Monitoring, Assessment

and School Outreach Activities

Report 2005 – 2006

Report Prepared For:

The Columbia Kootenay Fisheries Renewal Partnership and
The Columbia Basin Trust

Report Prepared By:
The Slocan River Streamkeepers
Winlaw, BC
V0G 2J0

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1. Summary

This report documents the third year of a multi-year assessment of the Slocan River and outreach in the Slocan Valley conducted by the Slocan River Streamkeepers.
The report includes activities that were initiated in January, 2005 through April, 2006 which can be divided into three areas:

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

Parameters studied were: water temperature, habitat conditions, benthic invertebrates, coliform bacteria, spawning fish and index site fish counts. The locations of the Streamkeeper's monitoring stations are given on the map. See page 9.

Regarding river water temperatures, the average daily values in 2005 for all stations were between those found during 2004 and 2003. The maximum was higher than in previous years for Crescent Valley and Winlaw.

Stream habitat indicators and water chemistry except for acidity were close to values reported in 2004. Acidity levels were significantly higher at the South Slocan station. The character of the invertebrate population was different in 2005 than 2003 and 2004. Diptera (*Chironomidae*) was the dominant taxa at all three stations. In addition, the EPT to total ratio dropped at all three stations. Sampling technique did vary in 2005.

Regarding total and fecal coliforms as a reflection of drinking water quality – the geometric means counts for 2005 were between 2003 and 2004 and rainfall was seen as the most significant factor in driving these counts.

The numbers of spawning fish were up in spring, 2006 and the data appears to support the theory that water temperatures regulate fish numbers.

The index site survey summary is given with the report on page

2. Acknowledgements 2005

Members and friends of the Slocan River Streamkeepers initiated and carried out this project.

Streamkeepers Naami Hicks, Laura Tiberti, Jen and Aram Yeow helped collect benthic invertebrate specimens and worked with students.
Pete Corbett, John Addison, Tim Hicks, Gerard Rodden and David Liskie helped with snorkel float assessments. Ministry of Environment employees Jeff Burrows and John Bell assisted our Streamkeepers in conducting the Snorkel Float of 5 index site as did Gerry Nellestijn from Salmo. We are grateful for their help.

Tim Hicks and Jen and Aram Yeow placed the data loggers in the field. J. and A. Yeow retrieved the data loggers at the end of the field season. Lesley Mayfield, Lori McMillian and Jennifer Yeow receive credit and thanks for their work sorting and identifying benthic invertebrates. Thank you, Passmore Laboratory for giving space to this work.

We have had the honor of working with the following teachers and their students: Kathy Knapik and the Mt Sentinel Biology 11 class, Lois Lawerence and her 4th grade class at Brent Kennedy Elementary, Megan Read and the Vallican Whole School focus class, the W.E. Graham Wilderness School and Kurt Kuchura and students at Robson Elementary. We are also thankful to have worked with Teresa Southam and students from Nelson Elementary Schools.

Acknowledgement goes to Mt. Sentinel Principal Frank Marisco and Don Warthe of Project "Help Mexico" for the great work that program represents.

The W.E. Graham Wilderness School Students have been great at helping with spawning trout studies. Thank you to Don Paul, Gary Theile, George Hames and the Valhalla Fire Camp for allowing us to use their river front land for assessments and data collection.

Gregoire Lamoureux, permaculture specialist, ensured that all aspects of tree preparation and planting went smoothly. Tital Lamoureux, Simon Constantin, Lori McMillian, Chris Wheeler, Sam Mackinnon, Dallas McGowan, Lori and Casey Postnikoff, Taya Voykin, Nicholaus Carlson, Nathan Burrell, Laura Tiberti, Gerard Rodden, Judy Laret, Tim and Naami Hicks, Jen and Aram Yeow helped build fences and plant trees beside the river.

Also thanks to Judy Laret and Judith Ceroli our bookkeepers who do a great job with the books. Fred Fraser has given inspiration and guidance to this on-going program. Jennifer Yeow wrote this report with contributions and help from Pete Corbett and Gregoire Lamoureux. Eva Johansson edited the final report.

Our Friends, the Salmo Streamkeepers, Gerry and Alice Nellestijn are a source of inspiration and guidance. And, we are grateful to Bruce MacDonald and Chris Beers for helping us become a group.

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

3. Project Objectives: Monitoring, Assessment and School Outreach

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

The objectives of the Slocan River Assessment for Year 3 are:

- Document rainbow trout populations by counting spawning fish and population estimates at established index sites.
- Document water temperature, water quality and benthic populations that characterize current conditions in the Slocan River.
- 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 small restorative projects that will enhance fish 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.

4. Introduction

In February 2003, the Slocan River Streamkeepers was formed as a member group of the Pacific Streamkeepers Federation. We came together out of concern about the Slocan River, 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 has enabled us to outreach to local schools and involve youth in restoration projects. Our partnership with Columbia Power Corporation has enabled 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, changes in tributary confluence location, decline in riparian vegetation and changes in water quality have been cited. In addition, as agriculture and recreation use increases, residents are concerned about environmental degradation and pollution from human/animal activities.

The Streamkeepers want to see the river restored to a healthy diverse system and recognize that a sustainable population of rainbow trout (Oncorhynchus mykiss) is a good indicator for ecosystem health.

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).

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 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 of the Little 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 limitations throughout the mainstem. Although findings indicated low nutrients levels, a healthy macroinvertebrate population was observed. The study investigated the possibility of fertilization. However, local residents were not supportive of this option.

Temperature

In many sections, the Slocan River is slow flowing. This fact, coupled with warm, lake fed water makes the Slocan warmer than most 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 (reference). In past years, the Columbia Basin Fish and Wildlife Compensation Program monitored water temperatures. At present, the Streamkeepers do this work.

Habitat Alteration

Timber harvesting, road building and crown land development have likely increased sedimentation of the river. Facilities such as train corridors, highways and roads, culverts on tributaries and B.C. Hydro corridors have also reduced habitat.
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 the fishery is closed, 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 of current violations of the ban on fishing.

The Slocan River Streamkeepers stress the importance of riparian restoration as the 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 used to protect sensitive riverbanks from livestock impacts.

5. Parameters and Outreach

Streamkeeper activities include documentation of water temperature, substrate composition, habitat conditions, spawning rainbow and redd counts, snorkel surveys and benthic invertebrate surveys. Total and fecal coliform tests are also conducted as indicators of biological activity and drinking water quality.

The Benthic Invertebrate Survey provides a reflection of stream health on many levels. This is due to the fact that insects are relatively stationary when compared with fish, and healthy invertebrate populations require good water quality, habitat and abundant food sources and are thus often used as indicators (Barbour et al 1997). The methods used for the surveys help Streamkeepers learn how to collect consistent data and allow us to compare sites on a yearly basis with the intent of detecting trends. The information also helps us understand how the river responds to weather events, climate change, development as well as restorative activities

The Monitoring Sites, UTM Coordinates, parameters and frequency of collection are given on Tables 1 and 2, page 8. Map 1 on page 10 gives an overview of the site locations throughout the valley.Historic flow data, newspaper articles, benthic invertebrate and temperature data, and time sheets are given in the appendices of this document.

Studies on spawning fish counts and an index site survey is given in section II

A journal of Streamkeeper outreach activities is given in section III and a photo journal of Columbia Power Corporation's Riparian Restoration Program is given in section III.

Table 1. Monitoring Sites and Parameters for Baseline Data Collection on the Slocan River

Site	UTM coordinates (Zone 11U)			Parameters tested
	Easting	Northing	Altitude (m)	
Slocan (Valhalla Camp)	465762	5512056	509.9	Temp. data logger, substrate analysis, habitat, benthic invertebrates
Slocan Lower Bridge and Lemon Confluence	Observations 100 meters above to 100meters below bridge and at Lemon Confluence			Spawning fish and redds
Downstream Lemon Creek	Beginning at Lemon Creek/Slocan River confluence extending 1.5 km downstream			Index Site Survey (Oliver, 1992)
Winlaw	459064	5494303	496.9	Temp. data logger, substrate analysis, habitat, benthic invertebrates on west bank Coliforms on east bank
Winlaw	Starting at the Winlaw bridge and extending south 2.3 km			Index site for fish survey (Oliver, 1992)
Vallican	Beginning at Old Vallican Bridge extending 2.8 km to Passmore Bridge			Index site for fish survey (Oliver, 1992)
Slocan Park	A 3.4 km section immediately above and downstream of the Slocan Park Bridge			Index site for fish survey (Oliver, 1992)
Crescent Valley	A 2.7 km section of river above and downstream of the Crescent Valley bridge			Index site for fish survey (Oliver, 1992)
South Slocan	547583	547831	469.2	Substrate analysis, habitat, benthic invertebrates

Table 2. Monitoring Parameters/Frequency

Parameter	Collection frequency
Temperture 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 analysis	Once in Fall
Habitat survey	Once in Fall
Rainbow trout spawning and redd count	Visual from Lower Slocan Bridge: twice a week during March – April 2-3 snorkel surveys
Snorkel survey/index site study on Slocan River	As weather permits during late summer – fall

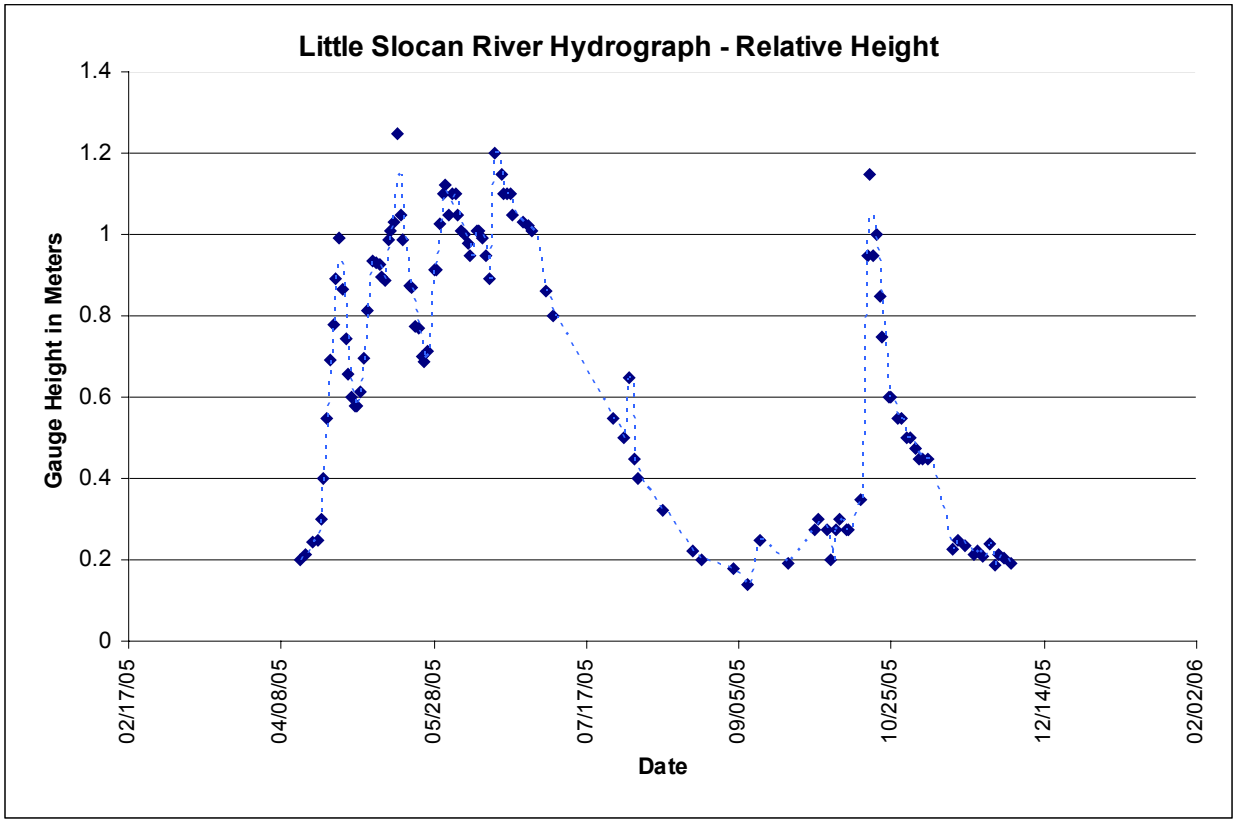
In 2005 a gauge to measure relative height on was installed on the Little Slocan River. The gauge height gives an idea of the yearly flow and water levels at the time of sample collection. Precipitation and air temperatures are also measured in Passmore.

Water Survey Canada (WSC) (www.scitech.pyr.ec.gc.ca/waterweb) has a water volume measurement station on the Slocan located at Shore Acres. Unfortunately, the data has "gaps" and the omissions can be at critical times.

The updated hydrograph for the Little Slocan is given below. A corresponding chart taken from the Water Survey Canada website (ibid.) that shows discharge for the Slocan River is given in Appendix I. Historic flow data on the Slocan River is also given in the appendix.

With peaks at 332 and 371m^3/sec, the information from WSC shows that both 2003 and 2004 had moderately low peak flows on the main Slocan River (ibid.). However, it also appears likely that at approximately 580 m^3/sec, year 2006 will be viewed as a relatively high flow year.

Chart 1 Readings taken at Passmore on the Little Slocan River


Little Slocan River Hydrograph - Relative Height
Gauge Height in Meters
1.4
1.2
1
0.8
0.6
0.4
0.2
0
02/17/05
04/08/05
05/28/05
07/17/05
09/05/05
10/25/05
12/14/05
02/02/06
Date

6. Temperature Summary

Methods

Three Hobo Water Temp Pro temperature loggers manufactured by Onset Technology 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. In previous years sensors were installed below Lemon and at Crescent Valley. This did not happen in 2005.

Table 3. Temperature Sensor Installation

Site	Date installed	Distance from bench full water line	Depth	Manual temp. reading
Slocan (Valhalla Camp)	April 30, 2005	3.5 meters from east bank	2 meters	8.0°C
Winlaw	July 06, 2005	7 meters from west bank	1meter	14.0°C
Little Slocan	July 05, 2005	5 meters from north bank	1.5 meters	14.0°C
Winlaw Creek (Tributary to Slocan River)	July 06, 2005	2 meters from north bank	0.8 meter	10.0°C

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. Charts 2 and 3 show typical daily scans of hourly temperatures for the Slocan River at Slocan, Winlaw, the Little Slocan River and Winlaw Creek

Winlaw Creek was added this year for the sake of comparison and because Winlaw Creek may serve as a cool water input on the lower river.

Historic information referenced in Table 4 is based on data collected during 1998 to 2004 by Arndt of the Columbia Basin Fish and Wildlife Compensation Program (CBFWCP) and C. Beers of the Columbia Kootenay Fisheries Renewal Partnership (CKFRP).

Findings for 2005

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) indicated that 13 – 15°C is 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 number of days that the mean water temperature exceeded 20°C for the Slocan River stations ranged from 4 days at Slocan to 6 days at Winlaw. Mean water temperatures exceeded 19°C for 27 days at Slocan and 24 days at Winlaw.

The Little Slocan did have instantaneous readings above 20 °C and the maximum reported was 21°C. However, no daily averages above 20°C were reported.

The average daily and maximum temperatures for two Slocan River Stations, one Little Slocan River Station and on Winlaw Creek are given in Charts 2 and 3 pages 14 & 15.

The sensor at Winlaw may have experienced dewatering between August 22nd and September 3rd. When it was checked on September 4th it was just below the water. Dewatering may explain the fluctuations in temperature observed during this period.

Unlike previous years, in 2005, the sensor at Valhalla Slocan was installed early - at the end of April. This was done to obtain a record of water temperatures during spawning and through the spring.

After a sudden drop during mid May, all temperatures rose approximately 1 degree per day between May 21st and May 29th. This event followed a period where over 45 mm of rain and cool air temperatures (Passmore weather station) were recorded over 5 days. Stormy conditions were also noted and likely agitated Slocan lake water. As seen in previous years, weather conditions on Slocan Lake greatly influence river water temperatures and this is likely what we saw during mid-May.

Regarding maximum water temperatures, both Slocan and Winlaw reported high individual temperatures of 22.0 and 22.1°C respectively. These temperatures were reported at different times but both were during the beginning and end of August. The total number of days that daily means rose above 19 °C was lower than seen in 2004 for all stations. However, it was higher than seen in 2003.

The maximum temperature observed at Winlaw and Slocan in 2005 was lower than 2004 and higher than 2003.

Table 4. Water Temperature Comparisons for Sites in the Slocan and Little Slocan Rivers 1997 – 2005

Station	Year	Observed maximum (°C)	Number of Days	
North to South			Daily Mean > 20 °C	Daily Mean > 19 °C
Slocan (Valhalla Camp)	2001**	20.6	4	14
Slocan (Valhalla Camp)	2003*	20.2	3	22
Slocan (Valhalla Camp)	2004***	23.1	22	32
Slocan (Valhalla Camp)	2005***	22.0	4	27
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 confluence	2003*	20.9	4	13
	2004*	22.4	14	26
Above Little Slocan confluence	1997*	21.3	23	
	1998*	24	58	
Winlaw (below Winlaw Creek)	2001**	20.2	3	13
	2003***	20.2	3	20
	2004***	22.8	23	30
	2005***	22.1	6	24
Little Slocan (above bridge)	2001*	19.1	0	1
	2003***	19.9	0	1
	2004***	22.6	0	5
	2005***	18.1	0	0
Crescent Valley	2001***	22.4	23	28
	2003*	21.2	11	22
	2004*	23.8	23	30

* CBFWCP
** CKFRP
*** Slocan River Streamkeepers
Time period for measurements
1997: July 2 - Sept 30th
1998: July 1 - Sept 15th
2001: July 12 - Oct 4th
2003: July 22 – mid Oct
2004: July 15 - mid Oct.
2005: April 30 - mid Oct

Chart 2 Average Daily Tempertures at 4 Stations on the Slocan River, Little Slocan River and Winlaw Creek, Summer 2005

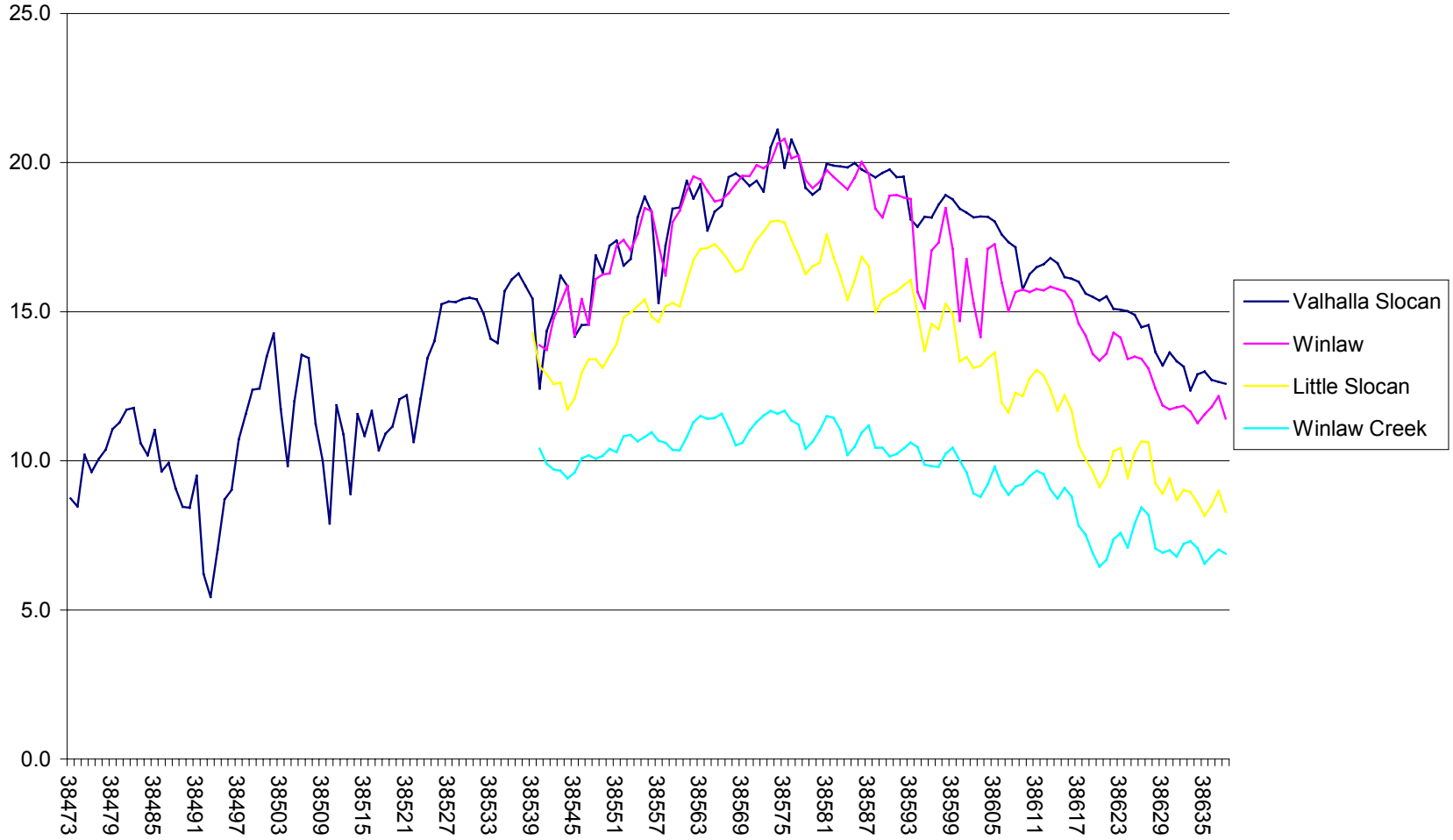
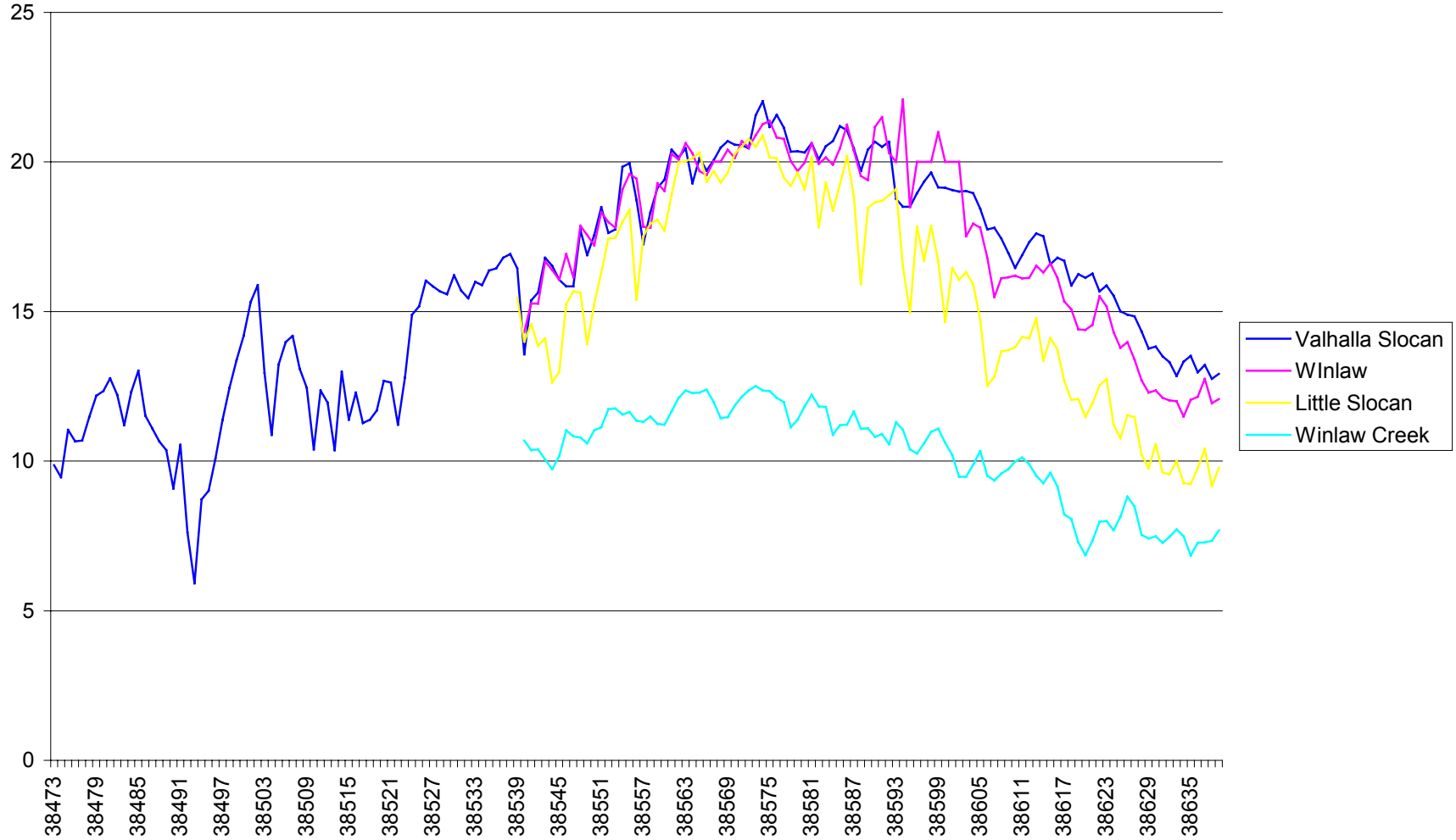


Chart 3 Maximum Daily Temperature at 3 Stations on the Slocan, Little Slocan and Winlaw Creek, Summer,2005



7. Stream Habitat Data

The field data collection methods are based on "Invertebrate Biomonitoring Field and Laboratory Manual for running water habitats" (Environment Canada, 2004).
All surveys were conducted at sites marked #1, 2 and 3 on the overview map page 10
The UTM (Universal Transverse Mercator) coordinates for the mid-site at each station are given on table 1, page 8 .

Methods

Diameter, width, length and average of 10 rocks chosen at random for substrate analyses

Percent embeddedness for 15 - 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.

Water chemistry tests were done using a Hach Kit model no. AL-36B

Table 5. Stream habitat data

	Site1 South Slocan	Site 2 Winlaw	Site 3 Slocan Valhalla
Date	9/23/2005	10/13/2005	10/13/2005
Stream Order	5	5	5
Habitat Type	Riffle	Riffle, straight run	Riffle, straight run
Habitat Sampled	Riffle	Riffle	Riffle
Canopy coverage	0-25%	0-25%	50-75%
Riparian Zone			
Ferns/grasses	present	present	present
Shrubs	present	present	present
Deciduous trees	present	present	present
Coniferous trees	present	present	present

	Site1 South Slocan	Site 2 Winlaw	Site 3 Slocan Valhalla
Benthic Invertebrate Sample			
Operator	J. Yeow	J. Yeow	J. Yeow
Sampling time	3 min	3 min	3 min
# of containers	1	1	1
Typical depth	50 cm	80 cm	60 cm
Substrate			
Predominant particle Size (6= 5-10cm, 7= 10 – 25cm)	7	6	7
2nd most predominant particle size	6	7	6
Size of matrix	Sand (<.5cm)	silt (<.2cm)	sand (<.5cm)
Embeddedness	15%	30%	20%
Velocity m/sec			
Replicate 1	21	37	25
Replicate 2	20	37	25
Replicate 3	18	36	24
Average velocity m/sec	19	37	25
Water temperature °C	11.7	11.5	12.5
Water chemistry	Performed in Fall, 2005	Performed in April, 2006	Performed in Fall, 2005
pH	7.5	7.5	7
Alkalinity mg/l	9.1	41	
Acidity mg/l	54	18	20
Dissolved oxygen mg/l	9	9	9
Hardness mg/l	41	52	

8. Benthic Invertebrate Survey

Background

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. As an essential part of the aquatic food web they feed on plants and, in turn, are eaten by fish and other animals.

Regarding methods of feeding for invertebrates, there are three ways food is acquired in a stream: autrophic (based on sunlight and algae/plant production), heterotrophic (based on leaf litter that falls into the stream from riparian areas), and predatory capture. Macroinvertebrates can be differentiated into groups according to their mode of food acquisition. These are: scrapers, shredders, collectors and predators.

Certain groups of macroinvertebrates are sensitive to conditions in the water e.g. to nutrients, temperature and pollutants and they won't be seen in impacted streams. Others thrive in streams that have impacts. Hence, the types of organisms present can serve as an indicator of stream conditions (Barbour et al 1997). These insects are known to be sensitive to pollutants and so, when they are found in abundance (as a group called EPT) they serve as an indicator for good water quality (ibid.)

For example, some of the three most common macroinvertebrates found in the Slocan River are Mayflies or Ephemeroptera, Stoneflies or Plecoptera and Caddisflies or Trichoptera. Historically, in the Slocan Watershed, the Winlaw Watershed Committee monitored macroinvertebrate populations on four tributary creeks in 1999. The creeks were Airy, Bonanza, Lemon and Winlaw. Findings from that work reveal that the greatest abundance of macroinvertebrates was observed in Winlaw Creek (Quamme & Sunberg 1999). Also, that Winlaw, Airy and Lemon Creeks had the most diverse feeding group assemblages and that Winlaw and Airy Creeks supported the greatest diversity of benthic taxa (ibid.).

In 2003 and 2004, Streamkeepers monitored four sites on the Slocan and Little Slocan River.

Methods for 2005

In 2005, three sites were monitored at locations selected in past years They included South Slocan (Don Paul's beach), Winlaw (George Hames' Beach) and Slocan Valhalla.

A Kick Net was used and the collector was timed for 3 minutes per sample. One sample per site was collected. The collector held the net vertical just above the substrate and zigzagged upstream over the stream bottom. Samples were collected on the west side of the river at Winlaw and on the east side at South Slocan and Slocan Valhalla.

In 2003 and 2004, a Hess sampler was used. The reason for changing the sample collection technique was:

1. Good technical support and resources available through use of Environment Canada protocol and the fact that this method has been used on the Fraser River (Reynoldson et al).
2. High probability of collecting more organisms, hence good representation of existing benthic communities

3. Inherent strength of a reference condition approach.

All macroinvertebrate samples were preserved in 70% isopropanol. In South Slocan, samples were initially taken to the Biology 11 lab at Mt. Sentinel. Subsequently, all samples were taken to Passmore Laboratory Ltd. for counting and further identification. Streamkeepers sorted, counted and identified specimens during February, 2006.

The following references were used for identification of specimens:

- 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, Tricoptera and Plecoptera. Other names such as Baetidae, for example, refer to a Family under the Ephemenoptera or Mayfly Order. Every attempt was made to identify to the lowest taxa and, in most instances this was Family

The metrics used were:

- Percent abundance by taxa which compares the relative abundance of all taxa
- EPT to Total Ratio which is the total number of Ephemenoptera, Tricoptera and Plecoptera
- (EDP) divided by the total number of organisms
- Simpson's Diversity Index quantifies biodiversity by measuring both richness (number of species in a sample) and evenness which measures the relative abundance.
- Shannon-Wiener Diversity quantifies the degree of uncertainty that an organism will be present.

Findings for 2005

A review of the benthic data for 2005 shows a diverse population at all three sites but fewer EPT organisms in relation to other taxa the Winlaw site. The Winlaw site also had a higher percentage of Diptera and they were mainly Chironomidaes. At a count of 335, Winlaw also had the lowest total number of organisms. South Slocan had 655 and Slocan Valhalla had 747. The low count at Winlaw may be due to the relatively high water conditions during sampling.

Comparison with years 2003 and 2004

In previous years the predominant taxon was Tricoptera or Caddisfly at the majority of Stations. In 2005, the predominant taxon was Dipteria at all three stations.
We did not see a large number of hydrozoans at the Slocan Station as in 2003, however, relatively more Coleoptera (Elmidae) were seen at Slocan in 2005.
The different sampling technique makes it impossible to compare total numbers of organisms; rather a comparison of numbers relative to each other is possible.

South Slocan appears to have the most diverse assemblage in both 2004 and 2005.

Chart 4

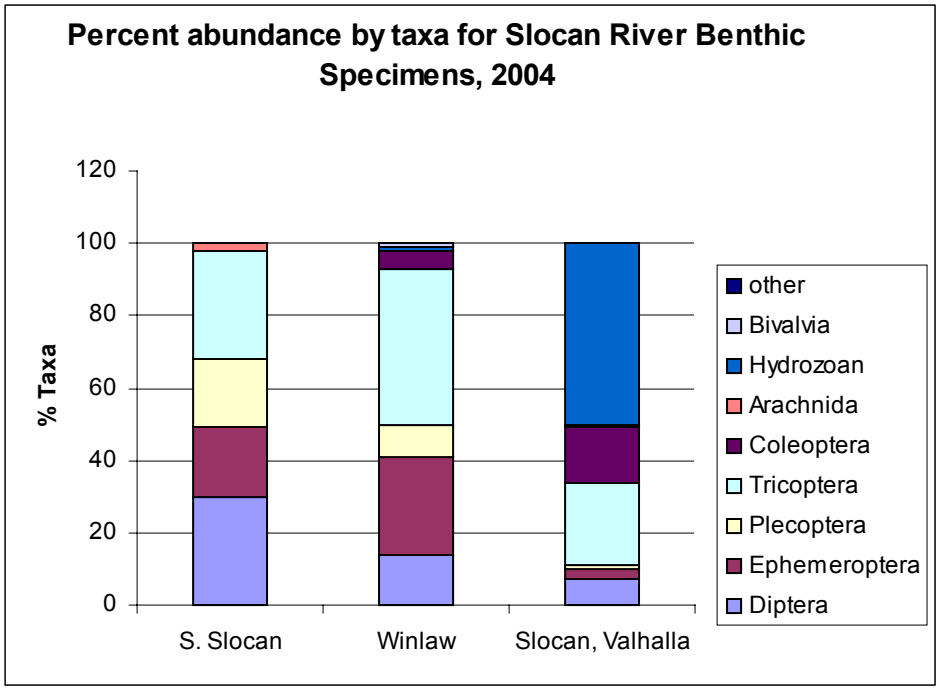


Chart 1. Percent abundance by taxa for the Slocan River

Percent Abundance

As seen in the charts below, year 2004 saw a relatively high abundance of EPT organisms in relation to total organisms at all the sites except Slocan where Hydrozoan was predominant. Plecoptera represents the lowest number within the EPT group. This may reflect the timing of sampling as many of the stoneflies may have emerged by late fall

In year 2005 a shift toward higher relative percentage of Diptera is seen in all samples collected. There may be a factor in sampling methodology that selects for Diptera but this is unlikely. The temperature at sampling time was slightly lower in 2005 and all other water chemistry tests were close except for acidity which was higher in 2005.
See Table 5

Chart 5

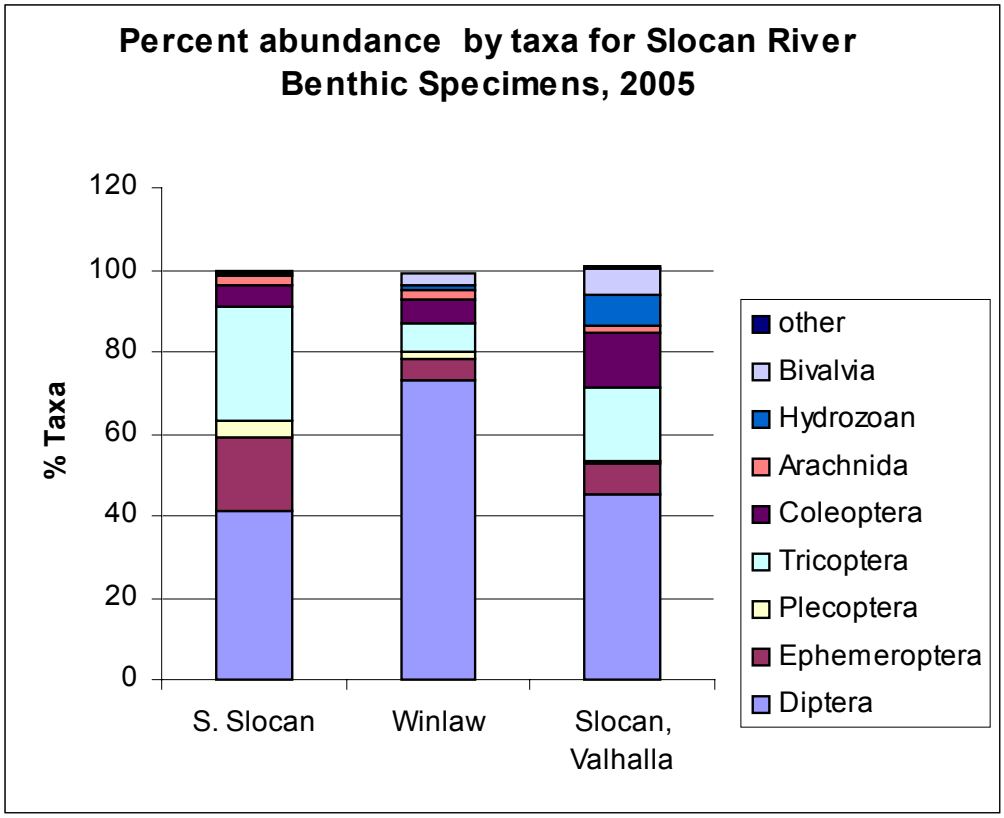


Chart 2. Benthic abundance by taxa

The EPT to total Ratio is important because it gives the abundance of the three groups that are indicative of good water quality as well as organisms that provide food for fish

The findings below show that EPT numbers relative to other Orders have declined at two of the three sites over the last three years. The large number of hyrdozoans seen in 2004 and 2005 may explain a decline in the ratio for Slocan, Valhalla. Rises and falls of the hydrozoan population may be cyclic as they were not seen in large numbers in 2003.

Table 6. EPT to Total Ratio for Slocan River benthic specimens 2003 – 2005

Site	2003	2004	2005
South Slocan	.41	.65	.49
Winlaw	.69	.51	.14
Slocan, Valhalla	.83	.27	.26

The values for the Simpson Diversity Index for 2005 were 0.82, 0.42 and 0.65 for South Slocan, Winlaw and Slocan, Valhalla respectively. A low diversity index number for Winlaw is likely the result of the low number of total organisms and relatively high number of Chironomidae (Diptera) collected at this site.

The values for Shannon-Wiener Diversity Index were 2.06, 1.02, and 1.32 for South Slocan, Winlaw and Slocan, Valhalla respectively and reflect similar trends seen above.

9. 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 slimes inside pipes. (APHA 1989)

Because they are cultured at 44.5°C on selective media, the sub-group called "fecal 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. Again, 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 near the river. In fact, a survey conducted by the Regional District in 2004 found that 76% of respondents obtained water from these two sources. 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 is permitted.

Methods

Three stations on the Slocan River were tested four to six 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 current standard for

The test methodology for total and fecal coliforms was 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 Standards Council of Canada.

Findings

Total Coliforms

Total Coliform counts ranged from 4 to 200 colony-forming units (cfu's) per 100ml. Though lower than 2004, the counts were higher than seen in 2003. See Chart 6, page 24. The Geometric mean for samples taken during 2003 – 2005 are:

Table 7. Geometric mean of five total coliform samples over 30 days 2003 to 2005.

Site	2003	2004	2005
South Slocan	9	71	28
Passmore	5.4	61	18
Winlaw	6	61	22

Fecal Coliforms

Fecal counts ranged from 4 to 32 cfu's per 100ml and followed a similar trend to total coliforms in that counts were higher than 2003 and lower than 2004. See Chart 7 page 25. The geometric mean for the 17 samples collected are:

Table 8. Geometric mean of five fecal coliform samples over 30 days 2003 to 2005.

Site	2003	2004	2005
South Slocan	4.6	23.1	6.4
Passmore	5.1	21.7	10.2
Winlaw	3.4	25.7	9.4

The standard for *E. coli* in direct contact recreational water specifies that the geometric mean of 5 samples taken over 30 days not exceed 77cfu's/100 ml. Since *E. coli* is a sub-group of the fecal coliforms, it can be assumed that none of the samples exceeded the standard.

Observations

At 28 mm, the rainfall recorded during August, 2005 was significantly lower than 2004 when rainfall was recorded at 73.7 mm. By contrast, in 2003 rainfall in August was only 7.1 mm.

As seen in Charts 7 and 8 and Table 9 below, the geometric mean for counts for 2005 was between 2003 and 2004. Hence, there appears to be a strong correlation between rainfall and coliform counts.

Table 9 Total Coliform Counts vs. Rainfall in mm

Site	2003 Total Rain August in mm	2003 Maximum Total coli Count cfu/100ml	2004 Total Rain August in mm	2004 Maximum Total coli Count cfu/100ml	2005 Total Rain August in mm	2005 Maximum Total coli Count cfu/100ml
South Slocan	7.1	26	73.7	26	28	200
Passmore		11		300		200
Winlaw		7		300		46

Most of the rain did not fall within 1 – 2 days of sample collection; hence, it appears that coliform organisms continue to pass into the river system for days or weeks after rain events. Regarding water temperature, readings were high (above 17°C) during all sample collection days, however, counts were occasionally high with cooler water. Hence, although temperature is an important factor that may contribute to high counts, the correlation is not as direct as rain.

There were no distinct trends between stations and the geometric means for all stations were very close.

Chart 6

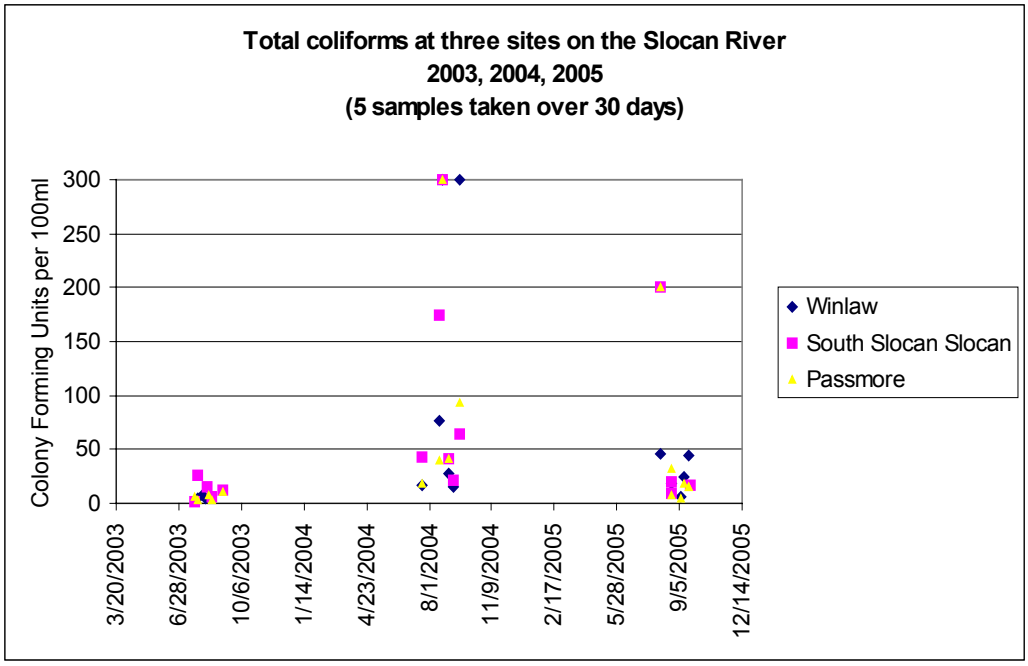
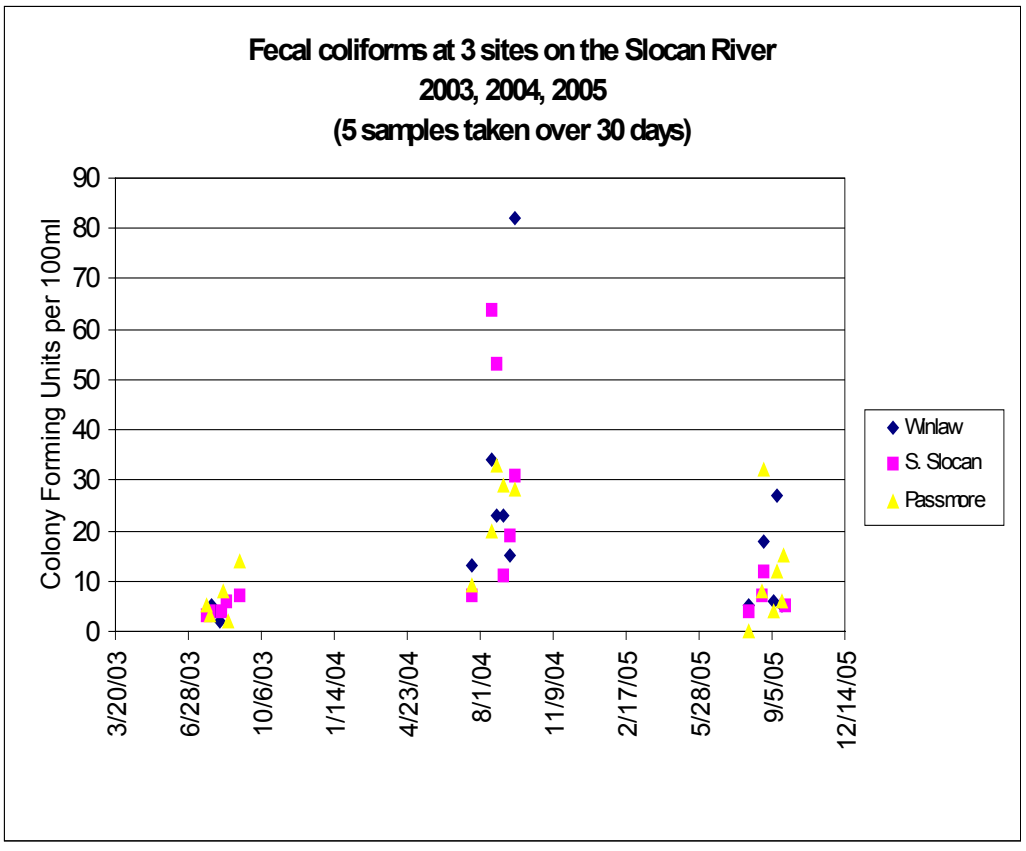


Chart 7



Recommendations for Future Studies

Year 2005 has been successful in introducing the program to new students, members of the public and teacher participants. Outreach through the Slocan Valley Recreation Commission is an effective means for involving the larger community. In April, 2006, an Earth Day outing to Winlaw Nature Park for two classes from Brent Kennedy was also highly successful.

In class, we have learned that the older students appreciate hands-on activities related to water chemistry. To accommodate them, we developed a work station with color change indicators for acids and bases using common kitchen items like beet and grape juice and tumeric herb. The hand out sheet for this learning tool is given in the appendix.

We recognize that it is important to expand beyond the classroom and find opportunities to engage the broader groups in our community.

Some of the changes we recommend for 2006 - 2007 are:

1. Spawning Fish and Total River Counts
In year 2004 – 2005 we were successful in continuing to collect numerical data on spawning fish and total numbers of trout in five established reference sites. We have refined our spawner count technique by relying on snorkel floats rather than a fixed plot to determine total number of redds and spawning fish. These procedures will continue in 2007. Regarding the Index Site Survey, a single pass, full river swim is recommended.

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 5 stations.

3. Coliform Bacteria
There is concern about elevated fecal coliform counts during warm weather and/or rain events in summer and early fall. Because of high recreation use and the fact that the river water is diverted for human consumption, occasional checks for the presence of *E. coli* in fecal coliform isolates is recommended. *E. coli* is considered a definitive indicator for human infection and is the new standard for drinking water under the B.C. Safe Drinking Water Regulations 2005.

4. Benthic Invertebrates
We are in the process of building a Marchant box for use in sub-sampling invertebrate specimens. In 2005, we found that some samples had high numbers of organisms which made sorting laborious. The CABIN procedure specifies using a Marchant box to sub-sample up to 300 organisms as a representation for the entire sample.
We will also work towards collecting samples in a broader range of representative habitat types to enlarge our reference base.

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 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.

10. References

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Water Survey Canada Websitehttp://scitech.pyr.ec.gc.ca/waterweb/fullgraph.asp Real-Time Hydrometric Data and Archived Hydrometeric Data for the Slocan River station #08NJ013

Winlaw Watershed Committee, 2001 Slocan Valley Water Quantity and Quality Monitoring Program, year 5

11. List of Appendices

Attached as follows

1. Real-Time Hydrometric Data from Environment Canada
2. Published newspaper articles
3. Benthic Invertebrate Metrics (CABIN)
4. Benthic Invertebrate Taxa counts (CABIN)
5. Temperature Data
6. Water Chemistry and Insect Worksheet for Students
7. Slocan River Streamkeepers Time Log