West Coast Region Steelhead Stock Assessment 2017/2018

Findings of investigations funded by the Freshwater Fisheries Society of BC, the Ministry of Forests, Lands and Natural Resource Operations and the Habitat Conservation Trust Foundation

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SECTION 1 – EXECUTIVE SUMMARY

This project continues the long-term steelhead stock assessment data collection on key Vancouver Island streams. A combination of methods including direct underwater observation (snorkel survey) and electrofishing assessments were used to determine relative abundance, habitat saturation and an estimate of absolute steelhead abundance in the Englishman River.

Winter steelhead snorkel surveys were completed and results were contrasted against historic indices of abundance on the Englishman (1998–2017) and Gold (1998–2018) rivers. Summer steelhead surveys are summarized for the Tsitika (1976–2017), Heber (1975–2017) and Gordon (1985–2017) rivers. Snorkel surveys indicated relatively low overall abundance of steelhead across their range for both summer and winter stocks.

Consecutive surveys in the Gold River in 2018 showed only two and three individual steelhead in 7.8 km of habitat and indicates a significant decline over benchmank conditions. Assessment activity on the Gold River in 2017 has stimulated a successful application to the Habitat Conservation Trust Fund (HCTF) by the British Columbia Conservation Foundation (BCCF) for a larger project investigating factors in the decline. This multi-year project will commence in the summer of 2018.

Electrofishing data are summarised for the Cowichan, Englishman (1998–2017) and Gold (1990;2017) rivers. Gold River represents a new addition and was added in response to significant declines in adult abundance noted in 2017. Future assessment activities will be funded by the BCCF's approved 4 year HCTF Gold River steelhead assessment program.

Steelhead fry density on the Cowichan River continues to be below the the 5-year average but are likely near the minimum abundance needed to saturate availble parr habitat (Ptolemy, pers comm). Steelhead densites on the Englishman River are consistent with the small estimated adult population size and are likely below or near levels that fully saturate parr habitat.

Englishman River peak counts of 41 steelhead in the spring of 2017 yielded a population estimate of 138 steelhead only slightly above the lower quartile values within the intensively monitored years of 2002 – 2018. The spring 2018 peak count of 26 adult steelhead yields a population estimate of 72 and is below the lower quartile bound and near the minimum on record. These population estimates reflect a reduced marine productivity period observed broadly throughout the Region. This level of abundance

places the Englishman River in the **Extreme Conservation Concern Zone** based on both absolute population size and our understanding of this stock.

These data are important for the management and maintenance of steelhead populations and angling opportunities on Vancouver Island. Additionally, data build on long-term trend monitoring inside and outside of the Georgia Basin.

SECTION 2 – PROJECT OVERVIEW

Introduction

Funding was provided by the Freshwater Fisheries Society of BC (FFSBC), the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (FLNRORD) and supported in part by the Living Rivers- Georgia Basin/Vancouver Island and the B.C. Conservation Foundation (BCCF).

Winter steelhead snorkel surveys were completed and results were contrasted against historic indices of abundance on the Englishman (1998–2017) and Gold rivers (1998–2018). Summer steelhead surveys are summarized for the Tsitika (1976–2017), Heber (1975–2017) and Gordon (1985–2017) rivers.

Electofishing data are summarised for the Cowichan, Englishman (1998–2017) and Gold rivers. The Gold River has been reintroduced into the stock assessment program due to recently observed sharp decline in abundance.

Project Objectives

1. Monitor winter-run and summer-run steelhead stocks by snorkelling index sections of high priority streams including the Englishman, Gold, Heber, and Tsitika rivers.
2. Complete standardized electrofishing surveys on Englishman and Cowichan rivers to contrast fry densities with adult snorkel counts.
3. Obtain a preliminary dataset of fry densities on the Gold River to compare with winter and summer run adult snorkel counts.
4. Opportunistically document fish habitat condition and any changes to the stream channel and riparian areas.

CHAPTER 1: SNORKEL SURVEYS

Methods

Snorkel survey results are used to estimate total abundance on the Englishman River, an index of the whole population on the Heber, Tsitika and Gordon rivers and a relative index of abundance on the Gold River. These differences relate to the distance surveyed (i.e. whole or partial stream) and ecotype (i.e. summer or winter steelhead).

Standard equipment for all crew members included drysuits, felt-soled wading boots, neoprene hoods and gloves, and throw bags. Dive slates were used to record fish observations and digital thermometers to record stream temperature. A detailed safety plan was developed for each river, and egress points were identified for each section. Waterproof hand-held VHF radios were carried by one crew member on each reach and tuned to the same frequency as the radios mounted inside of each crew vehicle. A check-in/check-out person was used to ensure that the crew completed the survey and all members were accounted for once complete.

Results - Englishman River

The Englishman River is located on the central east coast of Vancouver Island (ECVI) where sharp declines in winter run steelhead populations have been observed since the 1990s. The Englishman is used as an indicator stream for central ECVI winter steelhead stocks. Snorkel surveys have been conducted intensively since 2002 with contemporary surveys bracketing peak abundance period, typically in mid to late April. Based on the population distribution that spans the fiscal year end period, summaries are provided for the 2016/2017 and 2017/2018 fiscal years.

2017 Surveys were conducted on March 9th, April 4th and May 1st, yielding 41, 34, and 35 adult steelhead respectively (Figure 1). The uncalibrated peak density in 2017 was 2.7 fish/km. The resultant population estimate using an AUC (area under the curve) method with a residence time of 50 days and a survey efficiency of 0.55 was 138 steelhead (Figure 2).

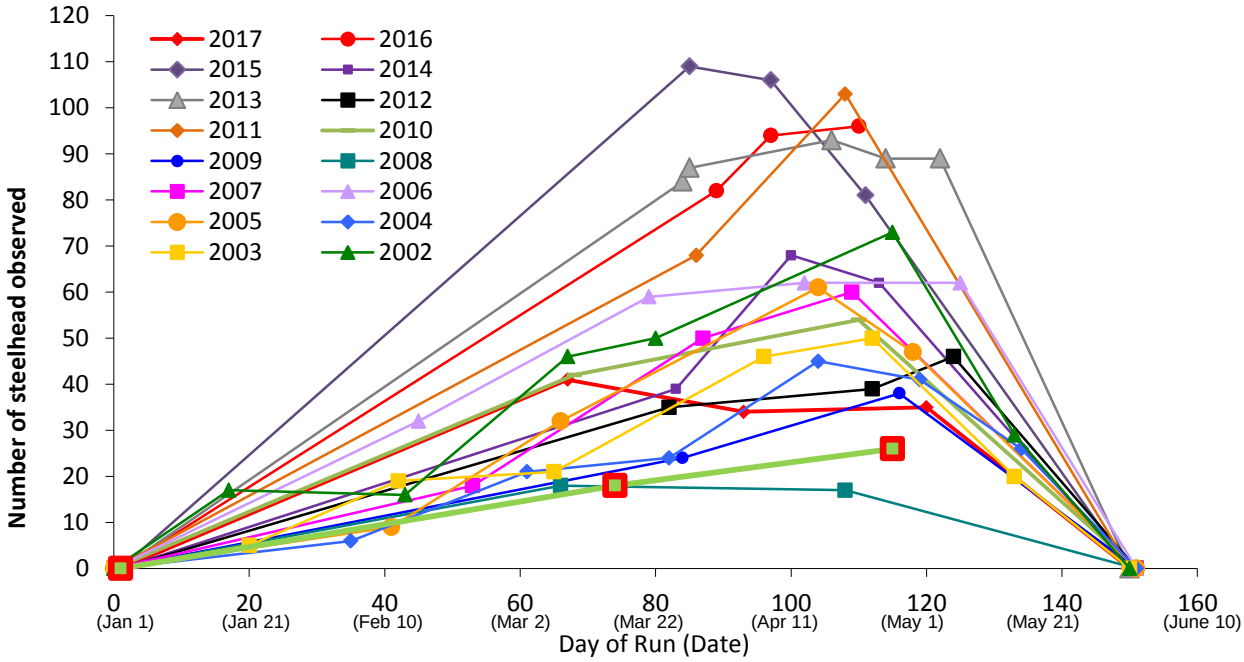

Figure 1. Uncalibrated steelhead abundance in the 15 km index of the Englishman River within intensively studies years from 2002 - 2018

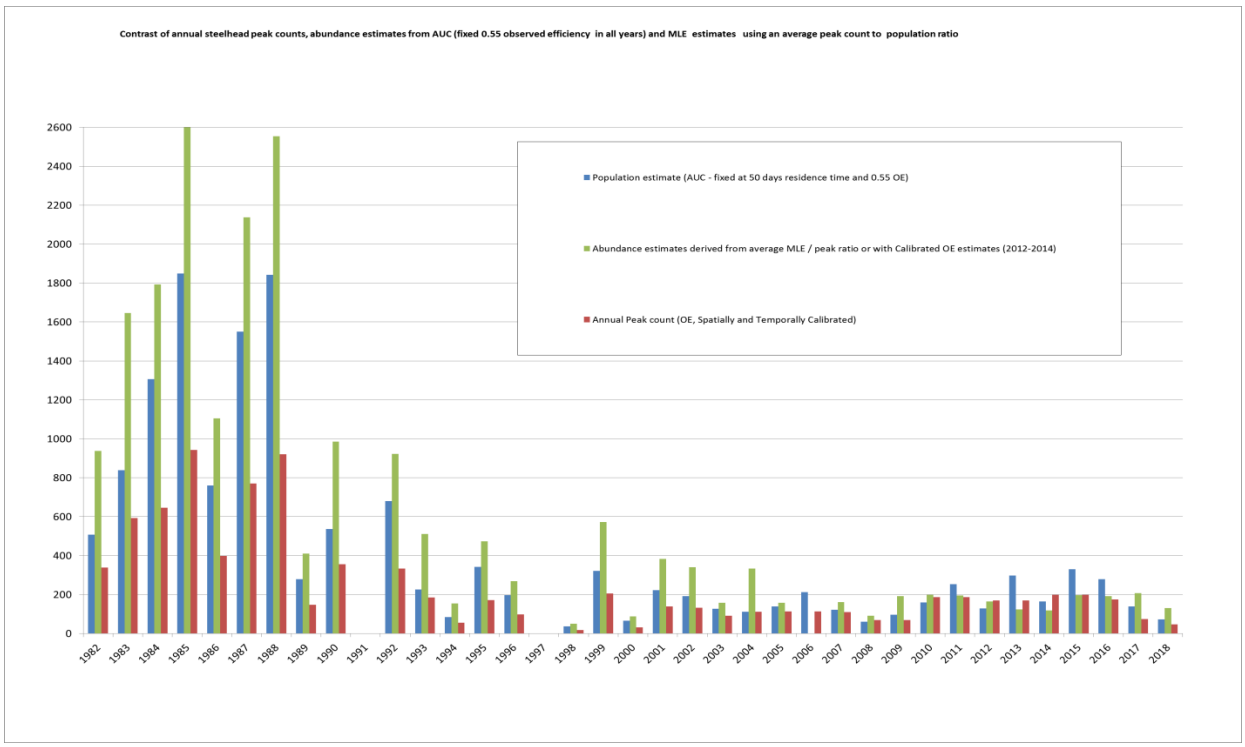

Figure 2. Estimates of steelhead abundance derived from AUC and Maximum Likelihood Estimation (MLE) models and calibrated annual peak counts (observer efficiency calibrated at 0.55).

2018 surveys occurred on March 16th and April 20th and April 26th, yielding 18, 16 and 26 steelhead respectively. The April 20th survey was censored for AUC calculations as it was completed during suboptimal conditions. The uncalibrated peak density in 2018 was 1.7 fish/km. The resultant population estimate using an AUC method with a residence time of 50 days and a survey efficiency of 0.55 was 72 steelhead (Figure 2). These population estimates reflect a reduced marine productivity period observed broadly throughout the Region. This level of abundance places the Englishman River in the Extreme Conservation Concern Zone based on both absolute population size and our understanding of this stock.

Gordon River

On September 25, 2017, a snorkel survey of the Gordon River was conducted. The Gordon River has been surveyed annually since 1998. Fall survey timing assumes that few additional fish will be arriving and that survey conditions are ideal. This is an index of abundance and has historically covered the preferred habitat typically occupied by the majority of this population.

The 7.0 km index was surveyed in two 3.5 km reaches. A total of 293 wild summer steelhead were observed for a density of 41.9 fish/km (Figure 3).

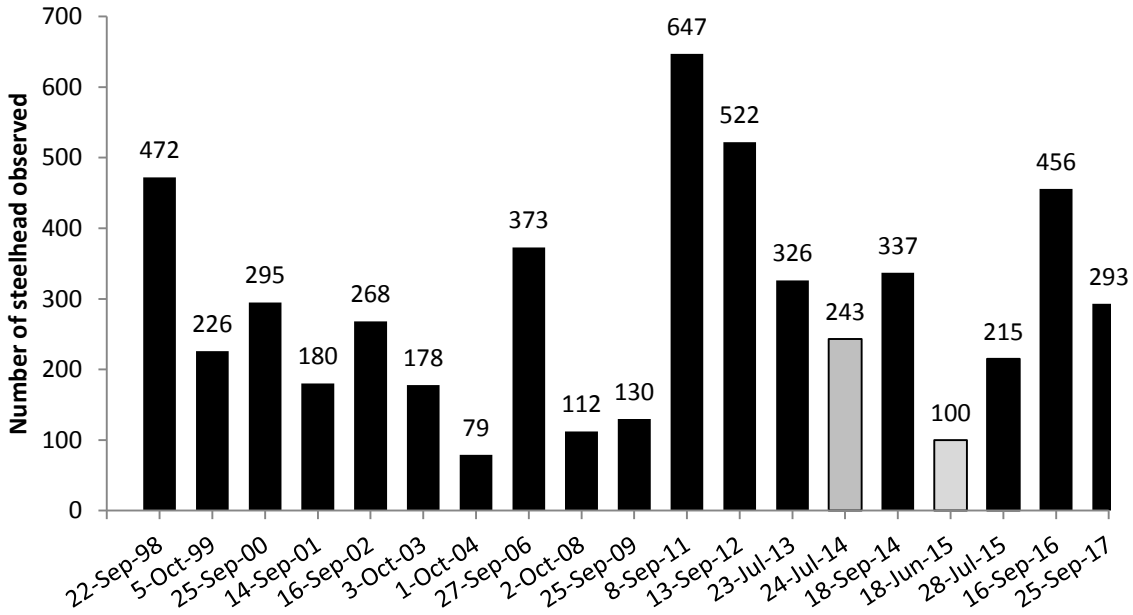

Figure 3. Steelhead abundance in the standard index section of the Gordon River between the TR3 Bridge and Buggaboo Creek confluence. Shaded bars represent reduced confidence surveys.

Heber River

The 43rd annual summer-run steelhead snorkel survey was conducted on August 23, 2017. The Heber River steelhead count is used as an indicator for wild, West Coast summer-run steelhead stocks. The physical characteristics of the watershed allow for a whole stream survey with high assumed precision. The 8.5 km index was split into two reaches starting at the anadromous barrier above and ending at the lower bridge near the Gold River confluence. Flows were extremely low and surveyors were required to walk large sections. Effective visibility was greater than 10 m allowing for a thorough inspection of all pools.

A total of 145 adult steelhead were observed for a density of 17 fish/km. Fish were distributed uniformly between the upper and lower sections, with 74 adult steelhead observed in the upper section (including Road Pool) and 71 adult steelhead observed in the lower section. This year's count is well below the 43 year average of 255 and represents a lower quartile result (Figure 4).

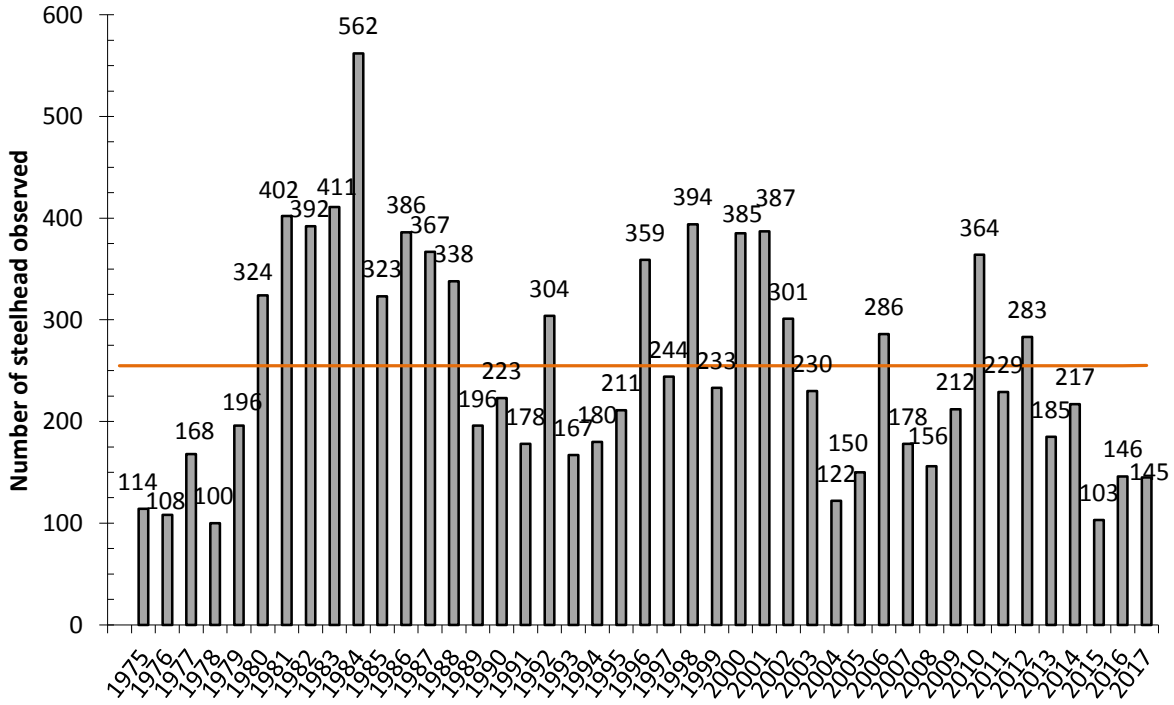

Figure 4. Steelhead abundance in the comprehensive survey of the Heber River between 1975 and 2017.

Tsitika River

Summer-run steelhead have been enumerated in the Tsitika River for 42 consecutive years starting in 1976. The Tsitika River, located on Northeast Vancouver Island, contains the largest population of East Coast summer-run steelhead. The 9.2 km index was split into two separate sections from 'Fannin's Fan' to 'Debris Torrented Tributary' (3.2 Km) and 'Slide Hole' to 'Catherine Creek' (4.4 km). The trail out from the Water Survey Canada (WSC) station has become too overgrown resulting in a reduction of the index length to 7.6 km from 9.2 km.

On August 22, 2017, 141 steelhead were observed over the 7.6 km index for a density of 17.2 fish/km. Distribution of adult steelhead was restricted almost exclusively to deep bedrock controlled pools in both sections, and no steelhead were observed within the lower 2.5 km of the lower section. A total of 930 summer run Coho were enumerated during the survey, with the majority located with steelhead in bedrock controlled holding pools. Additionally, 3 Cutthroat Trout, 5 resident Rainbow Trout, 8 Dolly Varden Char and 1 Chinook salmon were observed. This year's count ranks 27th overall (near lower quartile) and is below the long-term average of 188 (Figure 5).

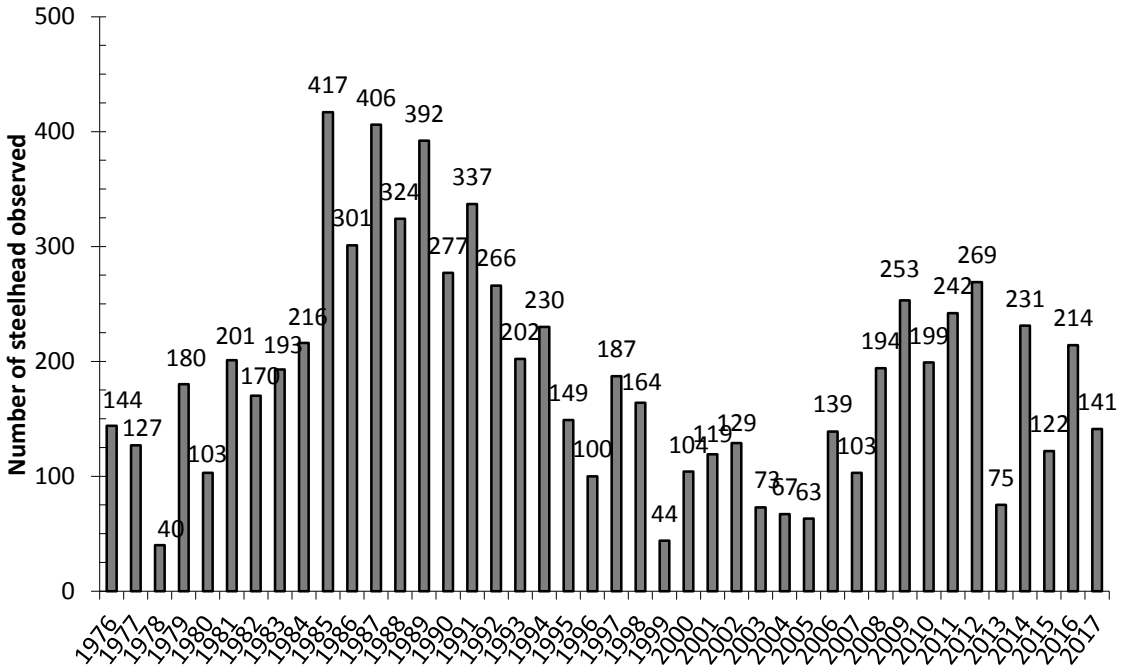

Figure 5. Steelhead abundance in the Tsitika River standard 7.6 km index from 1975 to 2017.

Gold River

The Gold River originates in the Sutton Mountain Range and flows 50 km south-southwest until it discharges into the Muchalat Inlet. The Gold River is comprised of multiple tributaries and small lakes which drain an area of 1010 km^2. The Gold River has historically contained the largest overall catch and highest CPUE of any large steelhead stream on Vancouver Island.

The survey index section is 8.1 km in length and is broken into two non-consecutive survey sections from the #1 bridge (main bridge in the town of Gold River) down to the Lion's Campsite and then from the 'Circus Pool' (top of the Lower Canyon) to the Ucona River confluence. During the winter 2018 surveys on February 21st and March 19th, only two and three winter-run steelhead were observed in the 8.1 km index survey reach, for a density of 0.25 and 0.37 fish/km, respectively. These survey results represent a startling decline from the historical yearly peak average fish density of 46.4 fish/km but comparable to 2017's peak count of one adult steelhead (Figure 5).

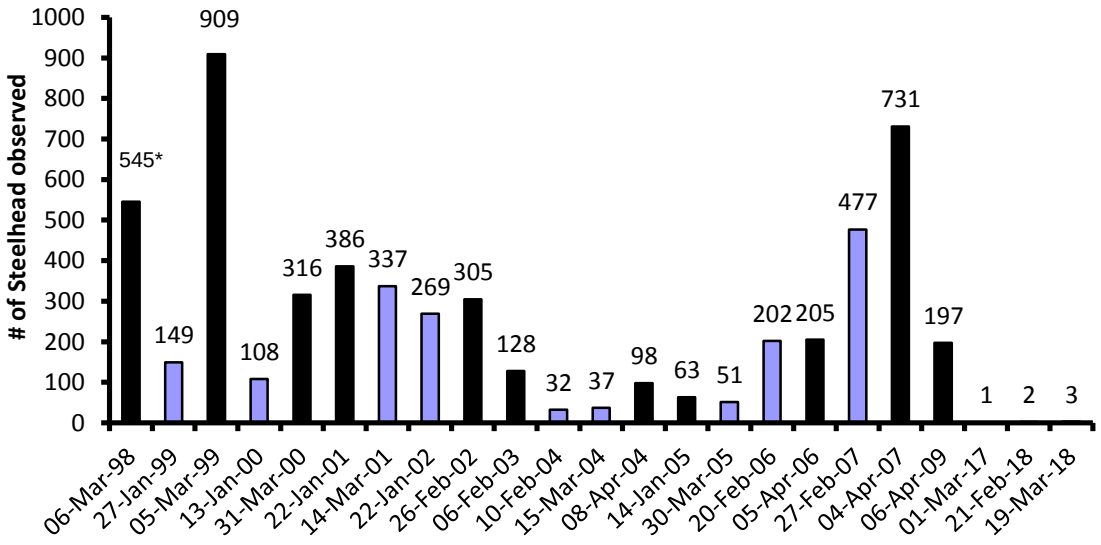

Figure 5. Summary of the Gold River adult steelhead surveys for the 8.1 km index sections. Black bars indicate season peak counts only. Reach 1: from Bridge #1 to Lions Campsite and Reach 2: from Circus Pool to the Ucona confluence, 1998 - 2018. (*Denotes survey completed over 6 km)

CHAPTER 2: ELECTROFISHING DEPLETION ESTIMATES

Methods

Cowichan River

Table 1. Electrofishing site names and locations by river km, Cowichan River, 1998-2017.

Site #	Site Description	Site Reference (km)
1	DFO Counting Fence	6.0
2	Vimy Boat Launch	13.9
3	200m d/s Bible Camp/Sandy Pool	21.8
4	400m u/s Rip-rap corner	25.8
5	150m u/s Stoltz launch	26.7
6	50m d/s Horseshoe Bend	32.3
7	750m u/s Skutz Falls	33.7
8	Block 51 Log Jam/3 firs (d/s 100m)	38.7
9	100m u/s 70.2 Mile Trestle	40.0
10	Saysell's Riffle	45.0

Ten standardized steelhead fry electrofishing sites were surveyed between August 31st and October 3rd, on the Cowichan River (Table 1). Historically, electrofishing on the Cowichan River has been conducted during late-August to mid-September with flow measurements in Duncan, BC (as per WSC) ranging between 2.4 and 5.2 m^3/s.

This year's density of 74 fry/100m^2 in preferred habitats is below the five year average of 145.6 FPU and slightly above the 1999-2005 average of 59 FPU. Of the ten sites surveyed in 2017, sites 6, 7, and 9 (middle to upper reaches) contained the highest density of steelhead fry (Figure 1, Figure 2).

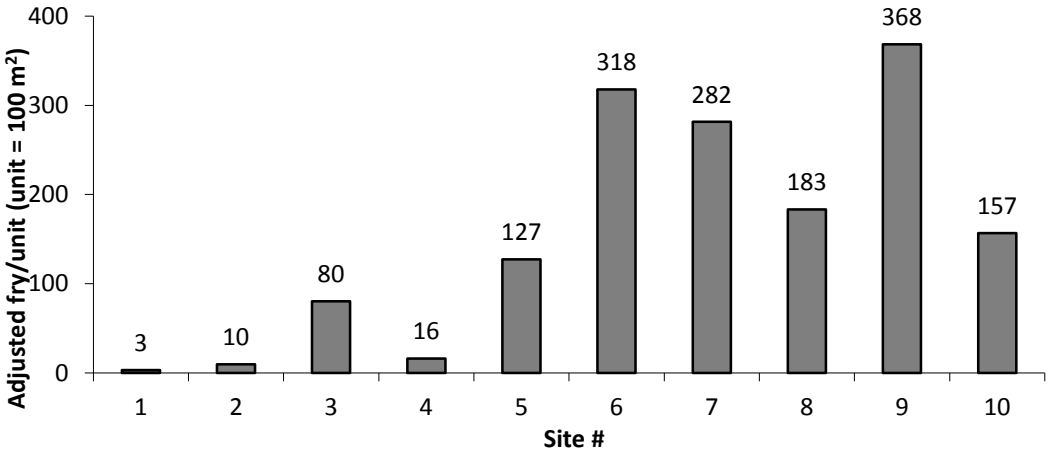

Figure 1. Steelhead fry density in 10 sites on the Cowichan River in 2017

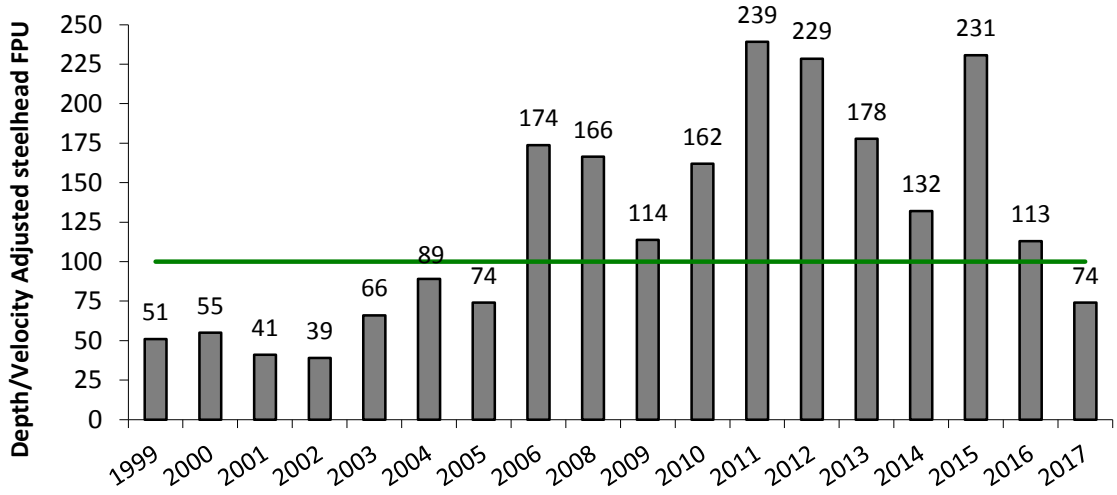

Figure 2. Summary of geometric mean depth/velocity adjusted steelhead fry densities in the Cowichan River, 1999-2017. The horizontal line (green) represents the target FPU for the Cowichan River.

See Appendix A for site photos and Appendix B for historic data.

An Allen Plot was completed for all species and age classes captured in each site (Figure 3). The nominal line is generated by an alkalinity model that predicts a maximum capacity of 1000 g/unit per species and age class. Points closer to the line represent sites that are closer to the modelled capacity. Steelhead fry biomass did not appear to be near predicted maximal values at any sites. Steelhead parr biomass varied throughout all sites, but all sites (with parr present) were found to be well below the predicted capacity. Coho Salmon fry biomass has increased from the historical low found in the

2016 estimate. Two-year-old (2+) Rainbow and Cutthroat Trout parr were absent from catches. It is important to note that fry habitat was targeted at each site and representative Rainbow/Cutthroat Trout parr and Coho fry habitat was not sampled in most cases.

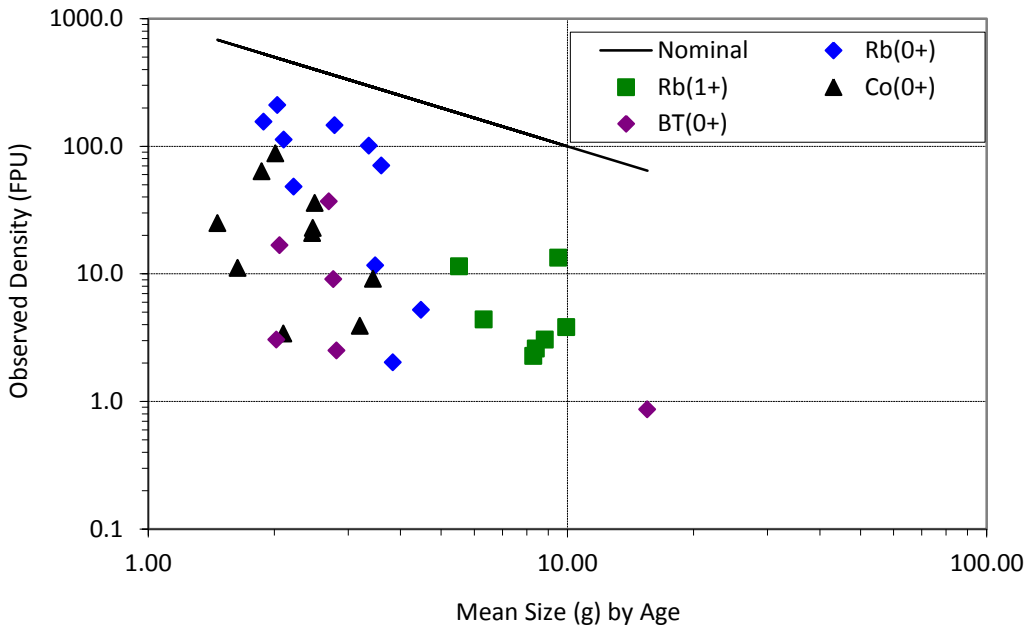

Figure 3. Allen plot of local fish density (unadjusted) versus size for discrete habitats electrofished (10 sites) in the Cowichan River (2017). Predicted biomass per age is 1000 g/100 m^2.

Englishman River

Eight standardized steelhead fry electrofishing sites were surveyed between September 20th and 21st, 2017 (Table 2).

Table 2. Electrofishing site names and locations by river km, Englishman River, 1998-2017. Sites on the South Fork and Allsbrook canyon have been discontinued.

Site #	Site Description	Site Reference (km)
1	50 m d/s of Hwy 19A bridge	1.26
2	Martindale Road	2.11
3	Allsbrook Canyon	4.65
4	Grassy Bank	5.57
5	Powerlines	6.85
6	South Fork	8.87
7	Side Channel Intake	8.72
8	End of Englishman River Road	9.84

Mean adjusted steelhead fry abundance estimates continue to be low and consistent with estimates of adult abundance. The 2017 result of 25 FPU is ranked 6th out of 15 years, and slightly below the 2017 value of 28 FPU.

Fry density was highest in 'site 8' at the top of the anadromous reach (Figure 4). Allen plot data suggest fry density at all sites was less than the estimated capacity of 202.1 g (Figure 5). Although, biomass increased from 2016 estimates, for all age classes of steelhead parr. See Appendix A for site photos and Appendix B for historic data.

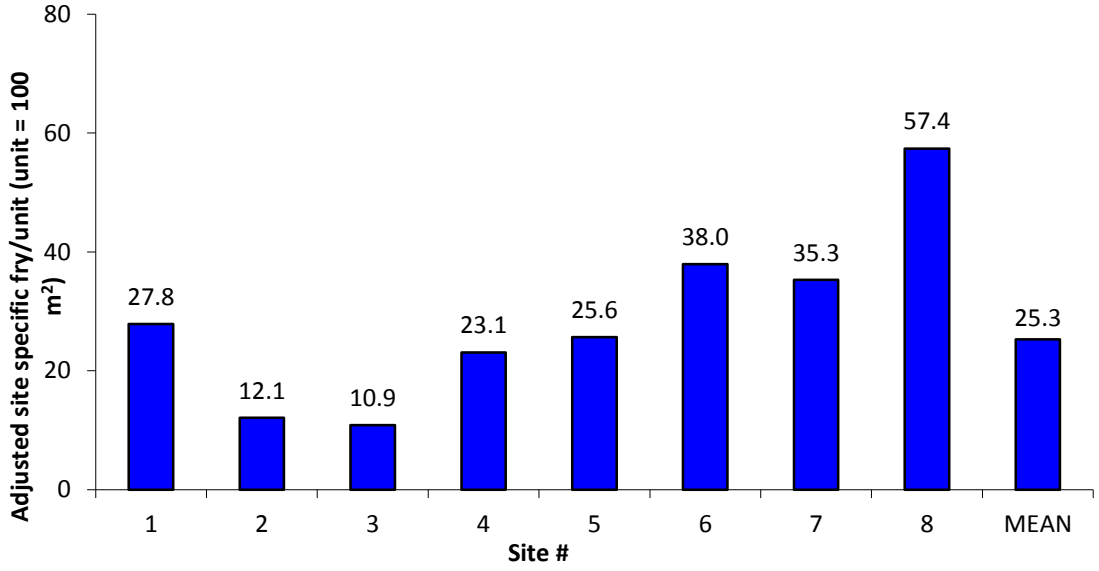

Figure 4. Site specific depth/velocity adjusted steelhead fry abundance at electrofishing on the Englishman River. Geomean = 28.0 FPU, 2017

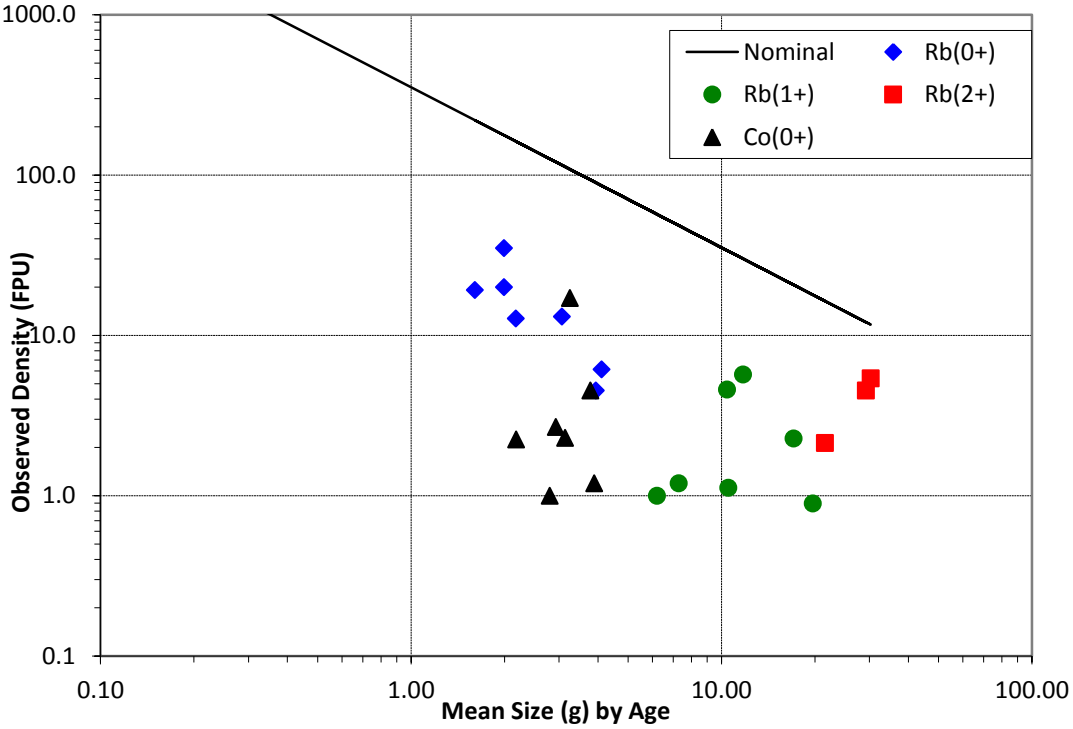

Figure 5. Allen plot of 2017 Englishman River electrofishing results across 8 sites and 2 species; unadjusted densities are displayed relative to a capacity of 202.1 g/100 m^2.

A relationship between spring adult counts and early fall fry estimates is shown in Figure 6.

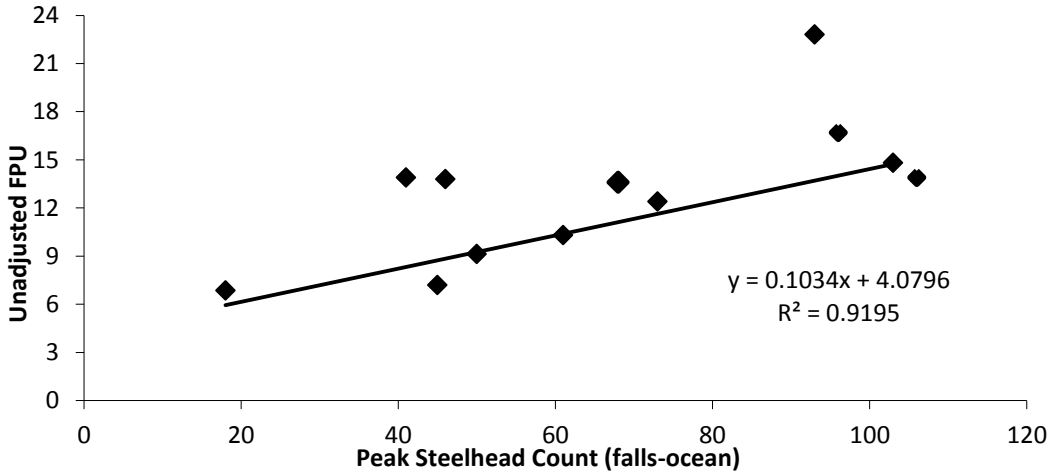

Figure 6. Unadjusted steelhead fall fry density in the Englishman River relative to the adult steelhead peak count (15 km index) 2002-2017.

Gold River

Five standardized steelhead fry electrofishing sites were completed on the Gold River on September 18th and 19th, 2017 (Table 3). Only one past year of standardized data has been collected on the Gold River with two sites completed in 1990.

Table 3. Electrofishing site names and locations by river km, Gold River, 2017.

Site #	Site Description	Site Reference (km)
1	Big Bend	12.5
2	Town Bridge	15.3
3	Bridge 2	19.1
4	High Angler Trail	23.1
5	Muchalat Bridge	25.6

The September 2017 electrofishing revealed larger fry (4.4 g) compared to historic observations from the 1990 electrofishing dataset (1.25 and 2.94 g per site). This may be a result of earlier emergence in 2017 but may also be related to density dependence with a much lower density observed in 2017 (10 FPU) relative to the 1990 assessment (75 FPU). The average of 10 FPU is about 13% of value noted in 1990 (Figure 8).

Yearling parr in 1990 averaged 21.7 g with a maximum density of 15.2 FPU. The at-capacity estimate for fry abundance in the control reach of the Gold River in 1990, assuming a mean fry size of 1.25 g, was 184 FPU given that Gold River alkalinity is approximately 20.5 mg/L with a suggested capacity of 230 g/100m^2 per age (R. Ptolemy pers com).

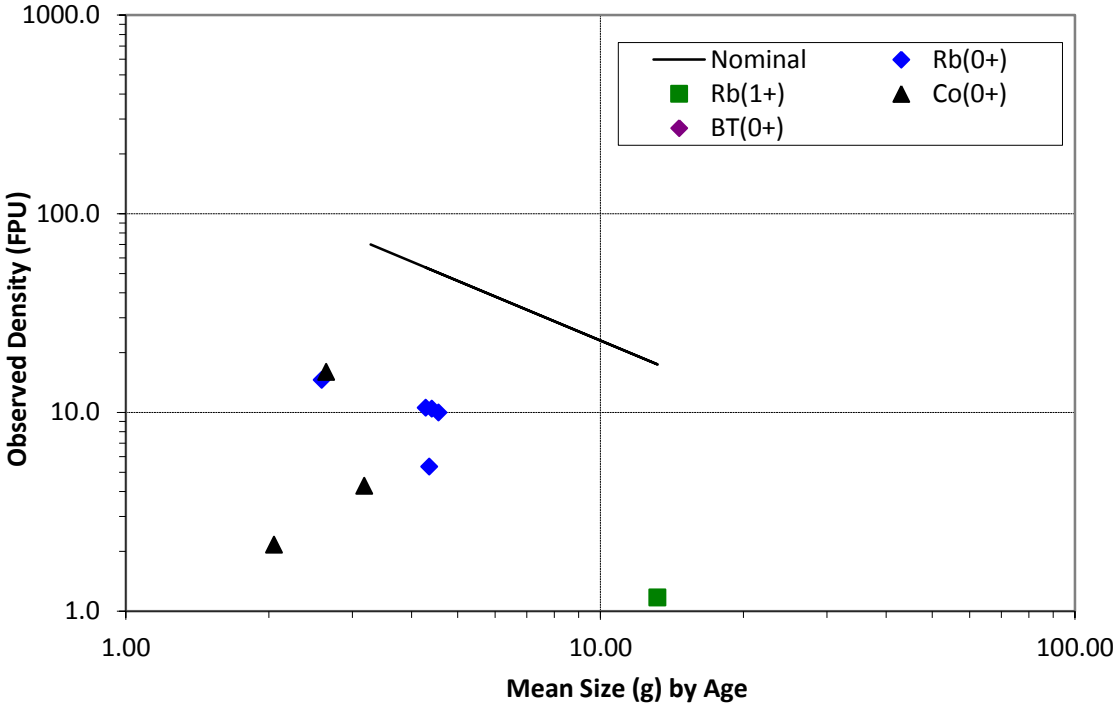

Figure 8. Allen plot of 2017 Gold River electrofishing results across 5 sites; unadjusted densities are displayed relative to a capacity of 230 g/100m^2.

Acknowledgements

The author acknowledges the contributions from the FFSBC with additional partnership funding provided by the Province of BC and the Living Rivers- Georgia Basin/Vancouver Island.

The efforts of BCCF crewmembers who participated in snorkel surveys and electrofishing are greatly appreciated and include: Jamieson Atkinson, Sandy Foxall, Jeramy Damborg, James Craig, Pete Law, Gary Horncastle, Jennifer Sibbald, Isaac Anderton, and Wayne Page Jr.

PHOTOS: Electrofishing Depletion Estimates

Cowichan River

1. Electrofishing site #1 – Silver Bridge

2. Electrofishing site #2 – Vimy Road

3. Electrofishing site #3 – Sandy Pool

4. Electrofishing site #4 – Rip-rap corner

5. Electrofishing site #5 - Stoltz

6. Electrofishing site #6- Horseshoe Bend

7. Electrofishing site #7 – Skutz Falls

8. Electrofishing site #8 – Three Firs

9. Electrofishing site #9 – 70.2 Trestle

10.Electrofishing site #10 – Saysell's Riffle

Englishman River

11. Electrofishing site #1 – Hwy 19 A Bridge

12. Electrofishing site #2 – Martindale Road

13. Electrofishing site #4 – Grassy Bank

14. Electrofishing site #5 – Powerlines

15. Electrofishing site #7 – Side Channel Intake

16. Electrofishing site #8- Englishman River Rd.

17. Electrofishing site #9 – Englishman River Falls

18. Electrofishing site #10 – Steelhead Place

Gold River

19. Electrofishing site #1 – Golf Course

20. Electrofishing site #2 – Bridge #1 (In Town)

21. Electrofishing site #3 – High Anglers Trail

22. Electrofishing site #4 – Bridge #2

23. Electrofishing site #7 – Muchalat Bridge

Historic Electrofishing Data

Englishman River

1998

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	1.36	2.4	5.00	148.6	3%
2	1.08	17.5	67.40	187.1	36%
3	0.7	7.2	9.50	288.7	3%
4	1.43	11.6	15.70	141.3	11%
5	0.71	27.2	85.10	284.7	30%
6	0.95	12.4	12.40	212.7	6%
7	1.19	8.5	9.30	169.8	5%
8	0.65	25.4	33.00	310.9	11%
9	0.53	57.9	75.20	381.3	20%
MEAN	**0.96**	**13.5**	**22.03 ***		**14%**

1999

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	0.51	6.1	12.30	396.3	3%
2	1.08	12.1	37.80	187.1	20%
3	0.37	46.0	68.70	546.2	13%
4	0.72	32.8	45.60	280.7	16%
5	0.66	30.5	41.20	306.2	13%
6	0.97	28.7	31.60	208.4	15%
7	0.92	17.2	19.50	219.7	9%
8	0.56	59.3	59.30	360.9	16%
9	0.59	60.8	96.40	342.6	28%
MEAN	**0.71**	**26.3**	**39.05 ***		**15%**

2000

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.61	12.0	37.09	77.4	48%
2	1.43	9.8	15.83	141.5	11%
3	1.60	1.3	1.65	126.3	1%
4	1.86	8.7	10.48	108.5	10%
5	1.50	5.7	7.81	135.1	6%
6	1.06	9.6	11.08	190.3	6%
7	0.59	2.6	3.93	341.3	1%
8	0.92	10.2	13.52	219.0	6%
9	1.14	44.1	122.11	177.2	69%
MEAN	**1.41**	**7.6**	**12.13 ***		**18%**

2001

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.54	8.4	21.27	79.5	27%
2	2.21	7.2	10.83	91.6	12%
3	1.12	7.9	15.89	181.0	9%
4	1.03	18.0	25.58	195.7	13%
5	1.20	22.0	30.89	168.2	18%
6	1.15	6.9	11.50	175.2	7%
7	1.39	7.7	8.68	145.7	6%
8	1.75	10.7	21.22	115.4	18%
9	1.07	36.7	86.17	188.6	46%
MEAN	**1.50**	**11.6**	**20.07***		**17%**

2002

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	1.75	13.5	21.24	115.8	18%
2	1.58	16.3	24.09	127.9	19%
3	2.80	2.6	5.46	72.2	8%
4	1.82	5.7	10.49	110.8	9%
5	1.28	28.6	39.21	158.4	25%
6	1.37	28.0	50.26	148.0	34%
7	1.18	14.8	21.13	171.0	12%
8	1.62	5.0	11.14	124.4	9%
9	0.79	36.2	51.05	257.1	20%
MEAN	**1.58**	**12.4**	**20.67***		**17%**

2003

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.1	10.6	22.6	65.5	34.5%
2	2.7	12.5	14.0	74.9	18.7%
3	2.1	7.2	10.8	95.7	11.2%
4	2.6	2.2	4.5	77.3	5.9%
5	2.2	6.9	10.5	93.4	11.3%
6	2.3	18.0	30.6	86.5	35.3%
7	1.3	10.2	12.1	152.9	7.9%
8	1.5	8.4	13.6	133.5	10.2%
9	1.7	19.7	35.8	119.3	30.0%
MEAN	**2.2**	**9.1**	**14.54***		**18.3%**

2004

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.92	25.27	49.36	44.1	112%
2	1.72	9.00	12.26	117.3	10%
3	1.44	5.68	7.26	140.0	5%
4	2.07	17.18	50.55	97.7	52%
5	2.21	3.94	5.80	91.6	6%
6	1.31	7.25	16.51	154.6	11%
7	1.87	3.78	4.07	108.3	4%
8	1.40	1.05	1.54	144.4	1%
9	1.27	20.39	38.60	158.7	24%
MEAN	**1.91**	**7.2**	**11.99***		**25%**

2005

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.04	12.97	18.16	66.4	27%
2	3.32	4.15	4.61	60.9	8%
3	2.08	5.92	9.85	97.4	10%
4	3.72	6.50	7.91	54.4	15%
5	2.49	8.48	18.90	81.1	23%
6	2.26	16.53	28.17	89.4	32%
7	2.77	16.67	25.29	73.0	35%
8	2.21	9.31	11.81	91.6	13%
9	1.43	28.94	44.58	141.2	32%
MEAN	**2.59**	**10.3**	**15.31***		**21%**

2006

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	1.26	25.41	55.59	160.0	35%
2	2.17	7.92	11.52	93.0	12%
3	2.44	5.97	11.07	82.7	13%
4	1.93	17.41	41.91	104.5	40%
5	1.38	17.75	30.49	146.0	21%
6	1.39	45.89	136.74	145.3	94%
7	2.03	11.56	17.96	99.5	18%
8	2.09	15.00	22.94	96.7	24%
9	1.31	57.58	99.69	154.5	65%
MEAN	**1.78**	**17.7**	**33.34***		**36%**

2008

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.18	7.94	31.81	63.5	50%
4	2.70	1.14	1.40	74.9	2%
5	1.15	19.89	30.92	175.7	18%
7	1.92	9.46	12.74	105.1	12%
8	1.34	3.11	5.08	151.0	3%
9	1.51	19.47	42.14	134.1	31%
MEAN	**1.97**	**6.8**	**11.5**		**19%**

2011

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	1.27	12.13	23.12	159.1	15%
2	0.99	17.11	27.80	203.8	14%
3	1.91	2.74	3.82	105.8	4%
4	2.15	23.83	40.80	94.1	43%
5	1.29	32.41	46.15	156.6	29%
6					
7	2.00	6.07	11.19	101.2	11%
8	0.94	13.95	21.35	215.6	10%
9	1.21	62.40	185.57	166.5	111%
MEAN	**1.40**	**14.8**	**25.94**		**30%**

2012

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.36	18.34	28.26	85.7	33%
2	1.22	24.02	32.39	165.1	20%
3	2.71	12.35	15.84	74.6	21%
4	2.87	24.30	40.64	70.5	58%
5	1.80	1.38	2.56	112.3	2%
6					
7	1.28	16.01	23.51	158.2	15%
8	0.93	25.04	48.06	216.4	22%
9	1.43	18.37	43.33	141.6	31%
MEAN	**1.70**	**13.8**	**22.83**		**25%**

2013

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.46	20.31	30.08	82.3	37%
2	1.17	18.37	22.43	172.8	13%
3					
4	4.01	22.58	57.48	50.4	114%
5	2.68	29.04	43.68	75.3	58%
6					
7	1.51	17.57	22.19	133.4	17%
8	1.29	29.87	52.38	156.4	34%
9	1.72	38.21	69.14	117.7	59%
10	1.52	14.70	22.78	132.9	17%
MEAN	**1.94**	**22.8**	**36.4**		**47%**

2014

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	5.80	1.30	1.81	34.8	5%
2	1.49	10.57	16.82	135.8	12%
3					
4	4.85	10.51	12.64	41.7	30%
5	3.64	4.83	6.21	55.5	11%
6					
7	2.51	3.08	3.86	80.4	5%
8	2.75	17.39	29.37	73.4	40%
9	2.29	62.40	87.91	88.2	100%
10	3.98	15.87	50.50	50.8	99%
MEAN	**3.04**	**8.8**	**13.6**		**29%**

2015

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	7.11	3.30	6.02	28.4	21%
2	3.52	21.32	32.41	57.5	56%
3					
4	5.33	19.28	38.92	37.9	103%
5	4.90	38.69	57.55	41.3	139%
6					
7	5.78	7.42	14.00	35.0	40%
8	3.69	13.72	24.66	54.7	45%
9	4.05	26.94	46.35	49.9	93%
10	3.92	9.51	18.50	51.6	36%
MEAN	**4.77**	**13.9**	**24.5**		**71%**

2016

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	5.59	20.35	52.44	36.2	145%
2	3.73	17.59	27.44	54.1	51%
3					
4	5.65	17.57	34.78	35.8	97%
5	4.33	12.05	16.14	46.7	35%
6					
7	2.99	9.74	14.16	67.7	21%
8	2.87	15.15	21.40	70.4	30%
9	2.16	24.86	46.45	93.7	50%
10	1.73	22.25	32.76	116.7	28%
MEAN	**3.70**	**16.7**	**28.0**		**61%**

2017

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	0.10	22.12	27.84	2119.4	1%
2	3.94	4.53	12.07	51.2	24%
3	4.11	6.11	10.86	49.1	22%
4	3.07	13.06	23.10	65.9	35%
5	1.99	19.95	25.64	101.4	25%
6	2.18	12.74	37.95	92.8	41%
7	1.61	19.14	35.27	125.7	28%
8	1.99	34.94	57.39	101.4	57%
MEAN	**1.69**	**13.9**	**25.3**		**29%**

Cowichan River

1999

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	-	-	-	-	-
2	2.91	30.1	41.20	343.6	12%
3	-	-	-	-	-
4	-	-	-	-	-
5	2.71	29.2	49.40	369.0	13%
6	-	-	-	-	-
7	-	-	-	-	-
8	4.65	31.9	55.90	215.1	26%
9	-	-	-	-	-
10	2.62	33.2	57.20	381.7	15%
MEAN	**3.22**	**31.1**	**50.51***		**17%**

2000

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	4.34	9.9	10.73	230.3	5%
2	2.13	20.8	28.55	470.3	6%
3	3.79	43.6	71.92	264.1	27%
4	4.52	53.1	85.27	221.4	39%
5	2.28	8.9	10.85	439.3	2%
6	2.97	59.8	101.47	337.1	30%
7	3.17	85.2	128.47	315.7	41%
8	3.57	43.4	57.36	280.4	20%
9	2.20	120.0	216.11	455.3	47%
10	1.88	39.9	71.27	533.1	13%
MEAN	**3.08**	**36.7**	**54.59***		**23%**

2001

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.28	8.9	16.59	438.0	4%
2	1.67	28.6	30.15	599.4	5%
3	3.66	40.2	71.68	273.5	26%
4	3.33	66.5	86.80	300.0	29%
5	2.42	16.2	29.05	413.2	7%
6	4.96	11.0	12.87	201.6	6%
7	3.03	16.4	17.71	330.0	5%
8	2.63	31.3	74.51	379.7	20%
9	1.84	84.5	119.44	544.5	22%
10	2.47	53.3	75.99	405.0	19%
MEAN	**2.83**	**27.9**	**41.15***		**14%**

2002

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.00	1.3	1.59	500.0	0%
2	2.36	41.8	94.74	424.1	22%
3	2.97	46.7	61.73	337.2	18%
4	3.48	78.4	176.90	287.7	61%
5	2.35	80.3	127.69	426.0	30%
6	2.40	76.0	137.67	416.8	33%
7	1.99	95.2	179.84	503.0	36%
8	8.23	2.8	3.72	121.6	3%
9	3.97	3.6	5.14	251.6	2%
10	2.43	43.6	76.11	412.0	18%
MEAN	**3.22**	**23.4**	**38.72***		**22%**

2003

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.98	15.4	17.19	335.5	5%
2	4.08	32.9	58.42	245.1	24%
3	-	-	-		
4	-	-	-		
5	3.89	43.1	59.63	257.2	23%
6	3.39	44.0	62.70	294.6	21%
7	3.68	79.3	128.21	271.7	47%
8	3.08	107.2	204.70	324.3	63%
9	2.64	72.7	86.84	379.1	23%
10	1.35	48.5	55.31	739.2	7%
MEAN	**3.14**	**48.1**	**65.66***		**27%**

2004

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.30	26.6	33.68	435.6	8%
2	2.17	83.2	142.97	460.1	31%
3	2.11	32.9	50.13	474.2	11%
4	2.50	48.9	62.87	399.7	16%
5	3.41	37.2	89.33	292.9	30%
6	2.82	91.6	244.76	354.3	69%
7	2.60	59.2	94.52	383.9	25%
8	3.07	38.3	79.66	325.7	24%
9	2.38	129.8	192.36	420.1	46%
10	2.30	54.4	65.42	434.6	15%
MEAN	**2.57**	**53.6**	**89.07***		**27%**

2005

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.07	11.4	26.21	325.5	8%
2	2.83	53.4	107.20	353.2	30%
3	2.28	40.8	53.62	439.4	12%
4	3.51	30.1	59.79	284.9	21%
5	3.25	21.5	47.02	307.8	15%
6	4.99	57.9	180.67	200.6	90%
7	2.71	31.0	48.15	369.3	13%
8	4.02	40.3	86.07	248.7	35%
9	3.44	60.2	133.45	290.5	46%
10	4.05	74.3	113.05	246.8	46%
MEAN	**3.41**	**37.3**	**73.79***		**32%**

2006

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.01	20.4	32.89	332.8	10%
2	2.00	94.0	397.14	499.3	80%
3	2.46	101.9	234.94	406.3	58%
4	1.73	124.3	199.03	578.6	34%
5	2.13	122.0	265.35	469.0	57%
6	3.23	120.8	225.12	309.8	73%
7	2.66	114.9	132.23	375.4	35%
8	3.56	51.9	147.66	280.6	53%
9	3.50	274.6	407.49	286.0	142%
10	1.80	50.1	86.41	554.3	16%
MEAN	**2.5**	**88.5**	**173.8**		**56%**

2008

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1					
2	3.53	26.8	71.87	283.4	25%
3	2.80	135.1	377.13	357.0	106%
4					
5	4.24	28.7	89.43	236.1	38%
6	2.07	121.4	181.62	482.0	38%
7	2.45	79.0	196.14	407.6	48%
8					
9	3.89	122.4	291.81	257.1	114%
10	1.98	37.0	140.08	505.3	28%
MEAN	**2.9**	**64.2**	**166.4**		**57%**

2009

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.04	5.4	11.66	329.4	4%
2	2.20	54.3	136.41	454.3	30%
3	1.56	139.1	209.45	639.8	33%
4	2.94	72.1	130.23	340.6	38%
5	2.98	95.2	129.10	335.5	38%
6	2.50	128.0	193.41	400.3	48%
7	2.02	112.5	249.42	494.2	50%
8	3.98	49.5	105.35	251.5	42%
9	2.42	73.9	92.74	412.5	22%
10	3.16	86.1	138.70	316.8	44%
MEAN	**2.6**	**64.6**	**113.9**		**35%**

2010

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.32	31.1	67.08	430.5	16%
2	2.79	42.8	168.27	357.8	47%
3	2.01	72.0	155.96	498.4	31%
4	4.12	59.4	114.73	242.8	47%
5	3.42	39.8	90.39	292.5	31%
6	3.01	159.1	291.29	331.7	88%
7	2.16	156.4	328.63	464.0	71%
8	4.95	131.7	190.47	202.1	94%
9	2.70	183.7	388.34	370.3	105%
10	1.25	48.7	96.49	799.7	12%
MEAN	**2.7**	**76.3**	**162.0**		**54%**

2011

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.36	15.0	19.75	422.8	5%
2	1.39	65.5	112.66	717.7	16%
3	1.37	165.3	253.54	728.6	35%
4	2.21	102.0	213.64	451.7	47%
5	1.37	306.2	591.51	728.5	81%
6	1.91	153.7	298.03	522.2	57%
7	1.67	272.8	596.51	598.8	100%
8	2.29	308.0	513.26	437.0	117%
9	1.99	345.3	727.81	503.4	145%
10	1.74	63.3	129.58	573.6	23%
MEAN	**1.8**	**130.5**	**239.2**		**62%**

2012

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.11	4.6	6.71	321.4	2%
2	2.71	102.8	219.48	369.7	59%
3	1.34	210.6	516.43	744.5	69%
4	1.98	111.9	223.86	504.8	44%
5	1.68	185.1	453.92	596.3	76%
6	2.53	141.9	299.06	395.1	76%
7	2.18	187.8	470.43	459.7	102%
8	1.75	262.3	378.01	572.1	66%
9	1.94	259.0	401.42	514.2	78%
10	1.94	159.6	308.11	514.2	60%
MEAN	**2.1**	**119.4**	**228.5**		**63%**

2013

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	2.28	6.0	6.77	439.2	2%
2	1.33	126.4	204.40	750.2	27%
3	1.01	296.1	402.13	990.0	41%
4	1.99	56.5	74.93	502.6	15%
5	1.38	188.2	325.94	725.4	45%
6	1.92	153.4	269.07	522.1	52%
7	1.11	346.1	510.29	898.1	57%
8	1.37	318.6	554.84	730.0	76%
9	1.78	226.5	332.82	561.0	59%
10	1.37	49.7	91.54	729.9	13%
MEAN	**1.5**	**116.3**	**177.8**		**39%**

2014

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	N/A	N/A	N/A	N/A	N/A
2	3.85	40.7	62.81	259.8	24%
3	2.18	116.8	144.47	459.2	31%
4	5.83	22.8	42.14	171.5	25%
5	3.36	94.1	170.01	297.5	57%
6	3.08	122.0	326.12	324.9	100%
7	2.77	105.2	166.05	360.7	46%
8	2.50	263.5	367.05	400.4	92%
9	2.65	147.8	249.92	377.8	66%
10	2.58	21.7	37.74	387.1	10%
MEAN	**3.1**	**78.3**	**132.0**		**50%**

2015

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	N/A	N/A	N/A	N/A	N/A
2	3.43	90.7	244.30	291.4	84%
3	2.68	138.5	239.69	372.8	64%
4	3.36	72.8	108.26	298.1	36%
5	2.35	200.6	348.80	425.2	82%
6	2.06	165.7	326.17	484.7	67%
7	2.54	140.9	243.97	394.0	62%
8	3.04	262.0	343.34	328.5	105%
9	3.17	135.2	240.18	315.3	76%
10	2.45	65.9	127.69	408.6	31%
MEAN	**2.7**	**129.2**	**230.7**		**68%**

2016

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	7.62	6.1	11.48	131.3	9%
2	5.79	45.0	70.46	172.6	41%
3	3.27	56.0	70.78	305.9	23%
4	8.03	27.4	32.84	124.5	26%
5	6.40	34.4	86.14	156.3	55%
6	4.13	152.8	268.61	242.0	111%
7	4.82	145.9	320.22	207.6	154%
8	4.18	217.6	495.04	239.2	207%
9	3.68	150.6	247.64	271.8	91%
10	2.99	103.3	203.65	334.8	61%
MEAN	**4.8**	**63.6**	**113.3**		**78%**

2017

Site #	Mean Weight (grams)	Unadj'd FPU	D/V Adj'd FPU	Predicted FPU	% of Predicted
1	3.84	2.0	3.23	260.6	1%
2	4.48	5.2	9.68	223.4	4%
3	2.23	48.0	80.37	449.3	18%
4	3.48	11.6	16.22	287.3	6%
5	2.99	70.3	127.44	334.7	38%
6	2.79	145.5	317.72	358.7	89%
7	1.88	155.5	281.62	530.7	53%
8	3.36	100.4	183.39	297.5	62%
9	2.03	209.8	368.35	491.8	75%
10	2.10	112.4	156.72	475.2	33%
MEAN	**2.8**	**43.1**	**74.0**		**38%**