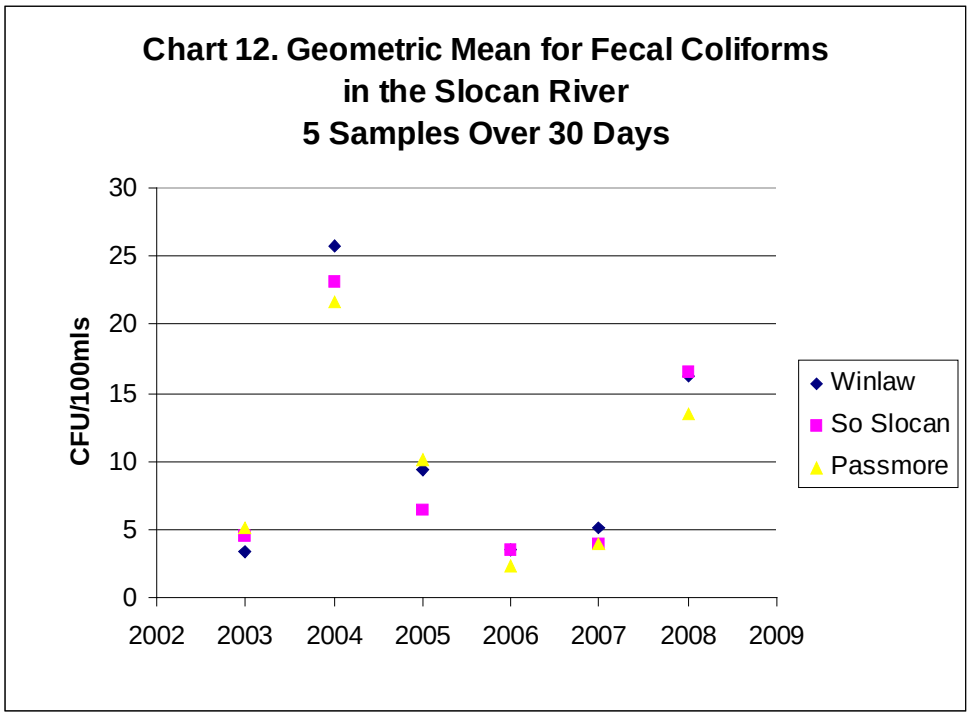


Chart 12. Geometric Mean for Fecal Coliforms in the Slocan River 5 Samples Over 30 Days
CFU/100mls
30
25
20
15
10
5
0
2002
2003
2004
2005
2006
2007
2008
2009
Winlaw
So Slocan
Passmore

Further Information and Recommendations

1. Spawning Fish and Total River Counts
   In years 2004 through 2008 we continued to count total numbers of trout in five established reference sites. Our annual spawner survey is not included this year because spawning occurred late, the water was turbid and accurate readings could not be taken. Regarding the index site survey, a single pass, a full river swim was recommended but not completed in 2008 due to funding constraints.

2. Temperature Survey
   In past studies, the Streamkeepers have received data for 2 stations from the Columbia Basin Fish and Wildlife Compensation Program. This activity has been discontinued. In future years, the Streamkeepers will be responsible for collecting data at 3 stations and, in conjunction with CBT's Waters Initiative and Kootenay River Network we will continue this work.

3. Benthic Invertebrates
   In 2008, the data collection and analyses was carried out in conjunction with other watershed groups, the Provincial Govt. and Environment Canada under CBT's "Waters Initiative Program". In 2009 we recommend continuing to collect at key sites in the Slocan Valley and especially work in conjunction with other community groups

4. School Outreach Links to IRP's
   The program currently links to the Integrated Resource Package for Biology 11 in the following ways:
   - Example of organisms of Phylum Arthropoda and further taxonomic hierarchical breakdown is made through "hands on identification" of specimens collected by students. Organisms of Class Insecta, orders Diptera, Ephemeroptera, Plecoptera, Tricoptera and other aquatic taxa are also studied.
   - Students learn hands-on procedures for conducting scientific habitat surveys including substrate surveys, streamflow measurements, evaluating vegetation and habitat character. The information is essential to understanding complex relationships between biotic and abiotic environments and specified in the IRP for Ecology for Biology 11.
   - Prior to field studies and after the field reviews, students engage in panel discussions on characteristics of good habitat, water pollution, impacts to wildlife from dams and changes in water quality due to human activities.

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List of Appendices

1. Raw Temperature data
2. Benthic taxonomy
3. Benthic biometrics
4. Coliform Test Data