Vancouver Island Juvenile Steelhead Stock Assessment

2003 Data Summary

prepared by:

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GREATER GEORGIA BASIN
STEELHEAD Recovery Plan
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Introduction

This year marked the sixth consecutive season of juvenile steelhead assessments on Vancouver Island watersheds by BCCF staff. Funding has been provided primarily by Habitat Conservation Trust Fund, with additional funding for specific projects coming from BC Hydro, Weyerhaeuser, San Juan Opportunistic Fund, and the Habitat Restoration and Salmon Enhancement Program. The total number of streams electrofished per year started at 12 in 1998, increased to 18 in 2001, and decreased 7 in 2003 (Table 1). River selection has been streamlined to target key streams within the Greater Georgia Basin Steelhead Recovery Plan, as well as those with specific monitoring objectives relating to stream fertilization (i.e., Salmon River and Harris Creek). A complete site list, including site names and locations can be found in Appendix A.

	System	# of sites	Total area electrofished (m^2)	Average site area (m^2)
1	Campbell	6	466.30	77.72
2	Cowichan	8	737.57	92.20
3	Englishman	9	802.43	89.16
4	Harris	4	306.38	76.60
5	Little Qualicum	8	602.54	75.32
6	Quinsam	7	503.42	71.92
7	Salmon	10	930.30	93.03
	Totals	**52**	**4348.9**	**82.3**

Table 1. Summary of streams surveyed by two-pass removal electrofishing by BCCF staff in 2003.

Methods

Sampling was conducted using closed-site electrofishing techniques. At each electrofishing site, about 80 m^2 of suitable steelhead fry habitat (typically cobble/gravel riffles, <30 cm in depth, and <25 cm/sec in velocity) was enclosed with small mesh stopnets. Fish were removed using the standard, 2-pass removal method. Lengths were recorded for all fish captured, and 30+ juveniles per species and age class (unless <30 were captured) were weighed using Ohaus top loading scales (model CS 200) accurate to 0.1 g. Habitat parameters were documented consistent with current Fisheries Branch techniques (methodology by R. Ptolemy, Rivers Biologist, MWLAP, Victoria), and each site was photographed. Upon removal of the stopnets, a depth/velocity profile across a representative transect within the site was recorded using a Swoffer current velocity meter, model 2100. Population estimates were calculated using the Seber equasion for two-pass removal and adjusted based on depth/velocity profiles using Habitat Suitability Index (HSI) curves developed in February 2001. Steelhead fry densities are typically expressed as fry per 100 m^2, or fry per unit (FPU).

The Ptolemy alkalinity model (1993) was used extensively from 1998 to 2001 and is still used for internal analysis, including the Allen Plots. This model predicts habitat capacity, or biomass of species per age class (0+ steelhead fry in this case) that can be supported per 100 m^2 of suitable habitat. The calculation is as follows:

$$(\text{total alkalinity})^{1/2} \times 36.3 = \text{biomass(g) per } 100 \text{ m}^2$$

BCCF technicians have used this model in creating Allen Plots and 'Percent of Predicted FPU' charts since 1998. This model provides a fairly accurate, science based capacity estimate, but does not take into account that the yearling to smolt life stages are typically more demanding on habitat area[1]. Furthermore, in underseeded habitats, early season biomass will be much lower than late season biomass, assuming there is very low mortality over the growing season. A more credible way of identifying escapement needs is to compare a standardized density (depth velocity adjusted FPU) to a **target density** recognizing that smolt or parr production reaches an asymptote after a certain density is achieved (Ptolemy pers. comm.). Preliminary target fry abundances set in 2002 are as follows:

- Campbell – 50 FPU
- Cowichan – 100 FPU
- Englishman – 50 FPU
- Little Qualicum – 60 FPU
- Quinsam – 50 FPU
- Salmon – 60 FPU

These target estimates may be adjusted as more information is gained for each system, particularly quality and quantity of parr habitat, parr density estimates, and smolt enumeration. Also, these values could be adjusted upwards as increased summer flows, stream enrichment, and/or large woody debris complexing improve juvenile steelhead rearing conditions.

The following relates the FPU target values to the exiting stock status measures used in the Greater Georgia Basin Steelhead Recovery Plan (Lill 2002):

- Routine Management Zone (RMZ) – a least 100% of target FPU
- Conservation Concern Zone (CCZ) – 33% to 100% of target FPU
- Extreme Conservation Concern Zone (ECC) – less than 33% of target FPU

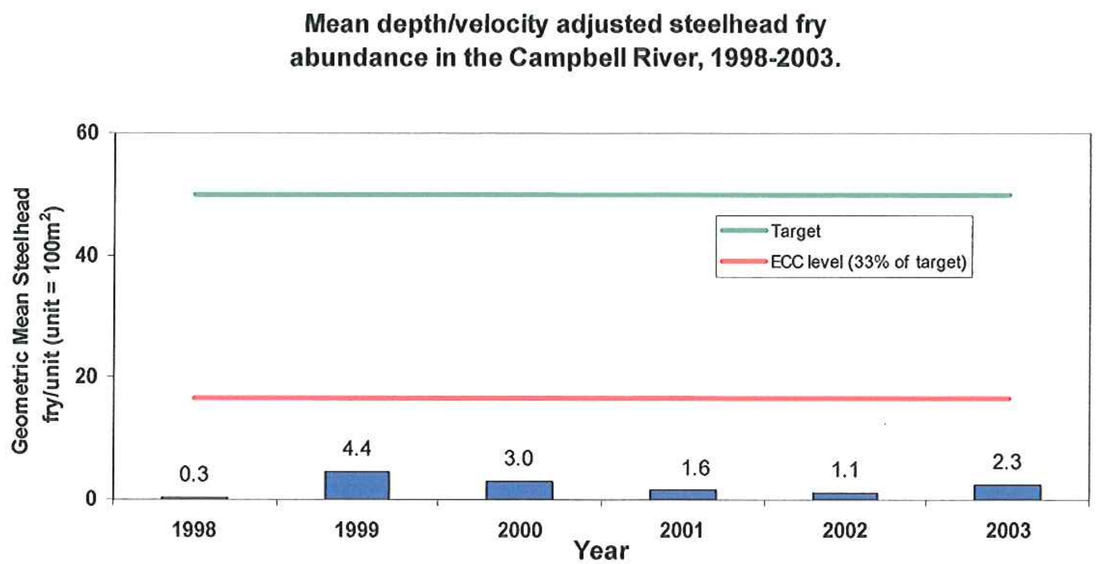
[1] The Campbell River may be an exception, where lack of suitable spawning habitat may be limiting to fry production.

Summary of Results

Campbell River (ECC)

Fry density data for the Campbell indicates that the steelhead stock status has been well below 33% of target for all years electrofished, and is therefore in the Extreme Conservation Concern Zone (Figure 1). Spawning gravel addition in Elk Falls Canyon and stocking Quinsam River Living Gene Bank fry into underseeded habitats in the Campbell River may contribute to improved steelhead escapement in future years.

Figure 1.



Cowichan River (CCZ)

The Cowichan River is highly productive compared to most other East Coast Vancouver Island (ECVI) streams and has a target density of 100 FPU. Electrofishing data collected from 1999-2003 indicates that Cowichan River steelhead have been in the Conservation Concern Zone (between 33 and 100 FPU) for the past five years (Figure 2). High turbidity limits snorkel efficiency, thus steelhead fry assessments and angler reports remain the primary indices of stock status. Adult stock status estimates reported by Lill in 2002 indicate recent steelhead escapements are between 500 and 800 fish. Results from the Steelhead Harvest Analysis Questionnaire for 1997-2002 estimate a mean annual steelhead angling effort of 5,340 producing a mean catch of 2,745.

Figure 2.

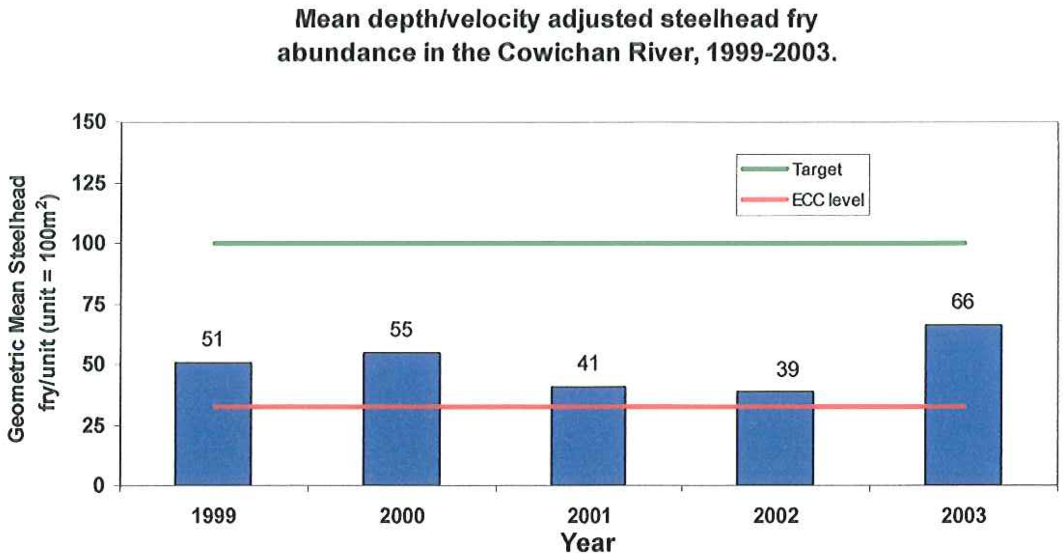
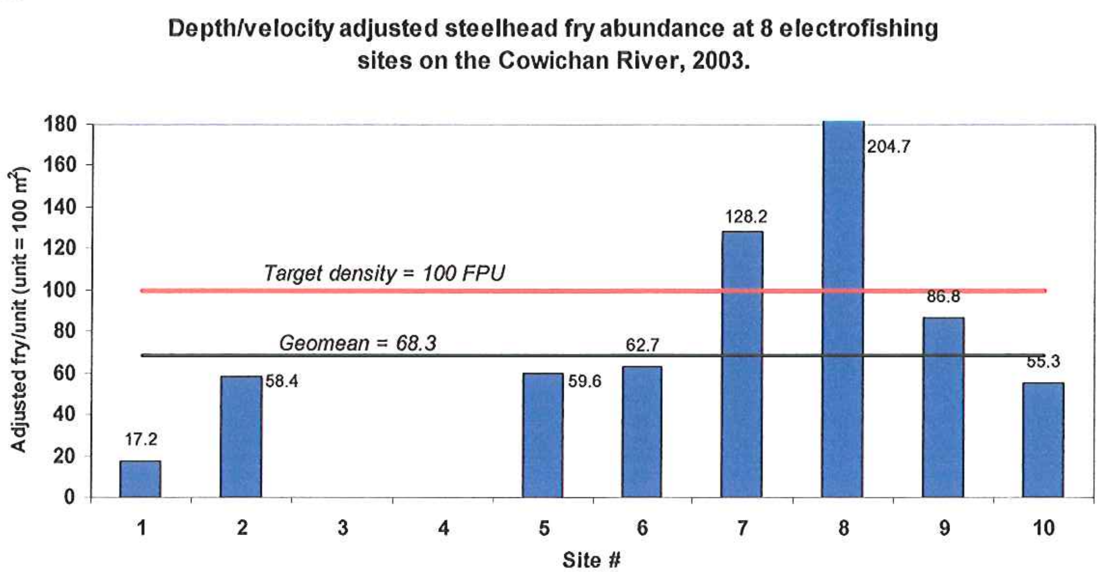


Figure 3 displays densities sampled at 8 sites from the Island Highway Bridge crossing upstream to the Road Pool near the town of Lake Cowichan. Peak densities were observed between Skutz Falls and the 70.2 Mile Trestle (sites 7 to 9, Appendix A). The greatest density (204.7 FPU) was measured at Block 51, where Ptolemy and Sholten measured densities in excess of 300 FPU in 1988. The 2003 mean fry density of 68.3 is conservative considering sites 3 and 4 are not included. The mean fry density measured at sites 3 and 4 during the past 3 years is 92.4 FPU.

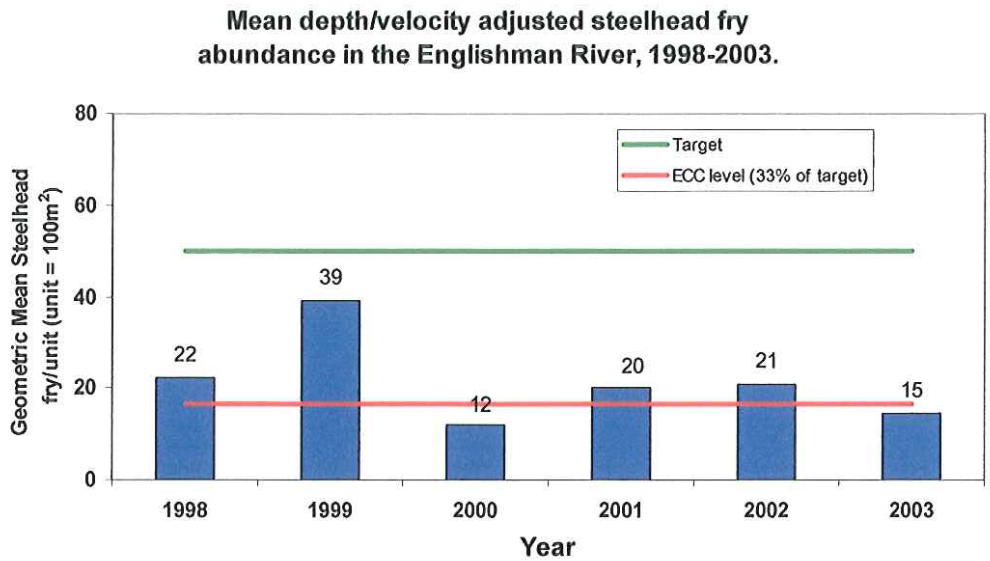
Figure 3.



Englishman River (CCZ/ECC)

Steelhead fry density data from 9 sites on the Englishman River indicate stock status has been in the Extreme Conservation Concern Zone (i.e., less that 16.7 FPU) for 2 of the past 6 years (Figure 4). The 2003 density of 15 FPU is below the ECC threshold, and is the second lowest since BCCF crew commenced sampling in 1998.

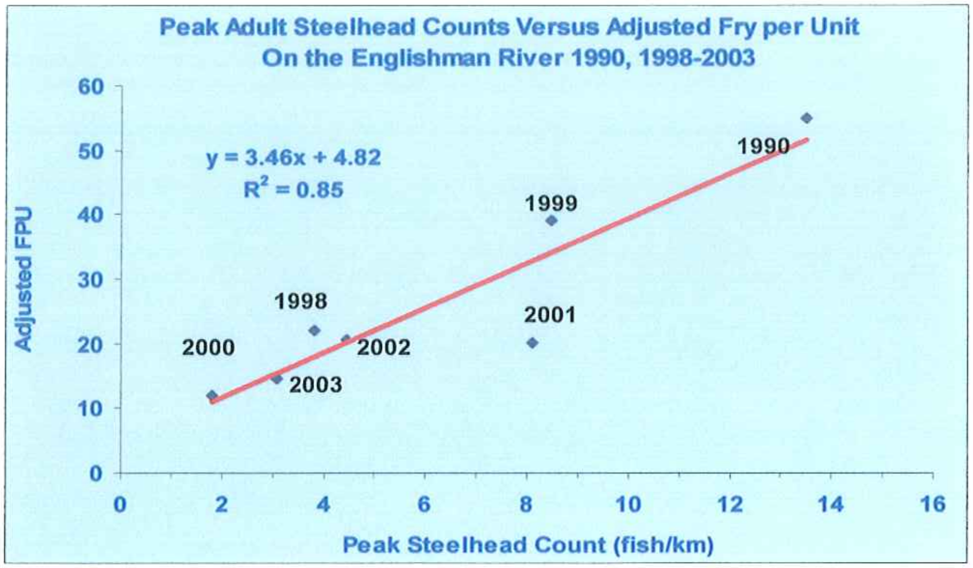
Figure 4.



The relationship between peak adult steelhead per kilometre observed during snorkel surveys and mean depth velocity adjusted FPU indicate a strong relationship between number of spawners and subsequent fry density (Figure 5). The Englishman River dataset produces a stronger relationship than other systems for the following reasons:

1. Electrofishing sites and snorkel surveys are done in the same reaches.
2. Snorkel surveys are done repeatedly with relatively good coverage to ensure consistent peak counts.

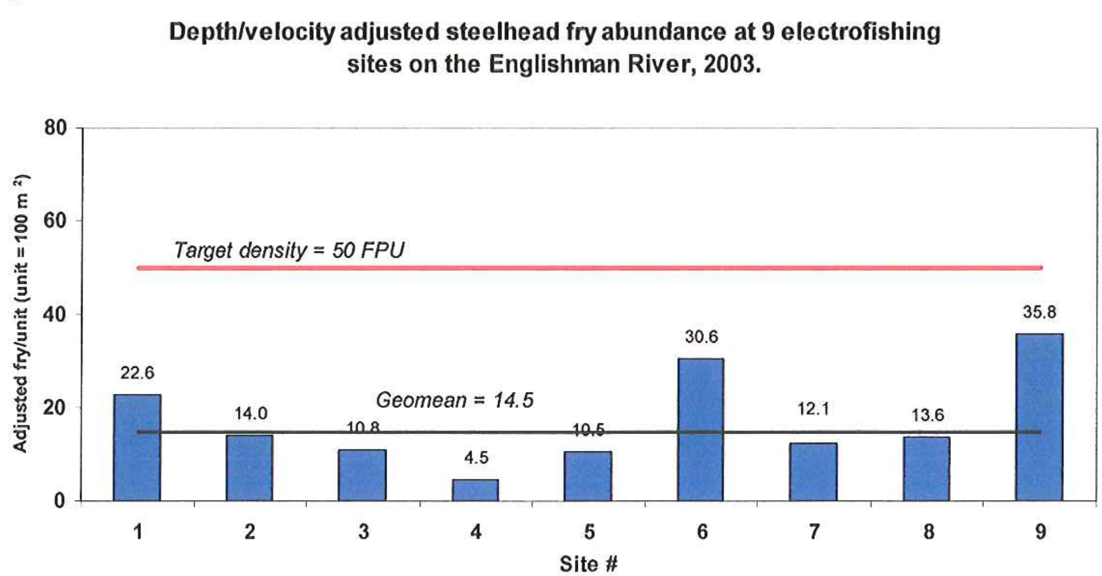
Figure 5.



Intensive snorkel surveys on Englishman River have produced adult steelhead escapement estimates of 145 fish in 2002 and 96 in 2003[2] (Smith 2003). Mean fry densities for those years were 21 and 15 FPU respectively, indicating a proportional decline in both stock abundance measures.

Site specific fry densities displayed in Figure 6 indicate slightly higher densities in the upper river, with the highest measured at site 9, located downstream of Englishman River Falls (cover photo, Appendix A). Site 6 is located in the lower South Fork Englishman, where fry densities are typically high due to very low summer flows.

Figure 6.

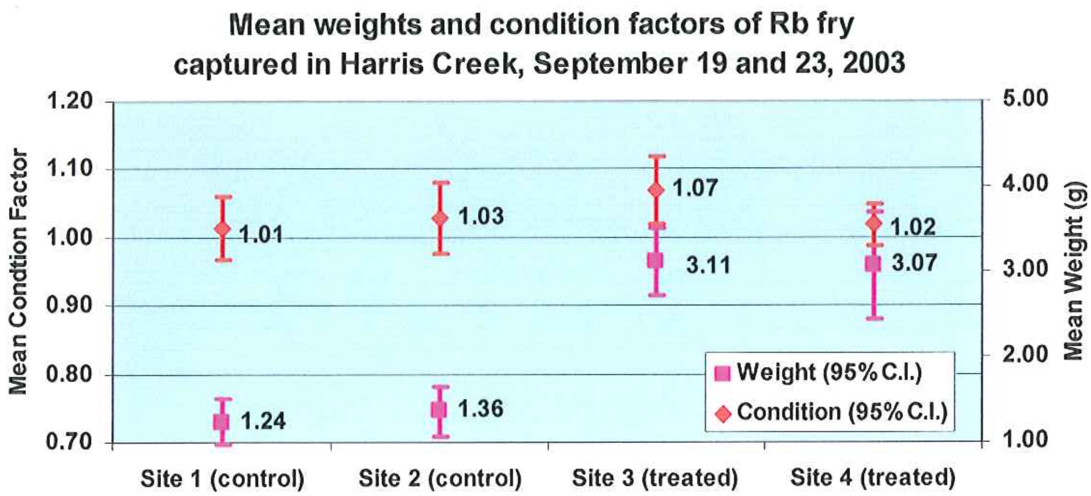


[2] Probable estimates based on snorkel survey efficiency of 60% and residence time of 60 days.

Harris Creek (RMZ)

Four sites were done in upper Harris Creek to assess the size and density of steelhead fry in sites enriched with slow release fertilizer pellets. Figure 7 compares mean weights and condition factors of fish sampled in treated and untreated sites. While mean weights were two times greater in treated sites than untreated sites, condition factors were roughly equal.

Figure 7.



Although these results indicate a positive growth response to enrichment, control sites (3 and 4) had much greater FPU than the treated sites (Table 2), which may have attributed to density dependent growth differences.

Site #	Mean Weight (grams)	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.08	112.42	90.4	124%
2	3.11	76.53	89.6	85%
3	1.36	178.43	204.7	87%
4	1.22	210.99	228.6	92%
MEAN	**2.19**	**134.15***		**97%**
Sites 3 and 4 are controls, 1 and 2 are within the fertilized reach.				

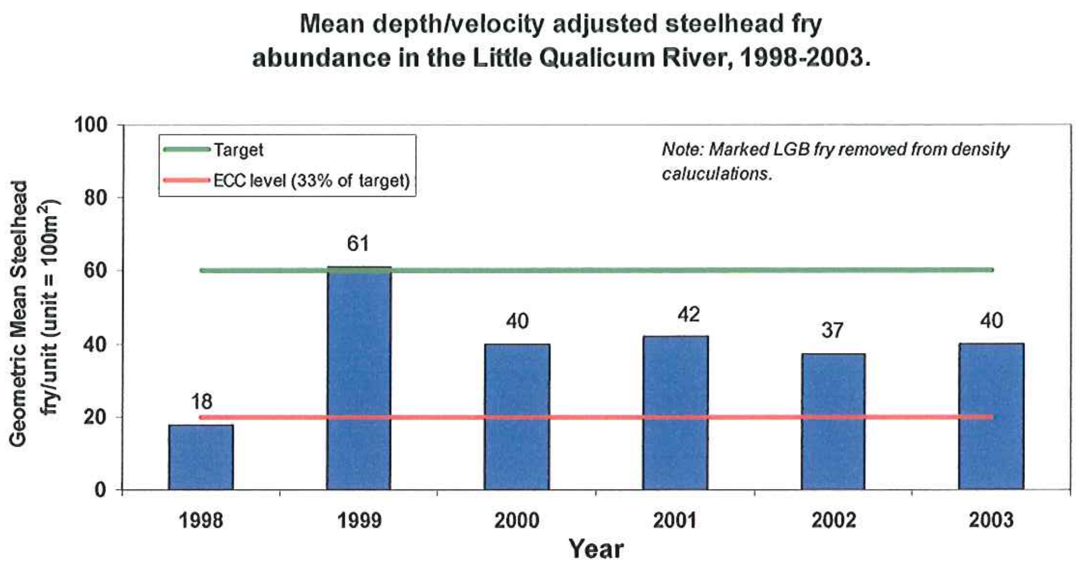
Table 2. Harris Creek steelhead fry data summary, 2003.

Sites on Harris Creek were clumped within a 2.3 km reach immediately upstream and downstream of the stream fertilization site. If fry densities were to remain somewhat constant throughout the anadromous reach, steelhead stock status would be within the Routine Management Zone, even if the target was set at 100 FPU to service exceptional parr habitat (Ptolemy pers. comm.).

Little Qualicum (CCZ)

Steelhead fry data collected since 1998 indicate stock status has been within the Conservation Concern Zone for all years except 1998, when densities were just below 33% of target (Figure 8).

Figure 8.



Similar to Englishman River, there is a strong correlation between peak adult counts and fry densities sampled the following summer (Figure 9). The Little Qualicum has a relatively short anadromous length that is effectively covered by snorkel survey and juvenile sampling is done within the snorkel reaches.

Figure 9.

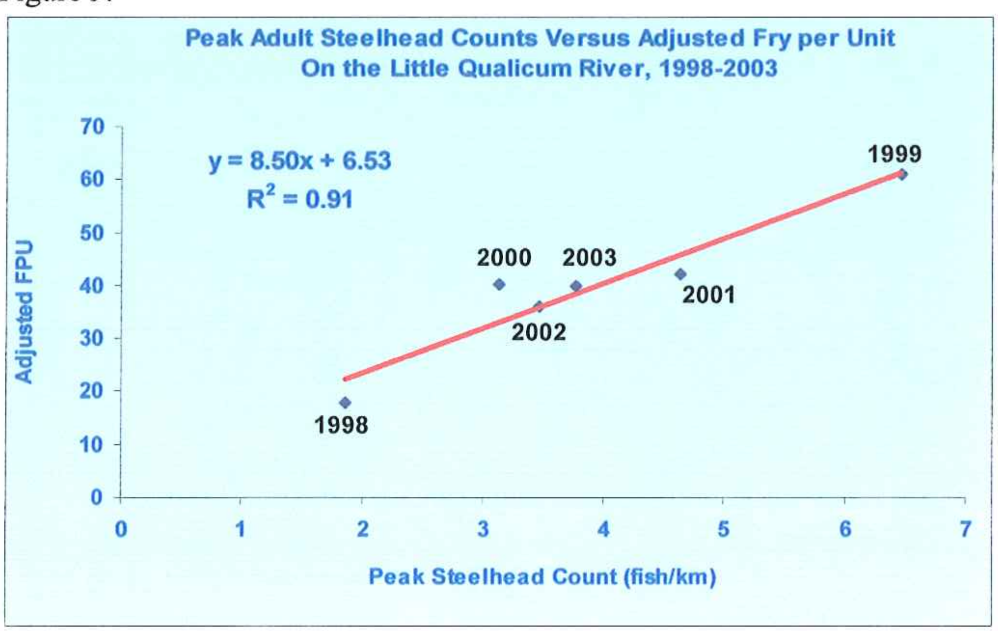


Figure 10 indicates that steelhead fry densities are slightly higher in upper river sites. Marked Living Gene Bank fry were captured in 7 of 8 sites, but these fish were removed from the density calculations so that data was more indicative of wild stock abundance. This assumes that Living Gene Bank fry were occupying empty spaces and not displacing wild fry that would otherwise be present within the within the sites. Results including marked fry are displayed in Figure 11; note the geometric mean fry density was 51.8 when marked fish were included, versus 40.0 for the 'wild only' analysis.

Figure 10.

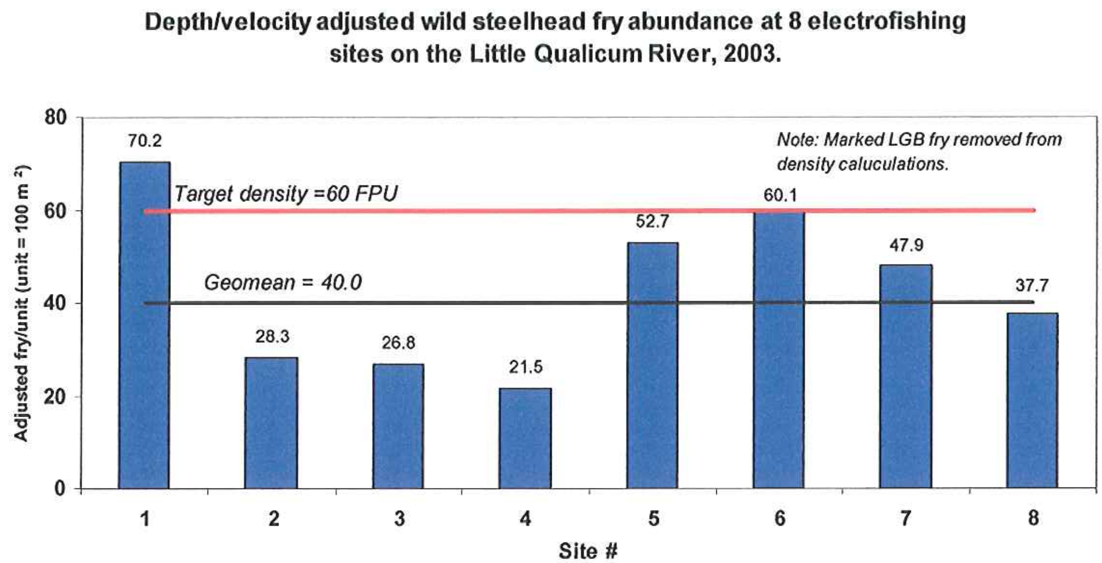
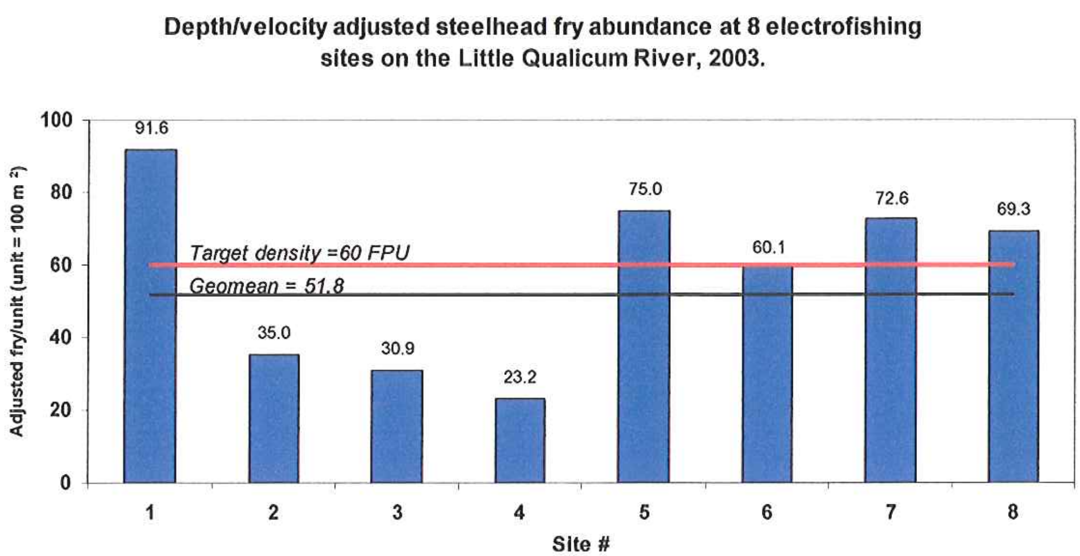


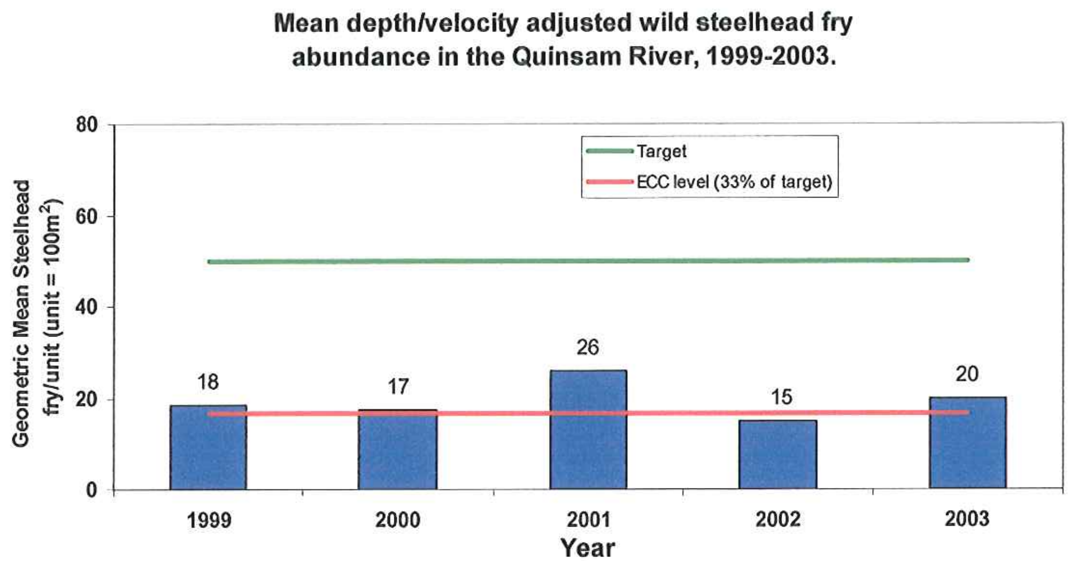
Figure 11.



Quinsam River (CCZ/ECC)

Wild steelhead fry densities have very near, or just below 33% of target for three of the past 5 years on the Quinsam River (Figure 12). There has been very little variance between years with geometric mean densities ranging from a minimum of 15 FPU in 2002 to a maximum of 26 FPU in 2001.

Figure 12.



Site specific densities sampled at 7 sites in the Quinsam River are displayed in Figures 13 and 14. The geometric mean density of 'wild only' fry was 20 FPU, compared to a total density of 32 FPU when LGB fry are included. Peak densities for wild fry were measured in sites two through four, located between Quinsam Hatchery and Elk River Mainline (Appendix A). Site one, located at the Argonaut Bridge crossing 1.35 km upstream from the mouth, typically has very high densities of steelhead fry. Very low densities this year are likely due to better may a result of better adult escapement to upper reaches and/or poor hydraulic suitability (44 % WUA for Rb fry).

Figure 13.

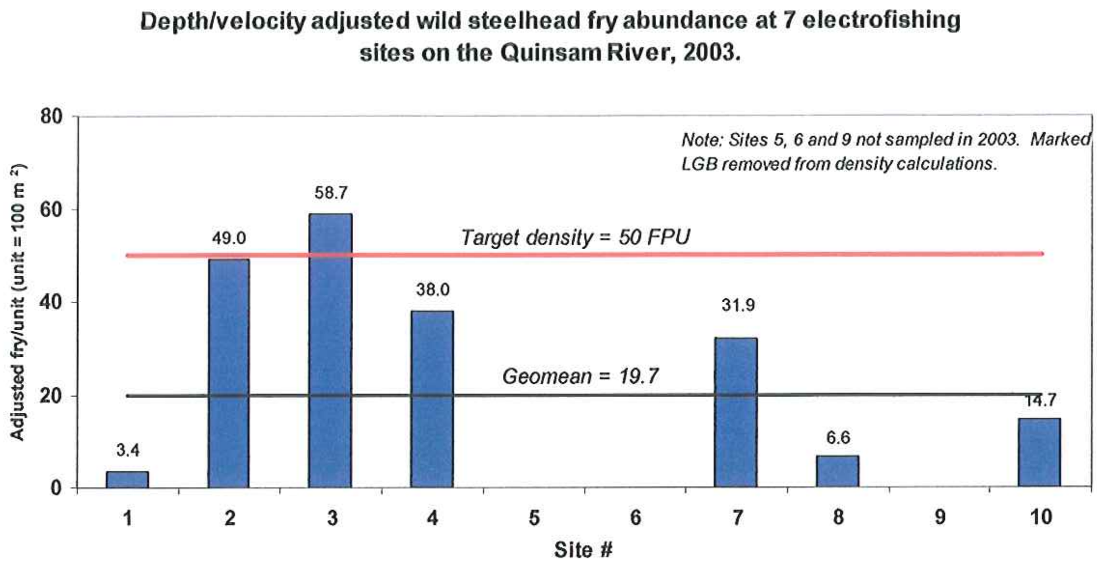
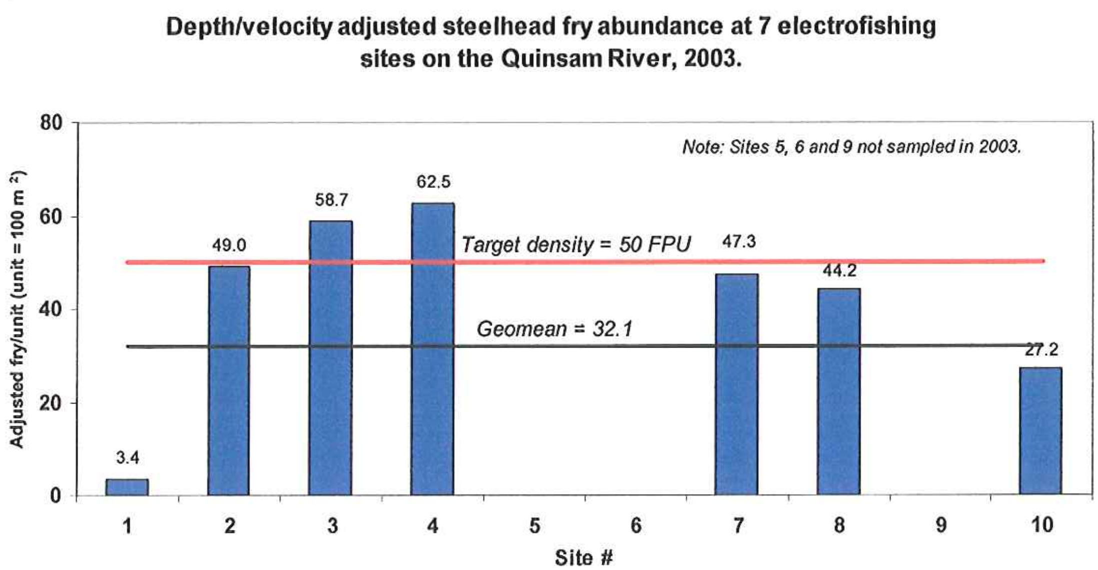


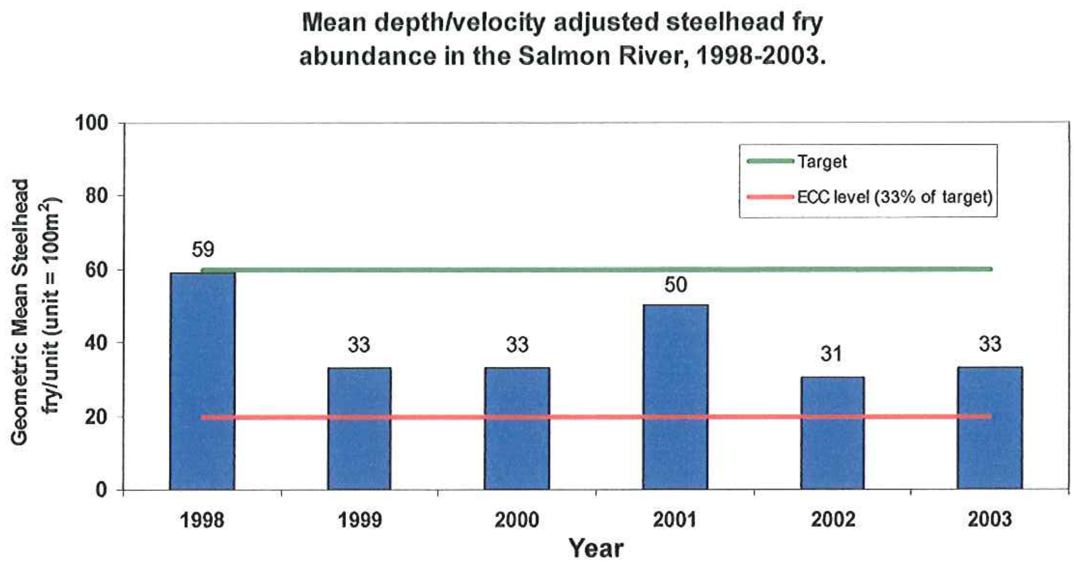
Figure 14.



Salmon River (CCZ)

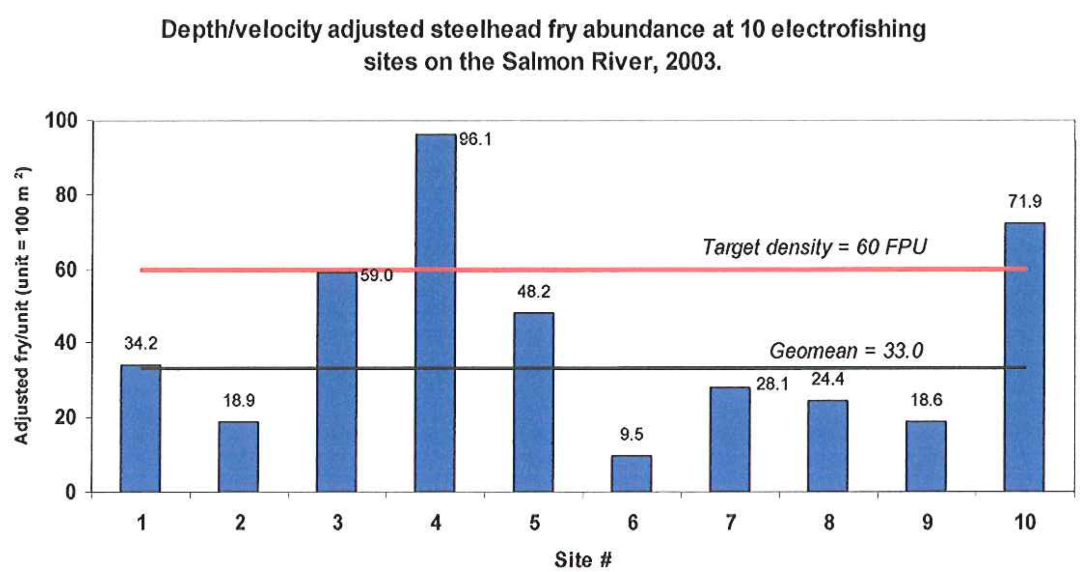
Steelhead fry densites measured on the Salmon River over the past 6 years indicates stock status is within the Conservation Consern Zone (Figure 15).

Figure 15.



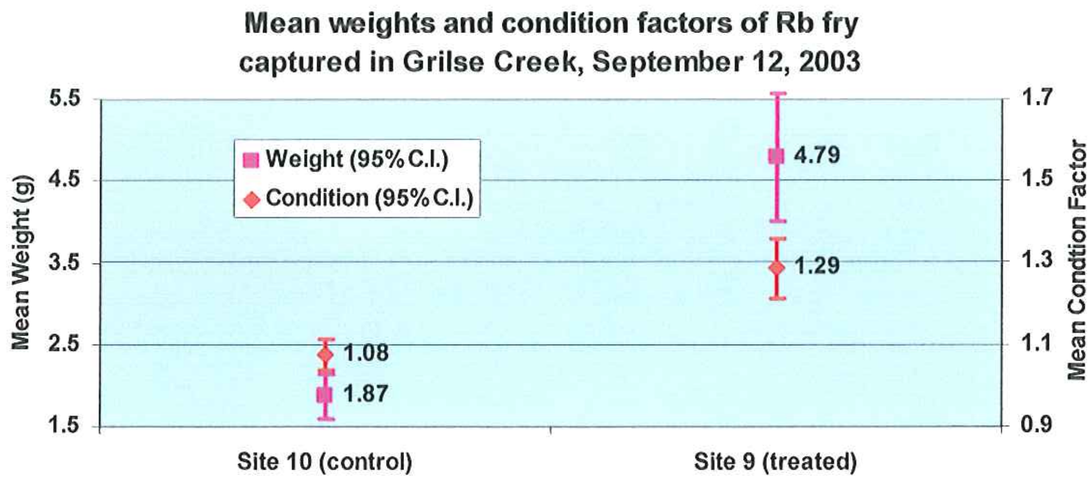
Site specific densities displayed in Figure 16 indicate a random distribution; with slightly greater densities measured in sites three through four (see Appendix A for site location). Site 10, located in Grilse Creek, and also produced a very high density of 72 FPU.

Figure 16.



Figures 17 compares mean weights and condition factors of fish sampled in treated and untreated sites. Steelhead fry sampled downstream of the fertilizer drip tank had significantly greater mean weight and condition factor.

Figure 17.



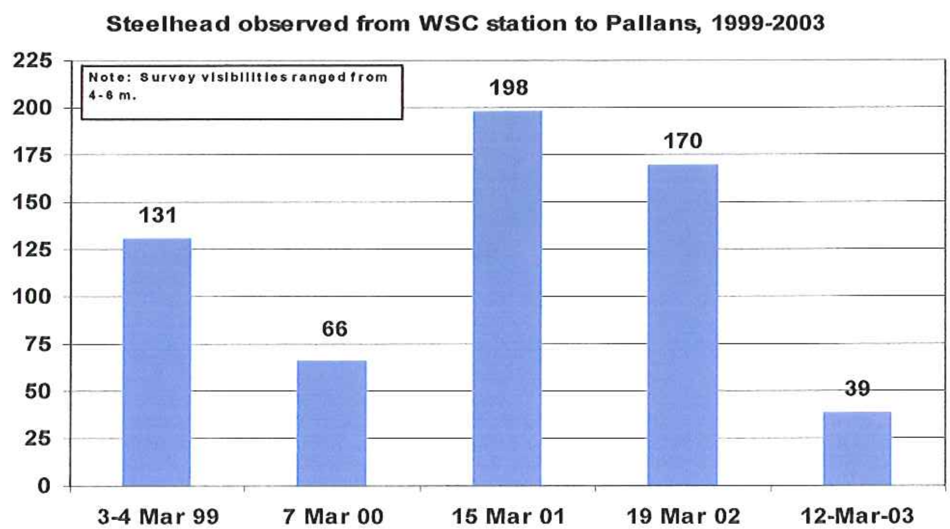
Although these results indicate a positive growth response to enrichment, the control site had much greater FPU than the treated site (71.9 vs. 18.6), which may have attributed to density growth dependent differences.

Conclusions

Englishman and Little Qualicum are the only streams where our juvenile electrofishing and adult snorkel survey results have a strong correlation. Thus, juvenile assessments are a reconfirmation of spawner abundance the previous winter. Continuation of juvenile sampling on these systems may be useful in confirming a strong spawner to fry density relationship, with potential to include smolt production estimates once more years of data are collected. So far, no relationship can be drawn using two years of smolt data from the Englishman River. One data point can be plotted comparing the estimate of age 2 smolts in 2002 plus age 3 smolts in 2003 with 2000 adult and fry densities. If fry assessments were to be discontinued and downstream smolt enumeration is continued, meaningful comparisons could still be made with adult data and fry data from 2000 to 2003[3].

On larger watersheds, like Quinsam and Salmon, where our adult snorkel assessments are less intensive, fry density data provides very meaningful stock status data. For example; last year on the Salmon, snorkel survey data indicated very poor run strength (Figure 18), while the juvenile data suggests that last year was slightly below average (Figure 15). Site specific data displayed in Figure 16 shows that peak fry densities were observed upstream of the snorkel survey index section, suggesting reasonable escapement to the upper river (WSC to Pallans only encompasses electrofishing sites 1 and 2, Appendix A).

Figure 18.



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[3] Preliminary reviews of the 2003 Englishman River downstream smolt enumeration data indicate that statistically valid data cannot be produced due to very low numbers of recaptures at the lower trap (J. Craig pers. comm.).

Appendix A
Site Summaries

Watershed: Campbell
Stream Code: 920-627900

System	Site #	Site Description	Site Ref. (km)	Date	UTM Code	Site Dimensions		
						Length	Width	Area
Campbell	1	Between Hwy. 19 Bridges, LB	2.1	06-Aug-03	337237-5544965	10.1	7.1	71.9
Campbell	2	Elk Falls Resort, RB	2.4	06-Aug-03	336919-5545041	11.4	6.8	65.4
Campbell	3	35m u/s of Duncan Bay Main Bridge, RB	2.5	06-Aug-03	336372-5545244	12.9	6.8	83.6
Campbell	4	45m u/s of Quinsam Confluence, RB	3.7	08-Aug-03	335662-5545353	13.5	6.5	83.4
Campbell	5	Mainstem Side of 2nd Island, RB	4.6	07-Aug-03	335007-5545953	12.2	6.0	72.6
Campbell	6	Opposite 1st Island, RB	4.9	07-Aug-03	334796-5546033	12.2	7.9	89.5
Campbell	7	Lower Elk Falls Side Channel	**NOT SAMPLED IN 2003**					
Campbell	8	Upper Elk Falls Side Channel	**NOT SAMPLED IN 2003**					
Campbell	9	Bottom of Second Island Side Channel	**NOT SAMPLED IN 2003**					
Campbell	10	Upper Second Island Side Channel	**NOT SAMPLED IN 2003**					

Watershed: Cowichan
Stream Code: 920-257700

System	Site #	Site Description	Site Ref. (km)	Date	UTM Code	Site Dimensions		
						Length	Width	Area
Cowichan	1	90 m u/s of Silver Bridge	6.0	02-Sep-03	448837,5402291	14.5	6.75	97.88
Cowichan	2	Vimmy Boat Launch	13.9	02-Sep-03	443226,5401118	12.9	6.38	83.80
Cowichan	3	site not completed in 2003						
Cowichan	4	site not completed in 2003						
Cowichan	5	100m d/s Stoltz launch	26.7	05-Sep-03	433933,5402484	17.2	6.03	101.56
Cowichan	6	Head of Marie Canyon	30.8	05-Sep-03	430798,5403057	20.5	4.30	87.27
Cowichan	7	u/s Skutz Falls	32.7	03-Sep-03	429843,5403776	14.6	7.23	100.33
Cowichan	8	Block 51 Log Jam	38.7	17-Sep-03	426494,5405386	15.4	5.35	74.39
Cowichan	9	70.2 Mile Trestle	40.0	17-Sep-03	426398,5406285	10.75	7.15	74.56
Cowichan	10	Saysell's Riffle	45.0	03-Sep-03	424273,5409213	14.15	8.33	117.80

Watershed: Englishman
Stream Code: 920-462800

System	Site #	Site Description	Site Ref. (km)	Date	UTM Code	Site Dimensions		
						Length	Width	Area
Englishman	1	50 m d/s of Hwy 19A bridge	1.26	21-Aug-03	406669, 5463666	16.7	5.20	85.10
Englishman	2	Martindale Road	2.11	26-Aug-03	407176, 5461951	15.25	4.73	72.13
Englishman	3	Allsbrook Canyon	4.65	22-Aug-03	407855, 5461575	20.85	3.40	69.47
Englishman	4	Grassy Bank	5.57	22-Aug-03	406923, 5460354	13	7.07	90.96
Englishman	5	Powerlines	6.85	21-Aug-03	406608, 5460077	13	7.15	91.09
Englishman	6	South Fork	8.87	26-Aug-03	405716, 5459144	22.2	7.38	139.17
Englishman	7	Side Channel Intake	8.72	21-Aug-03	404713, 5459345	13.4	7.40	96.19
Englishman	8	End of Englishman River Road	9.84	21-Aug-03	404214, 5458815	16.8	6.00	94.75
Englishman	9	Falls Site	14.83	28-Aug-03	401996, 5456485	10.09	7.00	63.57

Watershed: Harris
Stream Code: 930-053800-22100

System	Site #	Site Description	Site Ref. (km)	Date	UTM Code	Site Dimensions		
						Length	Width	Area
Harris	1	2 km d/s fertilizer (heli-boulder)		19-Sep-03		12.2	6.08	71.89
Harris	2	1.5 km d/s fertilizer (Faller's Bridge)		19-Sep-03		14.5	4.10	50.53
Harris	3	350 m u/s fertilizer		23-Sep-03		10	9.91	99.07
Harris	4	400 m upstream fertilizer		23-Sep-03		10	8.49	84.88

Watershed: Little Qualicum
Stream Code: 920-481800

System	Site #	Site Description	Site Ref. (km)	Date	UTM Code	Site Dimensions		
						Length	Width	Area
Little Qualicum	1	Pumphouse	1.24	29-Aug-03	392129, 5468645	12.65	6.18	78.11
Little Qualicum	2	50 m d/s of hatchery fence	3.34	27-Aug-03	391409, 5467504	10	8.1	81.00
Little Qualicum	3	Middle of chum channel	4.17	28-Aug-03	390986, 5468017	10	6.975	69.75
Little Qualicum	4	Lower Meadows	5.41	27-Aug-03	389920, 5467787	14.55	5.47	78.74
Little Qualicum	5	Middle Meadows	6.16	27-Aug-03	359879, 5467776	14.5	5.68	81.46
Little Qualicum	6	75 m u/s of Kinkade Creek confluence	7.70	27-Aug-03	380572, 5466945	14.45	5.83	84.17
Little Qualicum	7	80 m u/s of Inland Island Hwy.	10.20	29-Aug-03	387986, 5465223	14.2	5.30	71.50
Little Qualicum	8	Ozero Bridge	11.07	29-Aug-03	387523, 5465083	10	6.80	57.80

Watershed: Quinsam
Stream Code: 920 627900-03600

System	Site #	Site Description	Site Ref. (km)	Date	UTM Code	Site Dimensions		
						Length	Width	Area
Quinsam	1	Argonaut Bridge	1.35	05-Aug-03	335439,5544089	12.3	5.73	66.90
Quinsam	2	100 m u/s of hatchery fence	2.65	12-Aug-03	334993,5543012	14.5	5.50	77.36
Quinsam	3	Sandpits (80 m d/s of RB log jam)	6.67	07-Aug-03	334688,5540173	12.3	7.20	70.85
Quinsam	4	200 m u/s of hydrolines below Elk River ML Brid	11.28	12-Aug-03	333947,5538996	10.85	7.53	79.20
Quinsam	5	Hydrolines u/s of Elk River ML bridge	**NOT SAMPLED IN 2003**					
Quinsam	6	Dynamite Shack (~5 km u/s of Elk River ML Bric	**NOT SAMPLED IN 2003**					
Quinsam	7	Heli #2 (~1.5 km d/s of Quinsam Potholes)	20.51	13-Aug-03	334080,5534854	11.5	6.30	70.28
Quinsam	8	Quinsam Potholes	22.27	08-Aug-03	333248,5533624	8.9	7.90	63.28
Quinsam	9	Heli #3 (~1 km d/s of Lower Quinsam Lake)	**NOT SAMPLED IN 2003**					
Quinsam	10	Heli #4 (~20 m d/s of Iron River confluence)	31.60	13-Aug-03	326652,5534742	11.45	6.60	75.57

Watershed: Salmon
Stream Code: 925-725300

System	Site #	Site Description	Site Ref. (km)	Date	UTM Code	Site Dimensions		
						Length	Width	Area
Salmon	1	Pallan's	12.24	25-Sep-03	293530,5576518	12.9	8.6	109.4
Salmon	2	WSC Station (Kay Creek)	35.44	25-Sep-03	304045,5564254	13.7	8.1	111.2
Salmon	3	Memekay ML Bridge	52.6	11-Sep-03	309222,5556664	15.9	5.3	80.4
Salmon	4	Smolt Screen	58.02	26-Sep-03	309046,5552313	17.5	5.0	78.0
Salmon	5	Washout	67.73	11-Sep-03	302790,5548002	22.0	5.8	111.8
Salmon	6	Washout 500 m u/s of Grilse confluence	69.25	10-Sep-03	301495,5547162	12.4	6.9	78.9
Salmon	7	Memekay River (lower bridge)	27.93	25-Sep-03	302065,5566098	17.7	5.4	85.6
Salmon	8	Grilse Ck (100 m u/s of lower bridge)	70.77	10-Sep-03	300281,5547288	17.0	5.4	90.6
Salmon	9	Grilse Ck (300 m d/s of upper bridge)	74.27	12-Sep-03	297264,554698	14.6	6.4	89.1
Salmon	10	Grilse Ck (1 km u/s of upper bridge)	75.91	12-Sep-03	296047,5546134	16.9	5.8	95.2