

Fraser Salmon & Watersheds Program



Fraser Basin Council



2008 Final Report Template

FSWP File Number*

08 HLR52

*Please use the FSWP File Number provided in previous FSWP 2008 project correspondence

Contact Information

Sponsoring Organization's Legal Name

Simon Fraser University

Are you a federally registered Charity, Non-profit organization or Business (Yes /No)?

If yes, please indicate which.

Charity

Yes

Non-profit organization

Business

Registration number

118520725RP0002

GST number

Are you a registered Society (Yes / No)?

Society Registration number

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Project Information

Project Title

Fraser Basin Salmon Ecosystem Project (Year 2)

Project Location

Fieldwork: Takla Lake, North Central BC & Shuswap Lake, South Central BC

Labwork & Analysis: Simon Fraser University, Burnaby, BC

Amount Requested	\$86,300.00	Total Project Value	\$192,120.00	Non-FSWP funds²	\$105,820.00
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² Non-FSWP funds include both cash and in-kind funding. In-kind funding refers to all non-cash contributions such as equipment, supplies, labour, etc. Please refer to Budget Section for further details.

Project Summary

Please provide a single paragraph describing your project, its objective, and the results. As this summary will be used in program communications, clearly state the issue addressed and avoid overly technical descriptions. Do not use more than 300 words.

The overarching goal of our three-year project is to enhance our understanding of the interactions between salmon and their ecosystems, by examining how aspects of freshwater and riparian habitats affect salmon populations, and how adult abundance in turn affects ecosystem productivity for juveniles. Specifically, our work has three objectives:

- 1) To test quantitative links between proposed physical habitat indicators and past and current salmon abundance (Strategy 2 of the Wild Salmon Policy).
- 2) To test quantitative links between historical and recent salmon escapement and various indicators of ecosystem health and productivity (Strategy 3 of the Wild Salmon Policy).
- 3) To use this new information to inform future management decisions aimed at improving the sustainability of wild salmon stocks.

To meet Objectives 1 and 2, we are linking data from Fisheries and Oceans Canada (DFO) on salmon population sizes to new data that a team of graduate students and field assistants have collected by conducting detailed physical and biological assessments of 40 sockeye spawning streams across two regions of the Fraser River. This fieldwork, the ensuing data entry, the commencement of sample processing in the lab, and the entering of historic sockeye escapements from original DFO notes comprised our efforts in 2007 (Year 1).

In 2008 (Year 2), work toward Objective 1 has included additional fieldwork (during which we revisited all of our study streams to collect a subset of variables), followed by the completion of data entry and commencement of analysis. Work toward Objective 2 has consisted of lab processing of the biological samples. In addition to all this, we have continued to extend and enhance our collaborations and partnerships, further aligning our project with the implementation of the Wild Salmon Policy, helping us meet Objective 3 by project completion in 2009 (Year 3).

OPTIONAL If your project lends itself to sparking interest through a compelling sound bite (for potential use in FSWP media communications); please tell us what that sound bite would be. Do not use more than 150 words.

Species and life stage(s) the project targets: please list

Sockeye salmon (*Oncorhynchus nerka*) – Adults, Embryos, Alevins, Fry

The Stream Fish Community, including:

- Rainbow trout (*Oncorhynchus mykiss*)
- Bull trout (*Salvelinus confluentus*)
- Slimy sculpin (*Cottus cognatus*)
- Burbot (*Lota lota*)

Watershed(s) the project targets: please list

Location: North Central BC

10 Mile Creek, 15 Mile Creek, 25 Mile Creek, Ankwil Creek, Baptiste Creek, Bivouac Creek, Blanchette Creek, Casimer Creek, Crow Creek, Die Hard Creek, Forsythe Creek, French Creek, Frypan Creek, Gluskie Creek, Hooker Creek, Hudson Bay Creek, Leo Creek, Maclaing Creek, Narrows Creek, Point Creek, Sandpoint Creek, Shale Creek, Sinta Creek, Forfar Creek, Kynock Creek, Van Decar Creek.

Location: South Central BC

Bush Creek, Pass Creek, Cayenne Creek, Momich Creek, Fennell Creek, Harper Creek, Bear Creek, Gold Creek, Crazy Creek, Loftus Creek, Owlhead Creek, Yard Creek, McNamee Creek, Celista Creek.

Project Deliverables and Results

- Paste in the deliverables outlined in your Detailed Proposal (question #3 under project 'relevance and significance' heading) into the table below. Then, please list the results associated with each deliverable.
- Please include copies of any relevant communications products (brochures, posters, videos, website addresses etc.) resulting from this project.

Deliverable

Result

As a continuing project, a 2008 detailed proposal was not required. We present the performance expectations outlined in our attached report (see appendix).

Entry & formatting of salmon escapement data from DFO	Completed – May 2008
Physical habitat indicator entry	Completed – May 2008
Processing of fish stable isotope samples	Completed – August 2008
Processing of water nutrient samples	Completed – January 2009
Identifying appropriate metrics for physical habitat indicators. Statistical analysis of links between physical habitat indicators and past and current salmon abundance.	To be completed – April 2009
Shortened Field Season 2: Final data collection in Shuswap/Thompson & Stuart/Takla regions (removal of temperature and stage level data loggers).	Completed – September 2008
Processing of periphyton stable isotope and AFDM samples	Completed – January 2009
Entry of temperature and discharge data from loggers and statistical analysis	To be completed – April 2009
Sub-sampling and sorting of invertebrate samples	Completed – December 2008

Project Effectiveness

Please evaluate the effectiveness of the project, using the objective standards, quantifiable criteria and/or quality control measures identified in your Detailed Proposal (under question #1 in the 'performance expectations' heading).

As a continuing project, a 2008 detailed proposal was not required.

What are the top three lessons learned from this project that would be important to communicate to others doing similar work throughout the Basin?

1. Collaboration between NGOs, government organizations and First Nations has greatly improved the quality of this project through the sharing of equipment, personnel, data, and expertise. The consideration and development of these relationships prior to project commencement is a great asset.
2. The Fraser Basin sockeye stock assessment data is exceptional relative to other regions and species. Its importance to our research highlights the utility of consistently collected and detailed stock assessment data.
3. It is very difficult to accurately predict the budgetary requirements of a 3 year project in advance. Flexibility in the allocation of these funds between areas like labour, field equipment, and sample processing expenses is helpful and something we are grateful to the FSWP for.

Project Effectiveness

Please describe how your project has addressed each Priority Activity identified in your Detailed Proposal.

Priority Activity ¹	How the Priority Activity has been Addressed
<i>As a continuing project, a 2008 detailed proposal was not required.</i>	

¹Please paste each priority activity identified in your Detailed Proposal in the space provided.

Further Comments

Please provide any further comments including recommendations for future conservation efforts and suggestions for helping partners to meet the goals of the Fraser Salmon and Watersheds Program. If your project produced a narrative or scientific report or additional project products (e.g. maps, photos), attach them as an appendix.

Please see Appendix.

Appendix 1

Fraser Basin Salmon Ecosystem Project 2008 (Year 2) End of Year Report

Summary

The overarching goal of our three-year project is to enhance our understanding of the interactions between salmon and their ecosystems, by examining how aspects of freshwater and riparian habitats affect salmon populations, and how adult abundance in turn affects ecosystem productivity for juveniles. Specifically, our work has three objectives:

- 4) To test quantitative links between proposed physical habitat indicators and past and current salmon abundance (Strategy 2 of the Wild Salmon Policy).
- 5) To test quantitative links between historical and recent salmon escapement and various indicators of ecosystem health and productivity (Strategy 3 of the Wild Salmon Policy).
- 6) To use this new information to inform future management decisions aimed at improving the sustainability of wild salmon stocks.

To meet Objectives 1 and 2, we are linking available data from Fisheries and Oceans Canada (DFO) on salmon population sizes over the last 50 years to new data that a team of graduate students and field assistants have collected. To collect this data, we had a six-month field season during which we conducted detailed physical and biological assessments of 40 sockeye spawning streams across two regions of the Fraser River. This fieldwork and ensuing data entry, the commencement of sample processing in the lab, and the entering of historic sockeye escapements to our system from original DFO wet notes comprised our efforts in 2007. All the details for this work are contained in the 2007 end of year report.

In 2008, our project has progressed forward at the projected rate. Work toward Objective 1 has included additional fieldwork, followed by data entry and analysis. During our one-month field season we revisited all of our study streams to collect a subset of variables. We have completed data entry and have started our analyses. Work toward Objective 2 has principally consisted of lab processing of the biological samples, the details for which we discuss below. In addition to all this, we have continued to extend and enhance our collaborations and partnerships, thus helping to align our project with key processes such as the implementation of the Wild Salmon Policy and moving toward meeting Objective 3 by project completion in 2009.

Methodology

2008 (Year 2)

DFO Escapement Data

Central to Objectives 1 and 2 is the linking of available data from DFO on the salmon population sizes in our 40 study streams to the physical and biological data that we collect. While total stream escapements, going back up to 50 years, are available in spreadsheet form for our study streams, information on the density of spawners by 500 m stream reach can only be found on original stock assessment field notes. We have therefore had to work through archived data at DFO's Annacis Island office and enter it manually. This took more time than we had hoped and

we only completed half the work in Year 1. In Year 2, we completed the remainder of the data entry and conducted the data formatting required to generate the spawner escapement metrics that are of interest for our work. We are extremely thankful to Tracy Cone of Fisheries and Oceans for her generous help with this aspect of our project.

Physical Stream Assessments

To meet Objective 1, we conducted comprehensive stream surveys during our 2007 field season (see End of Year 1 Report for details). As a part of our stream surveys we deployed data loggers that would collect data over the year and be ready for collection in summer 2008. During our 2008 field season we recovered these data loggers as well as collecting additional data as part of our collaboration with DFO's Environmental Watch program. Therefore, our field season this past year consisted of revisiting all study streams to collect a subset of variables as well as downloading and replacing data loggers for DFO. The weather had not been kind to the loggers: some were buried or missing, and a few fallen trees ruined stage loggers. To date, I have compiled 600,000+ data points and summarized them into appropriate metrics. The indicators and the methods used to collect the data are described briefly below:

(i) Temperature

All three ibutton (DS1922L) temperature data loggers were removed, downloaded and re-installed in all but 3 control streams, which were permanently removed. Similar to our 2007 field protocols, loggers were programmed to record temperatures at 2-hour intervals for 1.5 years and are accurate to 0.5°C. Loggers were waterproofed and attached to a 1 m long section rebar that was inserted in the streambed. Loggers were stratified 15-20 cm below, on, and 15 cm above the substrate surface.

(iv) Water Quality

Water chemistry indicators measured included pH, dissolved oxygen, conductivity, total suspended sediment and turbidity. All water quality variables were measured twice at a single location pre and during spawning. We decided to forgo additional nutrient sampling based on advice from Erland Maclsaac, from DFO.

(v) Discharge

Spot discharge measures were conducted once during spawning for most streams however, streams with stage level data loggers were measured twice. These additional measurements will improve stage logger calibrations. Discharge measurements consisted of 10 depth and velocity measurements across two transects. All operational Unidata stage level data loggers were downloaded and re-installed.

Physical Data Processing

Kerry Parish at DFO's Cultus Lake Research Laboratory has analyzed the water nutrient samples collected in 2007. See below for turbidity and suspended sediment samples.

Biological Sample Processing

Many of the biological samples that were collected through the 2007 field season (see End of Year 1 Report for details) require extensive lab processing in order to generate the data required to meet Objective 2. This work comprised a very significant portion of our time in Year 2 and is described briefly in relation to the three organism groups we sampled:

(i) Periphyton

The stable isotope samples, which were suspended in stream water and frozen, were dried at ~55°C, ground and weighed prior to being sent externally (UCDavis Stable Isotope Facility, Davis, California, USA) for analysis. The ground samples were sent for analysis in early February 2009. With an estimated 8-week turnaround we anticipate receiving the data in April 2009.

The frozen filter papers for ash-free dry mass (AFDM) were dried for 48 hours at ~55°C,

weighed, ashed for 4 hours in a muffle furnace, and then re-weighed. These data were then used to calculate both dry mass (DM) and AFDM. This data has now been generated and will be analyzed as part of our Year 3 expectations.

The frozen filter papers for chlorophyll a analysis were supposed to be processed this year. Unfortunately there have been unforeseen delays in setting up the lab and equipment required for the procedure that meant we were unable to start processing the samples until March 2009. As such, the completion of these samples has been shifted to our early Year 3 expectations.

(ii) Aquatic Macroinvertebrates

The > 250 surber samples that we collected in the 2007 field season have all been sub-sampled using a Folsom plankton splitter and sorted to a count of > 300 invertebrates according to Environment Canada CABIN protocols. All samples were sorted into vials by Order (Ephemeroptera, Plecoptera, Trichoptera, Diptera, and Other) to facilitate later identification to a lower taxonomic level. Greater than 80% of the samples were sorted in-house at Simon Fraser University by hired Co-operative Education students. The remaining < 20% were sent externally (Biologica Environmental Services Ltd, Victoria, BC) for sub-sampling and sorting. More than 10% of all samples have been re-sorted to determine sorting efficiency, which has proved > 95% for all samples processed. This exceeds the 90% efficiency required by Environment Canada CABIN protocols.

The sub-sampled and sorted samples are currently being identified to family level. Greater than 60% of the samples are being identified in-house at Simon Fraser University by hired Co-operative Education Students. Heather McDermott, National Freshwater Invertebrate Taxonomist for Environment Canada, provided all in-house training in invertebrate identification. The remaining < 40% have been sent externally (Biologica Environmental Services Ltd, Victoria, BC) for identification. Currently we are about 75% of our way through the samples and anticipate completion by early May 2009.

While in our End of Year 1 Report performance expectations we stated that we would process the invertebrate stable isotope samples in Year 2, this was a mistaken assertion for two reasons. First, the funds we had allotted to cover the cost of sending these samples for analysis were part of our Year 3 request for funding. As such, we must wait on the outcome of our application before this is possible. Second, due to the limitations of identification while in the field, only some of the invertebrates for isotope analysis could be separated from the bulk of each sample and frozen in stream water. The remainder must be taken from the ethanol preserved samples after the completion of identification to family level, which we anticipate for early May 2009. As such, the completion of these samples has been shifted to our early Year 3 expectations.

(iii) Resident Fish

The fin clips that were collected for stable isotope analysis were dried, ground and weighed prior to being sent externally (UCDavis Stable Isotope Facility, Davis, California, USA) for analysis. All data have been received back and will be analyzed as part of our Year 3 expectations.

All electro-fishing data has been entered and formatted as required, however we have not yet calculated the resident fish density and condition indices as we stated in our End of Year 1 performance expectations. This is because as we investigated the use of different methods for estimating fish density from depletion sampling protocols, we became increasingly aware of the complexities and assumptions behind them and thus the importance of choosing the right method. We have since struck up a useful collaboration with a graduate student in the Department of Resource and Environmental Management at Simon Fraser University who is assessing the performance and accuracy of the different methods under different situations. We hope to use the outcome of his

work to facilitate ours and as such, have shifted the completion of this task to our Year 3 expectations.

Permitting/Approvals

No permits were required for the 2008 field season.

2009 (Year 3)

Physical Data Processing

Water samples collected through the 2007 and 2008 field seasons, for turbidity and total suspended sediments, still require processing. Processing requires equipment that has been occupied by samples from other projects but will be analyzed by the end of summer 2009. Turbidity measures will be conducted using a Lamotte 2020e colorimeter. Total suspended sediments will require drying and weighing of glass fiber filters, filtering of water samples, and then re-drying and re-weighing of the filters.

Physical Data Analysis

Our dataset is just about complete and we have started a preliminary data analyses. To test quantitative links between proposed physical habitat indicators and past and current salmon abundance we will use a variety of advanced statistical methods, as outlined below. We have not completed the full analysis therefore we have only included a summary of statistical methods in this report. A full analysis and results will be included in our final report.

Salmon Population Parameters

For our preliminary analysis sockeye escapement data for 2004-2007 from the Department of Fisheries and Oceans were used to calculate sockeye population metrics. Reach-specific density was calculated as:

$$\text{Density} = \frac{\text{Number of Fish}}{\text{Wetted Width (m)} \times \text{Length of Reach (m)}}$$

In addition we created pairs of streams based on the following criteria: 1) streams within a pair must have fish that rear in the same lake environment; 2) They must be close in spatial proximity to one another. To deal with missing data, streams that were removed from our datasets. Missing data was mainly due to lost temperature loggers and flow meter malfunctions in the field.

Physical Stream Habitat Variables

All physical habitat variables were summarized into mean values for each stream, otherwise specific metrics were calculated. These were a subset of the variables for which I collected data.

Statistical Methods

First we examined univariate relationships of all physical variables with a correlation matrix. All data were checked for normality using the Shapiro-Wilk test and transformations were performed when necessary. To test various models we used multiple linear regression analysis. Then, AICc was used to evaluate the relative importance of the candidate set of models. We encountered a number of statistical challenges using multiple linear regressions as a stand-alone method due to our small sample size and large number of correlated variables. We investigated other statistical methods that would complement multiple linear regressions and help tackle some of these issues, such as principal component analysis (PCA), regression trees and information criteria (AICc). We used PCA to reduce the number of variables and to reduce multicollinearity. Regression tree analysis was used to identify interactions between variables. Finally, all multiple regression models were compared using AICc in

order to identify the best models within a candidate set of models.

(i) Principal Components Analysis – Multicollinearity and Latent Variables

Multicollinearity is often a problem in observational data sets that include a large number of environmental variables. To reduce multicollinearity we used principal components analysis, which transforms the original data into new orthogonal (i.e. uncorrelated) variables. PCA is also commonly used as a variable reduction technique, which addressed our other concern of too many predictor variables given our sample size (N=40). Latent variables were constructed using variables that were correlated as well as ecologically related. For example, a cover index was constructed using large woody debris and pool area. It is well known that there is a strong relationship between large woody debris and pool metrics, and that spawning salmon are often found hiding under and in these physical structures.

(ii) Regression Trees and Interactions

To capture the physical complexity of our study areas, we used regression tree analysis to identify potential first order interactions. Regression tree analysis is ideal for describing multi-order interactions between variables in complex data sets.

(iii) Model Selection

We used Akaike Information Criterion (AIC), an information-theoretic, to compare multiple models as indicators of habitat status. We constructed 15 models to test the effectiveness of various combinations of variables at describing our data.

Developing models with multiple variables allows us to evaluate a suite of indicators but it does not enable us to evaluate the relative contribution of a single variable. There are methods that we will employ to identify the relative contribution of each variable. In addition, we will test the predictive ability of all models and individual indicators using cross-validation and model averaging techniques. Once we have completed our analyses on testing linkages between potential habitat indicators and present and past sockeye abundance, we will conduct a cost-benefit analysis, which will identify the most cost-effective suite of indicators. We will use data recorded in our 2007 field season on costs, and time required to measure physical variables.

Biological Sample Processing

As described above, the lab processing for some of the biological samples was not achieved as expected in our End of Year 1 Report. As such, some of our expectations have been carried forward to the early part of Year 3. Here we describe the work that is to be completed in this time period:

(i) Periphyton

The frozen filter papers for chlorophyll a analysis require pigment extraction in methanol followed by reading the pigment intensity using a Trilogy TD-700 Fluorometer. Jan Verspoor will carry out this analysis at Simon Fraser University with assistance and equipment provided by Dr Wendy Palen in the Department of Biological Sciences. We reasonably anticipate completion by April 2009.

(ii) Aquatic Macroinvertebrates

The remaining 25% of our invertebrate samples will be identified to family level. We anticipate completion by early May 2009. At this point, 10% of samples will be sent externally to verify the accuracy of our identifications, which must be > 95% according to Environment Canada CABIN protocols.

Upon identification of all our invertebrate samples to family level we will begin the processing of the invertebrate samples that are to be sent for stable isotope analysis. These samples will be identified to the level of genus and then dried, weighed, and packaged before being sent externally (UCDavis Stable Isotope Facility, Davis,

California, USA) for analysis. It is our intention to analyze samples from three genera of the Order Ephemeroptera and one genus each from the Orders Plecoptera, Trichoptera and Diptera. The genera will be selected based on presence across all our study streams and their functional feeding group. We will analyze three individuals from each of the four study sections in a creek. Across our 40 study creeks and two sampling time periods (pre and post-spawn) this will result in the analysis of over 5,000 invertebrate samples. Given the time consuming nature of invertebrate identification to species level and the preparation of isotope samples, not to mention the up to 2 month lag between sending the samples off and getting the data back, we do not anticipate completion of these samples until October 2009. These will represent the last biological samples to be processed as part of this project.

(iii) Resident Fish

We are collaborating with a graduate student in the Department of Resource and Environmental Management at Simon Fraser University who is assessing the performance and accuracy of different methods for estimating fish densities from depletion sampling methods, which is what we used in our 2007 field season. Upon completion of his research in early summer 2009 we will select the method of estimating fish densities that is most appropriate to our work and then calculate the appropriate metrics. We will calculate our metrics of fish condition during the same period. We anticipate completion of this task by August 2009.

Biological Data Analysis

When we have completed the lab processing of all our biological samples, we will use the data to generate the indicators of ecosystem productivity that we will use to quantitatively test the links between salmon and their ecosystems. We will use simple and multiple linear regression techniques to test the relationships between historic and recent salmon escapements and our chosen indicators of ecosystem productivity. The indicators that will be tested are:

(i) Periphyton

The chosen ecosystem indicators for this group are chlorophyll *a* and ash-free-dry-mass (AFDM), plus stable isotope analysis to investigate the use of marine-derived nitrogen and carbon.

(ii) Aquatic Macroinvertebrates

The chosen ecosystem indicators for this organism group are aquatic invertebrate density, biomass, and diversity, plus stable isotope analysis to investigate the use of marine-derived nitrogen and carbon in different invertebrate groups.

(iii) Resident Fish

The chosen ecosystem indicators for this organism group are fish density, diversity, and condition, plus stable isotope analysis to investigate their use of marine-derived nitrogen and carbon.

Presentation of Results and Findings

Upon completion of the physical and biological data analysis, we will synthesize our results into a final report. This will contain a) detailed field, lab, and statistical methodologies and rationales, b) a discussion of the relative costs and benefits of using our studied abiotic and biotic indicators, both individually and combined and c) suggestions for using our work to inform the future management of Pacific salmon, emphasizing the Wild Salmon Policy.

Performance Expectations

2008 (Year 2): Modified from End of Year 1 Report

Task #	Task Description	Proposed Completion Date	Realized Completion Date
1	Entry & formatting of salmon escapement data from DFO	May 2008	May 2008
2	Physical habitat indicator data entry	May 2008	July 2008
3	Processing of fish stable isotope samples.	June 2008	August 2008
4	Processing of water nutrient samples.	June 2008	January 2009
5	Identifying appropriate metrics for physical habitat indicators. Statistical analysis of links between physical habitat indicators and past and current salmon abundance.	August 2008	April 2009
6	Shortened Field Season 2: Final data collection in Shuswap/Thompson & Stuart/Takla regions (removal of temperature and stage level data loggers).	September 2008	September 2008
7	Processing of periphyton stable isotope and AFDM samples.	October 2008	January 2009
8	Entry of temperature and discharge data from loggers and statistical analysis.	October 2008	April 2009
9	Sub-sampling and sorting of invertebrate samples.	February 2009	December 2008

2009 (Year 3): Modified from End of Year 1 Report

Task #	Task Description	Time Required	Proposed Completion Date
1	Processing of periphyton chlorophyll a samples.	4 weeks	April 2009
2	Computation of resident fish density and condition indices.	4 weeks	August 2009
3	Identification of invertebrate samples.	8 weeks	May 2009
4	Processing of water samples (turbidity and suspended sediments).	3 weeks	July 2009
5	Processing of invertebrate stable isotope samples.	8 weeks	October 2009
6	Testing of quantitative links between historical and recent salmon escapement and various indicators of ecosystem productivity in periphyton, invertebrates, and resident fish.	16 weeks	December 2009
7	Statistical analysis of the relative costs and benefits of using the abiotic and biotic indicators, both individually and combined. Presentation of findings and suggestions for future management of Pacific salmon, emphasizing the Wild Salmon Policy.	16 weeks	March 2010

Partnerships

Over the past year, we have greatly enhanced the working relationship with the Department of Fisheries and Oceans (DFO) that we initiated prior to the project's commencement. Tracy Cone (Stock Assessment Data Manager) has been instrumental in providing us with access to the detailed historic escapement data. Erland Maclsaac, Dave Patterson, and Herb Herunter continue to provide considerable time and expertise to the planning of our field season, loaned field equipment, and have provided us with an array of data relevant to our study (salmon life history data, fish species composition data, invertebrate data, and information on water nutrients, chemistry, hydrology, and thermal regimes for several of our study streams). Kerry Parish (Research Technician) has prepared and provided the necessary sampling equipment for water nutrients as well as a complete analysis of all water nutrient samples. Dennis Klassen (Stock Assessment) provided invaluable field support, including our accommodations during the shortened 2008 field season.

In turn, interest from DFO regarding the objectives of our project continues to grow, particularly in relation to the development and implementation of the Wild Salmon Policy. This is in line with Objective 3 of our project, to use information from this study to inform future management decisions aimed at improving the sustainability of wild salmon stocks. Some highlights include:

In September 2008, Doug Braun, Jan Verspoor and John Reynolds presented our work on Objectives 1 and 2 to Heather Stalberg (DFO, former Wild Salmon Policy Strategy 2 Coordinator), Kim Hyatt (DFO, Strategy 3 Coordinator), Jim Irvine (DFO, Strategy 3 Research Scientist), Janelle Curtis (DFO, Strategy 3 Research Scientist), and Craig Orr (Watershed Watch, Director) with the objectives of updating each other on progress made and identifying avenues for further collaboration between groups.

In December 2008, Doug Braun in collaboration with Watershed Watch and SFU's Centre for Coastal Studies organized a Speaking for the Salmon Series titled "Salmon and Nutrients: A seminar on science and policy". This included Daniel Schindler as the keynote speaker followed by reviews from Kim Hyatt, Bruce Ward and John Reynolds. The purpose of the seminar was to examine the current research on salmon nutrient contributions to ecosystems and to use this information to advance implementation of Strategy 3 of the Wild Salmon Policy.

In January 2009, Doug Braun and John Reynolds attended a Habitat Indicators workshop organized by DFO, which reviewed Heather Stalberg's draft report on proposed stream, lake and estuarine habitat indicators. Doug Braun was invited to write a review of the proposed stream habitat indicators for Watershed Watch.

In March 2009, Doug Braun attended a workshop of the Aquatic Information Partnership, an initiative that is funded by the Fraser Salmon and Watersheds Program.

In addition to our partnerships with government, Watershed Watch Salmon Society has continued to provide both finance and expertise to the project. Watershed Watch was the industrial sponsor of Doug Braun's PGS-M NSERC scholarship, which ended in December 2008. Furthermore, supporting the implementation of the Wild Salmon Policy continues to be a major initiative for the organization. Interactions with their executive director, Dr. Craig Orr, have helped facilitate discussions of our work with key Wild Salmon Policy coordinators as well as public outreach, as mentioned above.