LAKE PEND OREILLE/CLARK FORK RIVER FISHERY RESEARCH AND MONITORING

2004 PROGRESS REPORT

PROJECT 2: 2004 LAKE PEND OREILLE BULL TROUT REDD COUNTS

PROJECT 3: 2004 CLARK FORK RIVER FISHERY ASSESSMENT PROGRESS REPORT

PROJECT 5: 2004 TRESTLE AND TWIN CREEKS BULL TROUT OUTMIGRATION AND LAKE PEND OREILLE SURVIVAL **STUDY PROGRESS REPORT**

PROJECT 6: 2004 JOHNSON AND GRANITE CREEKS BULL TROUT TRAPPING

PROJECT 7: 2004 TWIN CREEK RESTORATION MONITORING PROGRESS REPORT

PROJECT 8: 2004 TRIBUTARY FISH POPULATION MONITORING PROGRESS REPORT

Idaho Tributary Habitat Acquisition **and Enhancement** Program

Prepared by:

Christopher C. **Downs**
Senior Fishery Research Biologist
Idaho Department of Fish and Game

and

Robert Jakubowski
Natural Resources Technician
Avista Corporation

IDFG-05-51

Corp.

Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring Progress Report 2004

PROJECT 2: 2004 LAKE PEND OREILLE BULL TROUT REDD COUNTS

PROJECT 3: 2004 CLARK FORK RIVER FISHERY ASSESSMENT PROGRESS REPORT

PROJECT 5: 2004 TRESTLE AND TWIN CREEKS BULL TROUT OUTMIGRATION AND LAKE PEND OREILLE SURVIVAL STUDY PROGRESS REPORT

PROJECT 6: 2004 JOHNSON AND GRANITE CREEKS BULL TROUT TRAPPING

PROJECT 7: 2004 TWIN CREEK RESTORATION MONITORING PROGRESS REPORT

PROJECT 8: 2004 TRIBUTARY FISH POPULATION MONITORING PROGRESS REPORT

Idaho Tributary Habitat Acquisition and Enhancement Program,
Appendix A

Prepared by:

Christopher C. Downs
Senior Fishery Research Biologist
Idaho Department of Fish and Game
1402 E. Spring Creek Rd.
Clark Fork, Idaho
83811

Robert Jakubowski
Natural Resources Technician
Avista Corporation
Noxon, MT

Report to:

Avista Corporation
Natural Resources Field Office
P.O. Box 1469
Noxon, MT 59853

December 2005

006@0C Q@0000000•OGOOO 00een

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS — <u>Continued</u>

Page

r

TABLE OF CONTENTS – Continued

Page

LIST OF TABLES

TABLE OF CONTENTS — Continued

Page

LIST OF FIGURES

TABLE OF CONTENTS — Continued

Page

TABLE OF CONTEN'T'S <u>Continued</u>

Page

Project 5: 2004 Trestle and Twin Creeks Bull Trout Outmigration and Lake Pend Oreille Survival Study Progress Report

LIST OF TABLES

TABLE OF CONTENTS - Continued

Page

LIST OF FIGURES

"TABLE OF CONTENTS – continued

Page

LIST OF TABLES

TABLE OF CONTENTS - continued

LIST OF FIGURES

FABLE OF CONTENTS — continued

TABLE OF CONTENTS — <u>continued</u>

Page

LIST OF TABLES

Page

TABLE OF CONTENTS — Continued

LIST OF FIGURES

C

C,

(a1

TABLE OF CONTENTS — Continued

TABLE OF **CONTENTS — Continued**

Page

LIST OF TABLES

TABLE OF CONTENTS — Continued

Page

TABLE OF CONTENTS — Continued

LIST OF FIGURES

•

C

C)
0

TABLE OF CONTENTS — Continued

Page

TABLE OF CONTENTS — Continued

Page

C

TABLE OF CONTENTS — Continued

Page

0 0 0 0000OOOOOO ,ꟼ% 0 0 0 0 0 0 0 0

Project 2: 2004 Lake Pend Oreille Bull Trout Redd Counts

ABSTRACT

Bull trout *Salvelinus confluentus* redd counts were conducted in 18 tributaries to Lake Pend Oreille and the Clark Fork River, as well as the Clark Fork River spawning channel in 2004. The Middle Fork East River and Uleda Creek, both tributaries to the lower Priest River, were also surveyed. The total number of redds counted in these areas in 2004 was 754. Six of these tributaries (six index streams; Johnson, E. Fk. Lightning, Trestle, Grouse, N. Gold, and Gold creeks) have been surveyed consistently on an annual basis since 1983, and the 2004 redd count for these six streams combined (462) was lower than the long-term average of 505 redds. A low count of 102 redds in Trestle Creek was the cause of the overall lower redd count totals. We identified two statistically significant correlations in the 2004 redd count data. Statistically significant correlations between year and redd count for Porcupine Creek (tau-b = -0.36; $p = 0.045$) and Gold Creek (tau-b = 0.31; $p = 0.044$), indicate a long-term decline in the Porcupine Creek population, and long-term increases in the Gold Creek populations. While some populations such as Trestle and Gold creeks appear to be healthy and may be at or approaching restoration objectives, others, particularly those in the Lightning Creek drainage, appear to be persisting at very low levels. Most notably, Porcupine Creek, where redd counts as high as 52 were documented in 1984, but have averaged only three since 1992. Assessing and addressing the cause for the bull trout decline in the Porcupine Creek drainage, as well as in other Lightning Creek tributaries, should be among the highest bull trout restoration priorities in the Lake Pend Oreille system. Efforts to improve bull trout habitat in Lightning Creek offer the greatest potential to increase bull trout numbers in the Lake Pend Oreille system.

Authors:

Christopher C. Downs
Senior Fishery Research Biologist
Idaho Department of Fish and Game

Robert Jakubowski
Natural Resources Technician
Avista Corporation

INTRODUCTION

Redd counts, or spawning nest counts, are used across the range of bull trout *Salvelinus confluentus* to monitor population trends. They are typically used as an index of abundance to gauge the relative strength of adult escapement from year to year. They can also be used to estimate actual adult escapement by expanding the redd counts to fish numbers using various spawner to redd ratios. Redd counts require far less effort to conduct than other traditional monitoring methods such as trapping, and yet provide information on bull trout at the watersheds and/or population scale. However, redd counts are not without their limitations, as the technique has been shown to be prone to observer variability (Dunham et at. 2001). Yet they remain an important monitoring tool for bull trout populations.

Redd counts have been conducted annually since 1983 on six tributaries to Lake Pend Oreille (LPO), and intermittently since 1983 on an additional 10 tributaries based on the work of Pratt (1984, 1985). The Idaho Department of Fish and Game (IDFG) added the Clark Fork River spawning channel to the list of sites monitored annually in 1992, as well as Strong and Morris creeks more recently. Additionally, the Middle Fork of the East River and Uleda Creek (Priest River drainage) were found to support migratory bull trout from LPO (DuPont and Horner, in press). Monitoring of bull trout redds began in these two streams in 2001.

METHODS

IDFG hosted a one day redd count training course on Trestle Creek, a tributary to LPO with high densities of bull trout redds, immediately prior to conducting annual redd counts in September 2004. The objective of the training course was to improve the consistency of counts among experienced observers, and train new observers. The training session involved breaking into several teams to conduct replicate counts of redds in a section on Trestle Creek. After all individual groups had finished their counts and made their maps of the redd locations, the group reconvened and together walked the section again to discuss discrepancies in the redd counts.

Following the training session, IDFG with assistance from Avista fishery staff and the U.S. Fish and Wildlife Service (USFWS), conducted redd counts on 18 tributaries to LPO, as well as the Clark Fork River, between October 10 and October 19, 2004 (Figure 1; Table I). Redds were located visually by walking along annual monitoring sections within each tributary. Redds were defined as areas of clean gravels at least 0.3 x 0.6 m in size with gravels of at least 76.2 mm in diameter having been moved by the fish, and with a mound of loose gravel downstream from a depression (Pratt 1984). In areas of superimposition, each distinct depression was counted as a redd.

In addition to monitoring direct tributaries to LPO and the lower Clark Fork River, IDFG and USFWS staff counted redds in the Middle Fork East River system, which is a tributary to the lower Priest River. Recent telemetry studies have shown hull trout using this river system are from I .P0. They migrate downstream out of LPO in the Pend Oreille River to the Priest River, and then migrate upstream to the Middle Fork East River to spawn (DuPont and I lorner, in press).

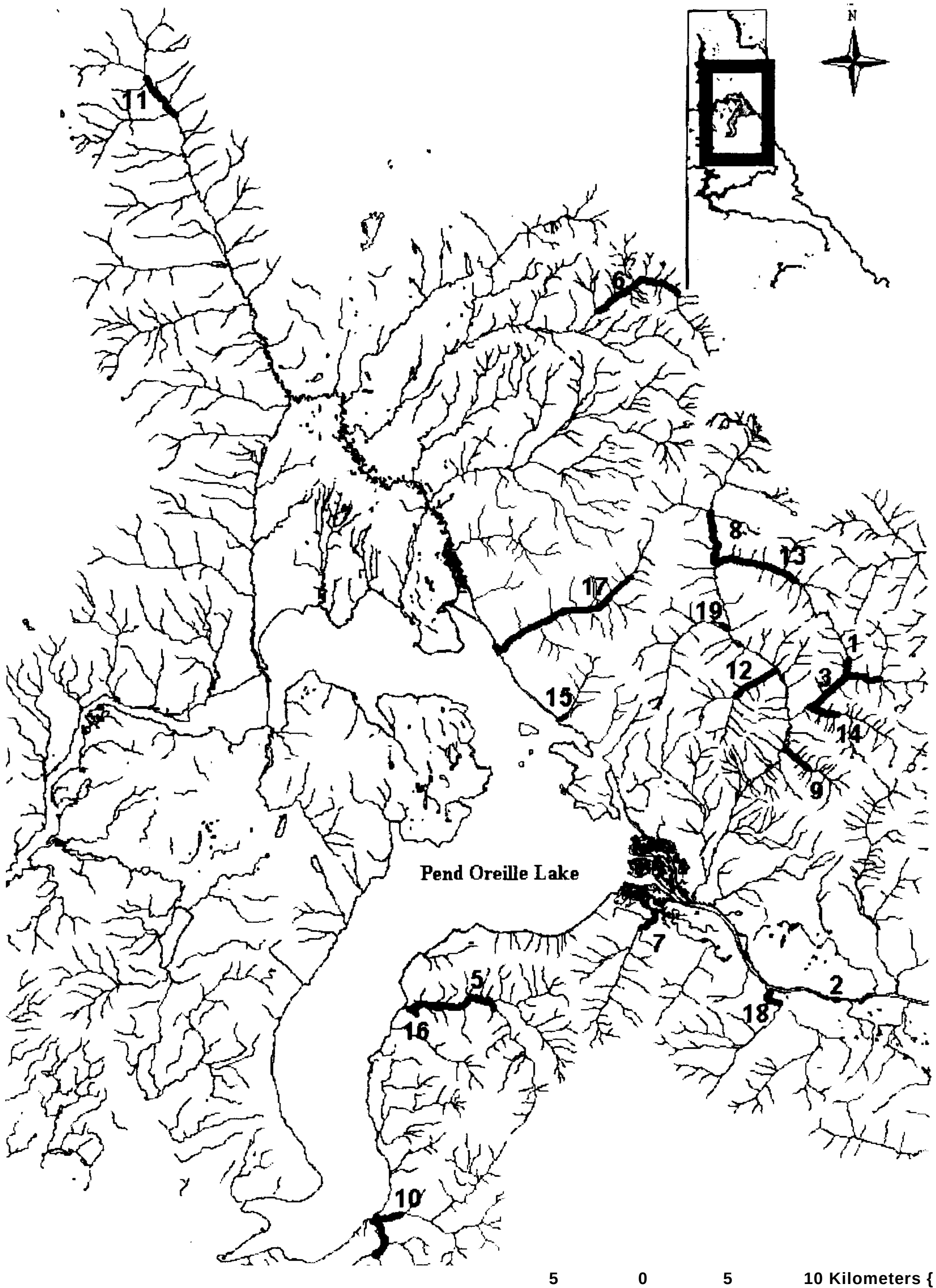


Figure I. Bull trout redd count sections (with shading) in tributaries of Lake Pend Oreille, Idaho. Numbers denote stream name in Table I

Table I. Survey streams for annual bull trout redd counts in tributaries to Lake Pend Oreille, Idaho.

Stream name	**Stream number**	**Section description (approximate length (km))**	**Years monitored**
Char Cr	1	Mouth to falls (1.2)	1983-1987, 1992-2004
Clark Fork River	2	Spawning channel (N/A)	1992-2004
E. Fk. Lightning Cr"	3	Savage to Thunder Creek (5.0)	1983-2004
Gold Cr"	4	Mouth to 0.2 km upstream of W. Gold confluence (2.4)	1983-2004
Granite Cr	5	Mouth to road 278 crossing (6.4)	1983-1987, 1992-2004
Grouse Cr"	6	Flume Creek to end of road 280 (2.4 km beyond gate) (6.5)	1983-2004
Johnson Cr"	7	Mouth to falls (1.5)	1983-2004
Lightning Cr	8	Rattle to Quartz (3.2)	1983-1987, 1992-2004
Morris Cr	9	Mouth to trail 132 crossing (N/A)	1999-2004
N. Gold Cr"	10	Mouth to falls (1.2)	1983-2004
Pack R	11	Road 231 bridge near McCormick Cr to Falls located 0.4 km downstream of W. Branch (2.8)	1983-1987, 1992-2004
Porcupine Cr	12	Mouth to S.Fk. (3.2)	1983-1987, 1992-2004
Rattle Cr	13	Mouth to falls by upper bridge (5.7)	1983-1987, 1992-2004
Savage Cr	14	Mouth to trail 61 crossing (2.0)	1983-1985, 1987, 1992-2004
Strong Cr	15	Mouth to diversion barrier (N/A)	1996, 2002, 2004
Sullivan Springs	16	Mouth upstream 0.4 km (0.4)	1983-1985, 1987, 1992-2004
Trestle Cr"	17	1.6 km upstream of mouth to 0.5 km upstream of the road 275 switchback (10.4 km); 0.5 km upstream of road 275 switchback upstream to confluence with first southeast hank un-named tributary (0.5 km)	1983-2004
Twin C r	18	Mouth to River Road (1.5)	1983-1987, 1992-2004
Wellington Cr	19	Mouth to falls (0.5)	1983-1987, 1992-2004

" Denotes "index" stream

The Lake Pend Oreille Bull Trout Conservation Plan (PBTAT 1998) proposed two restoration targets for bull trout: 1) Ensure the LPO basin bull trout population is not vulnerable to extinction and 2) Provide for an overall bull trout population sufficient to produce an annual harvestable surplus. Evaluating probability of persistence coupled with trend analysis has been recommended as an approach to assessing extinction risk (PBTAT 1998). The two primary metrics for determining if criteria have been met are that LPO supports at least six "healthy" bull trout populations, and efforts are underway to improve conditions in all high and medium priority tributaries. It is assumed that once Target l has been met, a harvestable surplus will exist (Target 2).

We used a nonparametric rank-correlation procedure, Kendall's tau (Daniel 1990), to test for trends in the long-term LPO redd count data set (Rieman and Myers 1997), as recommended in the Lake Pend Oreille Bull Trout Conservation Plan. We used tau-b to compensate for any bias caused by ties in the data, and noted statistical significance at the $a = 0.05$ level (Rieman and Myers 1997). Data for the year 1995 were not used for any streams except the mainstem Clark Fork River, Sullivan Springs, North Gold and Gold creeks in this analysis because poor water visibility due to high water conditions likely effected the accuracy of the counts. In addition, we did not use the 1983 data point for Grouse Creek or the 1986 data points for Rattle and E. Fk. Lightning creeks because some segments of these streams that may have contained relatively substantial numbers of redds were not counted. Where statistical significance could not be concluded, we used the sign of the correlation to infer trend. Specifically, we ran correlations between year and redd count from 1999 through 2004 using the full data set (1983-present). In the absence of statistical significance, if the sign of the correlation is positive for three out of the last five years examined, the population is inferred to be stable or increasing (PBTAT 1998). The alternative is that if three out of the five years exhibit a negative correlation, then the population is inferred to be decreasing. In addition, we tested for short-term trends using data collected since 1994. We used 1994 as the cutoff date for short-term analysis as the draft U.S. Fish and Wildlife Service Bull Trout Recovery Plan (USFWS 2002) requires at least 10 years of redd count data for trend analysis. The sign of the correlation was used to infer trend where statistical significance could not be achieved for the short-term trend analysis.

RESULTS

We successfully completed bull trout redd counts in 18 tributaries to LPO, as well as the Clark Fork River spawning channel in 2004. Bull trout redds were also counted in the M. Fk. East River and Uleda Creek, in the Priest River drainage. Redd counts ranged from a low of zero redds in Strong Creek to a high of 167 redds in Gold Creek (Appendix A).

The long-term correlation analysis revealed two statistically significant correlations between year and redd count. Correlations for Porcupine Creek (tau-b -0.357; p 0.045) and Gold Creek (tau-b 0.31; p — 0.044) indicate a long-term decline in the Porcupine Creek population, and long-term increases in the Trestle and Gold creek populations (Table 2). Granite ('reek bordered on statistical significance for a positive correlation, suggesting an increasing population trend in recent years. Six out of seven populations monitored in the Lightning ('reek drainage also displayed negative correlations, but none were statistically significant with the exception of Porcupine ('reek. Rattle ('reek, the lone tributary in the Lightning ('reek drainage with a positive long-term correlation value, has benefited from four consecutive years of above average redd counts.

Table 2. Correlations between year and redd count (trends) for bull trout populations monitored from 1983 through 2004 in tributaries to Lake Pend Oreille, Idaho.

Stream	Number of years	Tau-b correlation	P-value -
Char Cr.	18	-0.02	0.933
E. Fk. Lightning Cr.	19	-0.09	0.600
Gold Cr.	22	0.31	0.044[a]
Granite Cr.	17	0.33	0.068
Grouse Cr.	20	-0.15	0.359
Johnson Cr.	21	-0.01	0.976
Lightning Cr.	17	-0.14	0.429
N. Gold Cr.	22	-0.18	0.252
Pack R.	17	-0.20	0.264
Porcupine Cr.	17	-0.36	0.045"
Rattle Cr.	16	0.09	0.619
Savage Cr.	16	-0.01	0.963
Sullivan Springs	17	0.16	0.358
Trestle Cr.	21	0.23	0.138
Twin Cr.	17	-0.08	0.676
Wellington Cr.	17	-0.24	0.186

" Denotes statistical significance at the 0.05 level

When we apply the criteria for determining if a population is increasing or decreasing in the absence of statistical significance (PBTAT 1998), we conclude that a total 4 of 16 bull trout populations monitored are stable or increasing, while 12 have undergone long-term declines (Table 3).

Examining only the data from 1994 to present to obtain a view of the short-term trends in populations, we find that 12 of the 16 populations evaluated exhibited positive correlation values. This suggests that adult escapement is generally increasing in recent years. However, due to high variability in the redd count numbers and the short-term nature of the data set, only three correlations were statistically significant (Table 4).

Overall, 10 of 16 populations monitored since at least 1992, had redd counts in 2004 higher than the long-term average annual redd count. An additional three streams were within 25%, of the long-term average. The redd count in the Clark Fork River spawning channel was similar to its long-term average (Figures 2-18).

Table 3. Results of long-term trend analysis for 16 bull trout spawning tributaries to Lake Pend Oreille, Idaho. All populations have at least I I years of redd count data.

Stream	**Year**	**Kendall's tau-b**	**P-value**	**Trend conclusion**
Char Cr.	2000	0.16	0.458	
	2001	0.05	0.824	
	2002	-0.02	0.92	
	2003	-0.08	0.682	
	2004	-0.02	0.933	Decline
EF Lightning	2000	-0.22	0.255	
	2001	-0.22	0.242	
	2002	-0.16	0.37	
	2003	-0.16	0.344	
	2004	0.09	0.600	Decline
Gold Cr.	2000	0.22	0.196	
	2001	0.26	0.122	
	2002	0.33	0.04[a]	
	2003	0.34	0.032[a]	
	2004	0.31	0.044[a]	Stable/Increase
Granite Cr.	2000	0.14	0.5	
	2001	0.03	0.868	
	2002	0.13	0.52	
	2003	0.24	0.204	
	2004	0.33	0.068	Stable/Increase
Grouse Cr.	2000	-0.13	0.494	
	2001	-0.18	0.316	
	2002	-0.17	0.34	
	2003	-0.14	0.415	
	2004	-0.15	0.359	Decline
Johnson	2000	-0.13	0.452	
	2001	-0.02	0.91	
	2002	0.04	0.83	
	2003	-0.07	0.669	
	2004	-0.01	0.976	Decline
Lightning Cr.	2000	-0.37	0.075	
	2001	-0.31	0.123	
	2002	-0.25	0.2	
	2003	-0.2	0.276	
	2004	-0.14	0.429	Decline
N. Gold Cr.	2000	-0.23	0.179	
	2001	-0.29	0.081	
	2002	-0.28	0.08	
	2003	-0.3	0.061	
	2004	-0.18	0.252	Decline

Table 3. Continued.

Stream	**Year**	**Kendall's tau-b**	**P-value**	**Trend conclusion**
Pack R.	2000	-0.56	0.007'	
	2001	-0.43	0.033[a]	
_	2002	-0.36	0.06	
	2003	-0.29	0.114	
	2004	-0.20	0.264	Decline
Porcupine Cr.	2000	-0.55	0.009[a]	
	2001	-0.59	0.003"	
	2002	-0.62	0.001 [a]	
	2003	-0.5	0.007[a]	
	2004	-0.36	0.045[a]	Decline
Rattle Cr.	2000	-0.38	0.084	
	2001	-0.17	0.425	
	2002	-0.07	0.74	
	2003	0.04	0.842	
	2004	0.09	0.619	Decline
Savage Cr.	2000	-0.43	0.05[a]	
	2001	-0.35	0.094	
	2002	-0.2	0.33	
	2003	-0.11	0.571	
	2004	-0.01	0.963	Decline
Sullivan Sp.	2000	0.35	0.097	
_	2001	0.21	0.293	
	2002	0.21	0.27	
	2003	0.18	0.338	
	2004	0.16	0.358	Stable/Increase
Trestle Cr.	2000	0.13	0.482	
	2001	0.22	0.196	
	2002	0.31	0.07	
	2003	0.38	0.021"	
	2004	0.23	0.138	Stable/Increase
Twin Cr.	2000	0.08	0.711	
	2001	-0.03	0.868	
	2002	-0.01	0.96	
	2003	-0.08	0.682	
	2004	-0.08	0.676	Decline
_	2000	-0.34	0.108	
	2001	-0.31	0.119	
	2002	-0.29	0.13	
	2003	-0.24	0.196	
	2004	-0.24	0.186	Decline

[a] Denotes statistical significance at the 0.05 level

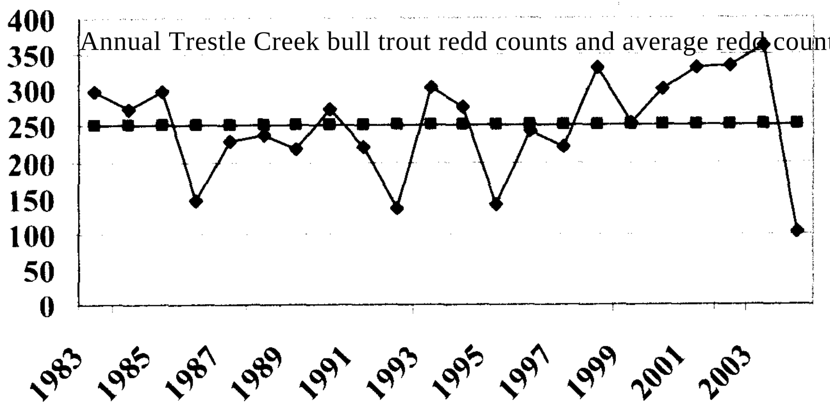
Table 4. Correlations between year and redd count (trends) for bull trout populations monitored from 1994 to 2004 in tributaries to Lake Pend Oreille, Idaho.

Stream	**Number of years**	**Tau-b correlation**	**P-value**
Char Cr.	10	-0.09	0.718
E. Fk. Lightning Cr.	10	0.33	0.180
Gold Cr.	11	0.38	0.102
Granite Cr.	10	0.33	0.180
Grouse Cr.	10	0.07	0.784
Johnson Cr.	10	0.32	0.205
Lightning Cr.	10	0.49	0.047[a]
N. Gold Cr.	11	-0.09	0.692
Pack R.	10	0.45	0.070
Porcupine Cr.	10	0.41	0.100
Rattle Cr.	10	0.64	0.010"
Savage Cr.	10	0.57	0.023" _
_	11	-0.22	0.346
Trestle Cr.	10	0.29	0.245
Twin Cr.	10	-0.11	0.647
Wellington Cr.	10	0.02	0.925

" Denotes statistical significance

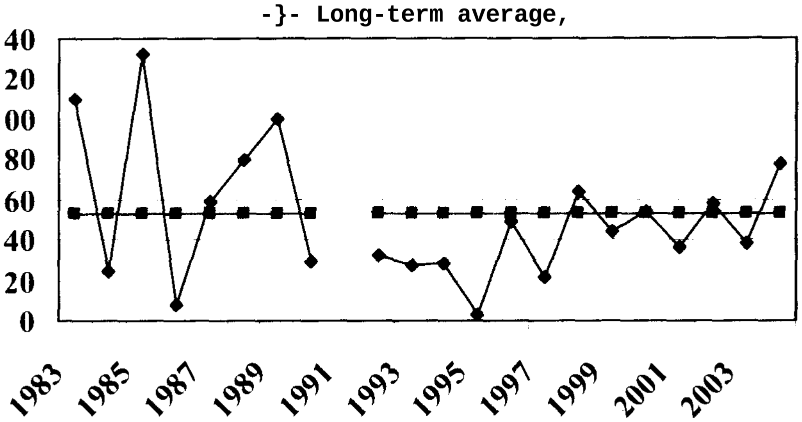
Year

Figure 2. Annual Trestle Creek bull trout redd counts and average redd count, 1983 through 2004, Lake Pend Oreille,



- + - **Annual redd count**

-}- **Long-term average,**



Year

Figure 3. Annual Fast Fork Lightning Creek bull trout redd counts and average redd count, 1983 through 2004, Lake Pend Oreille, Idaho.

- +– **Annual redd count**

-a--- **Long-term average**

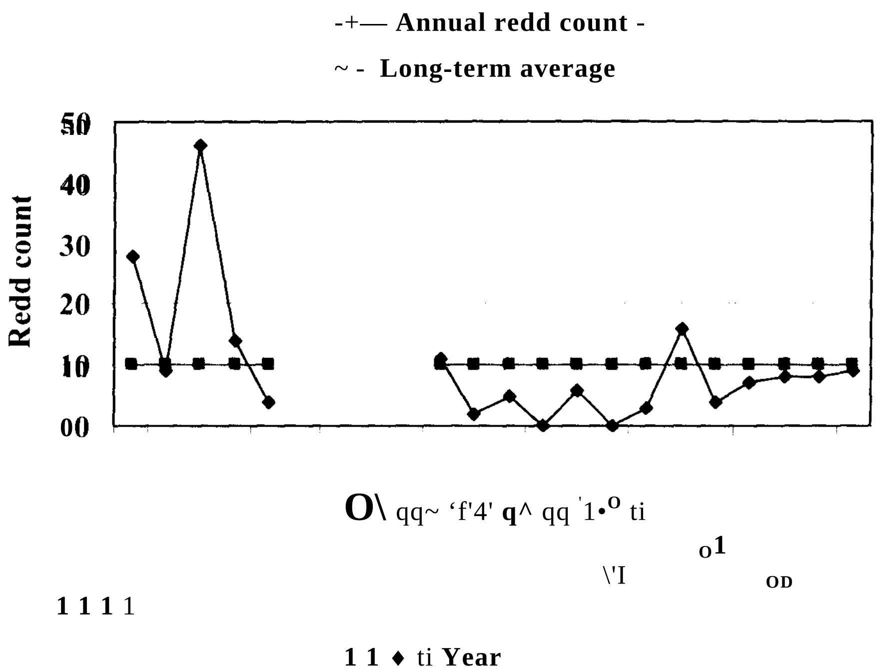


Figure 4. Annual Lightning Creek bull trout redd counts and average redd count, 1983 through 2004, Lake Pend Oreille, Idaho. —.-- **Annual redd count**

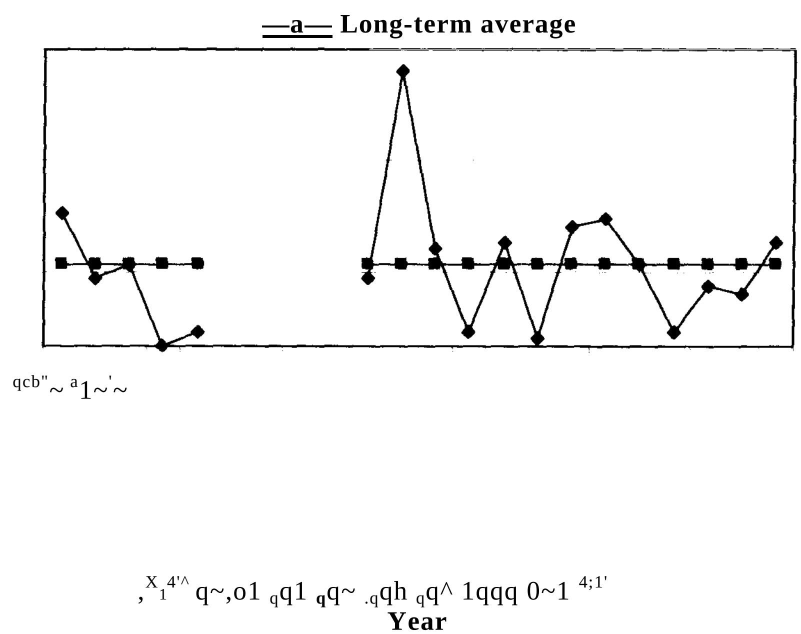
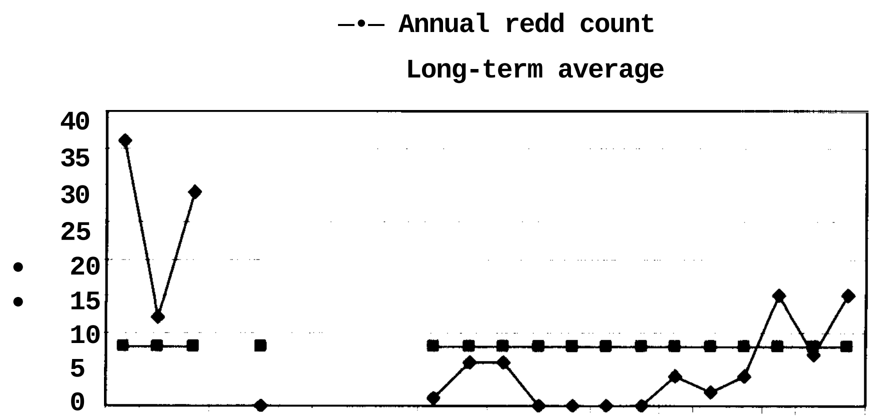
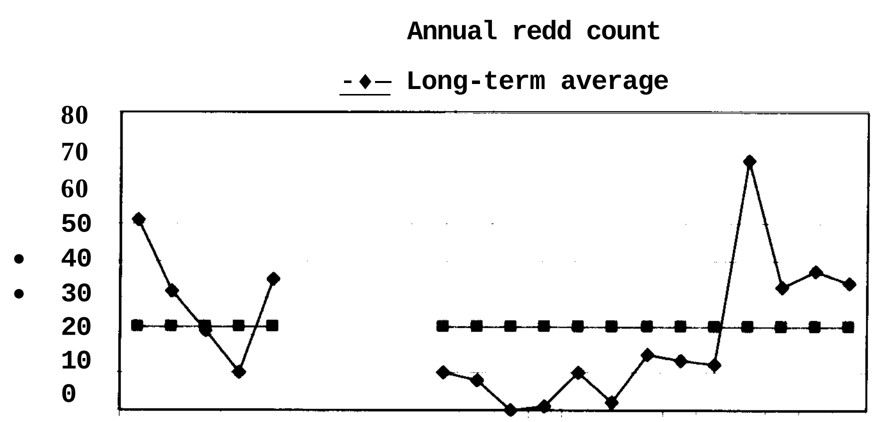


Figure 5. Annual Char Creek bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.



Annual redd count
Long-term average
40
35
30
25
20
15
10
5
0



Annual redd count
Long-term average
80
70
60
50
40
30
20
10
0

ots, c,''' se re e

se ;1;' 4\ 0

.4s. se

Year

Figure 6. Annual Savage Creek bull trout redd counts and average redd count, 1983 through 1985, 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.

tiq~~ 1q~~ 1e ?1q` tiroA

Year

Figure 7. Annual Rattle Creek bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.

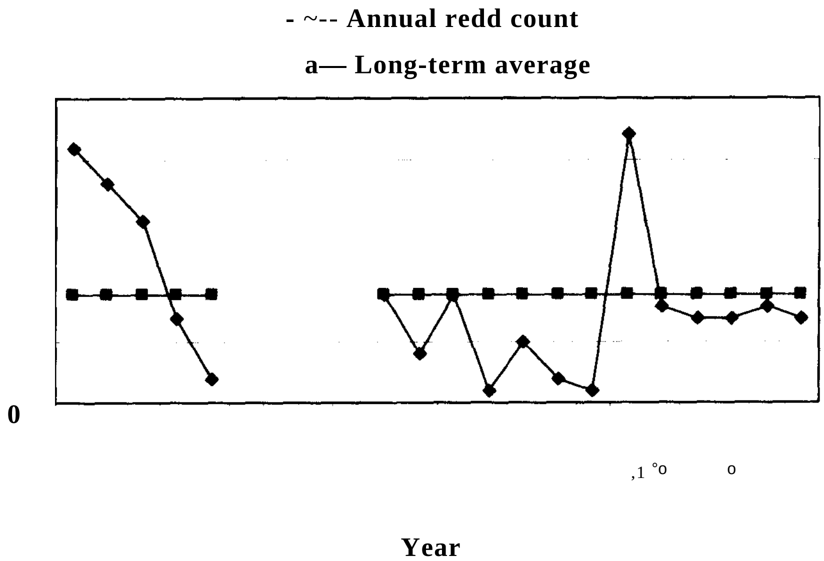


Figure 8. Annual Wellington Creek bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.

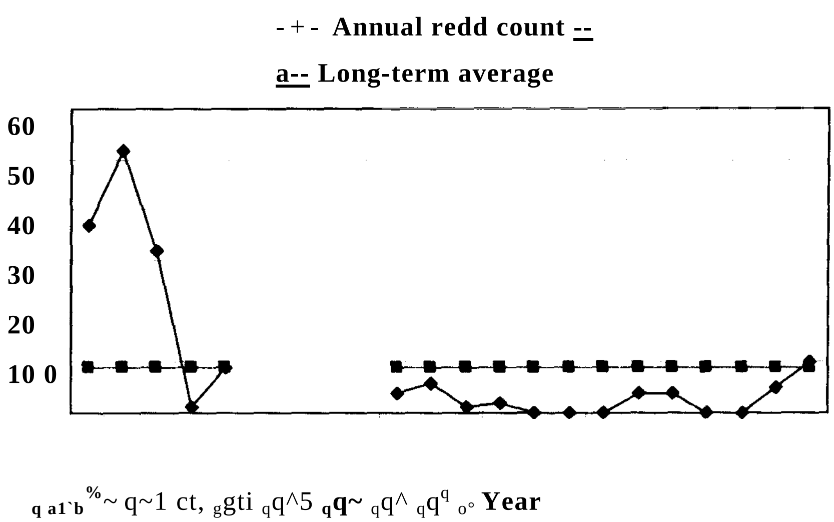


Figure 9. Annual Porcupine Creek hull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.

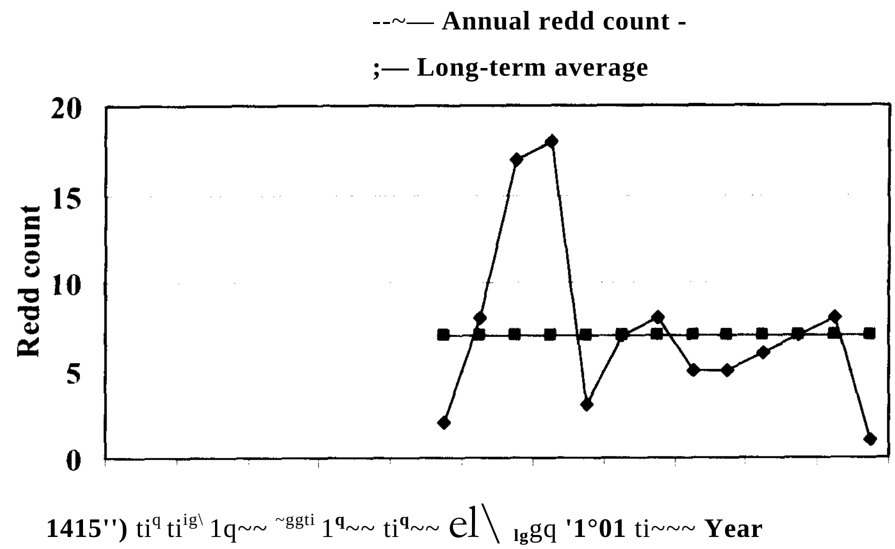


Figure 10. Annual Clark Fork River (Cabinet Gorge Fish Hatchery spawning channel) hull trout redd counts and average redd count, 1992 through 2004, Lake Pend Oreille, Idaho.

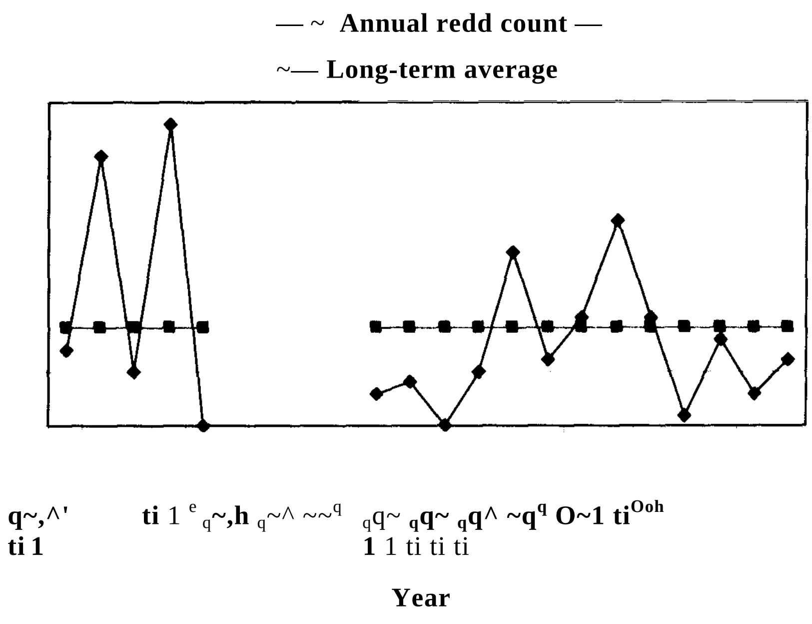


Figure I I. Annual Twin ('reek hull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.

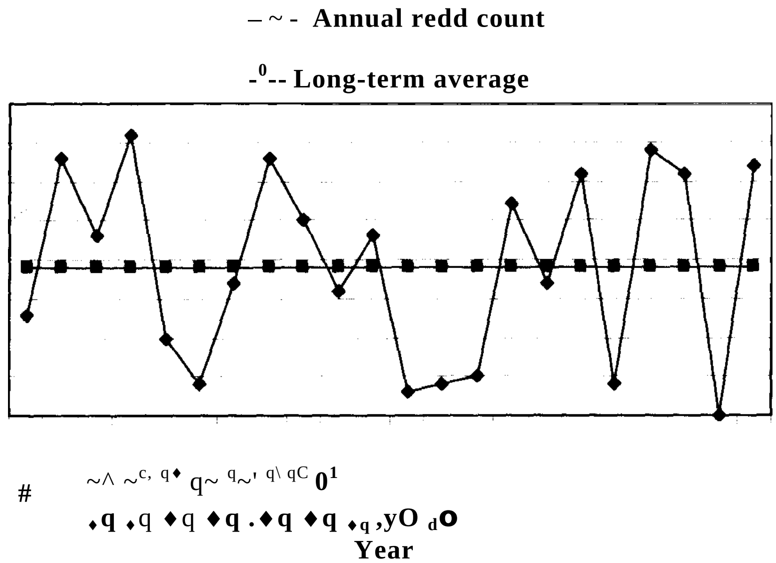
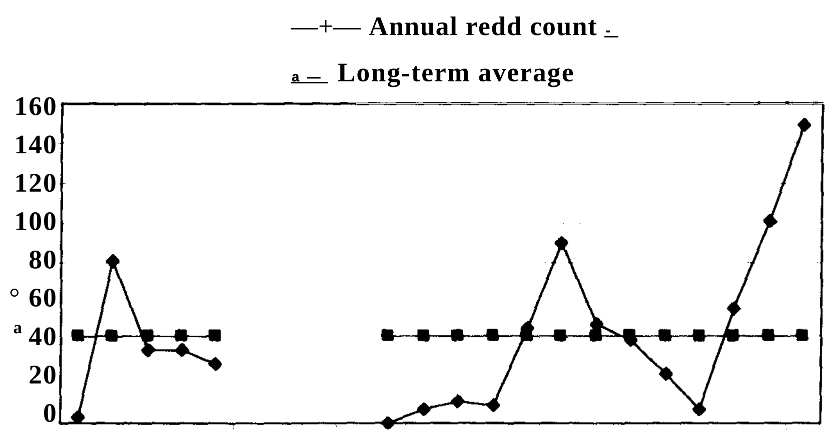


Figure 12. Annual Johnson Creek bull trout redd counts and average redd count, 1983



through 2004, Lake Pend Oreille, Idaho.

‘;S · · Y O qq♦ qq~ qq~ qq~ qqq 001 00~ Year

Figure 13. Annual Granite ('reek hull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.

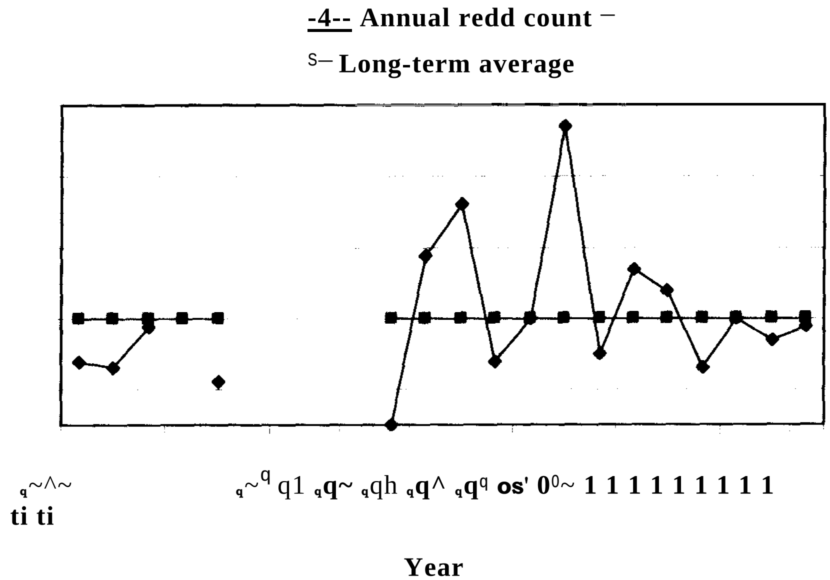


Figure 14. Annual Sullivan Springs Creek bull trout redd counts and average redd count, 1983 through 1985, 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.

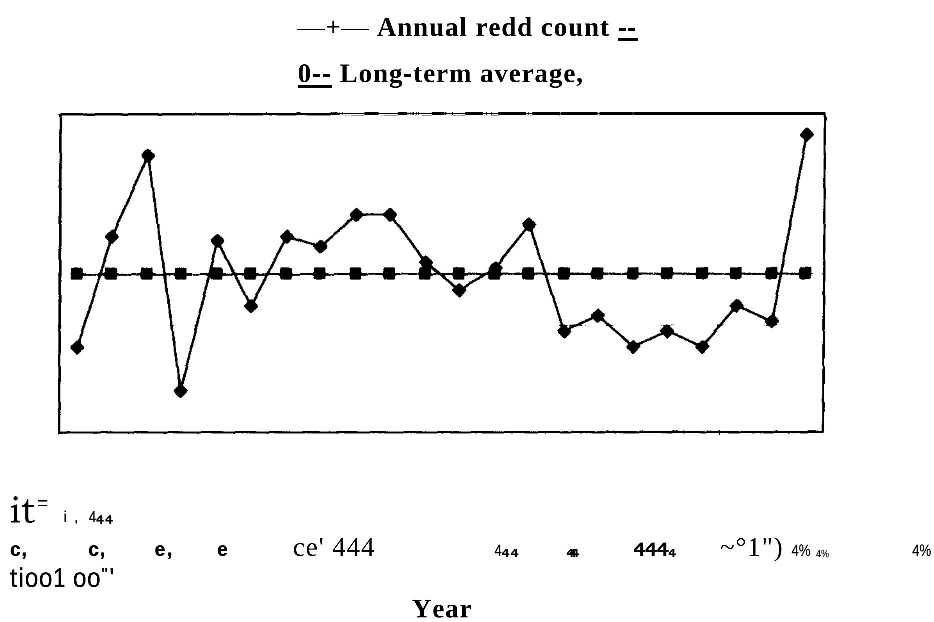


Figure 15. Annual N. Gold Creek bull trout redd counts and average redd count, 1983 through 2004, Lake Pend Oreille, Idaho.

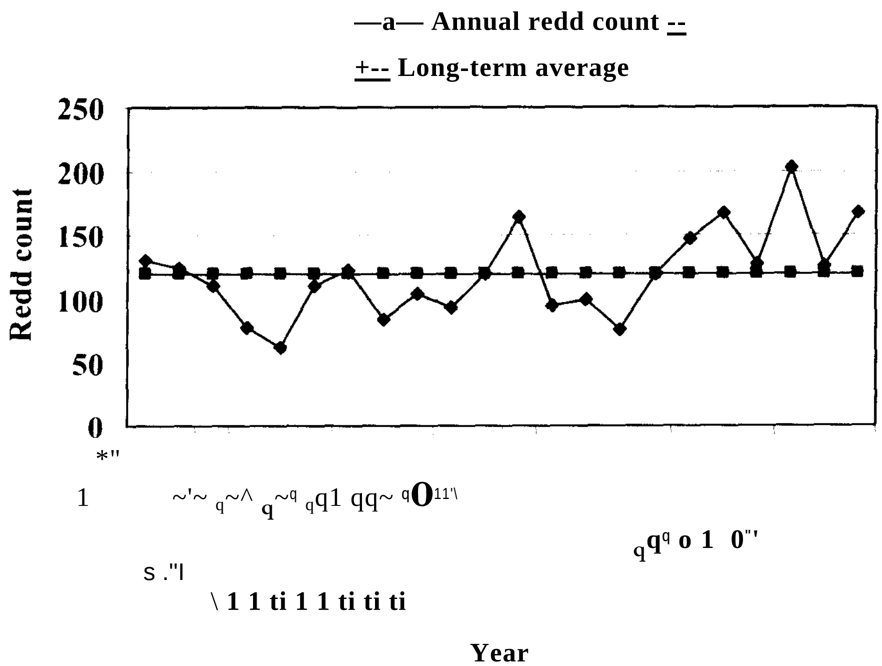
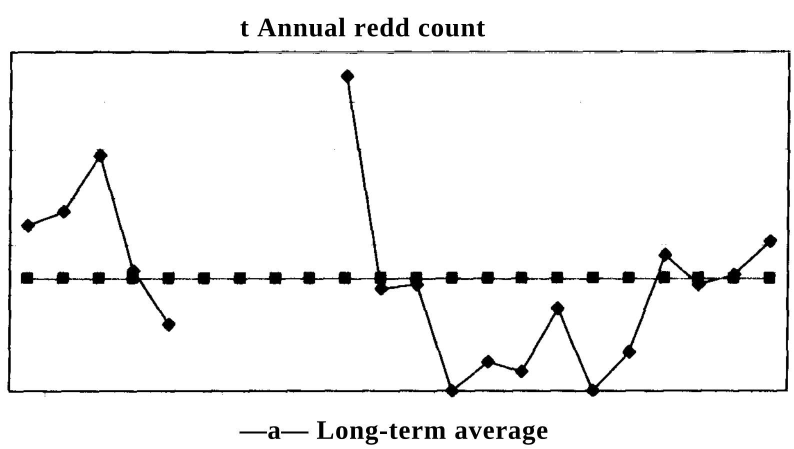


Figure 16. Annual Gold Creek bull trout redd counts and average redd count, 1983 through 2004, Lake Pend Oreille, Idaho.



0

~~ 4h ~b^ ~q ot1 q~ c~ ct e1 01 O~
Nq 1q 1el 1q Vel 1q ♦ el Vel ti0 ti0

Year

Figure 17. Annual Pack River bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2004, Lake Pend Oreille, Idaho.

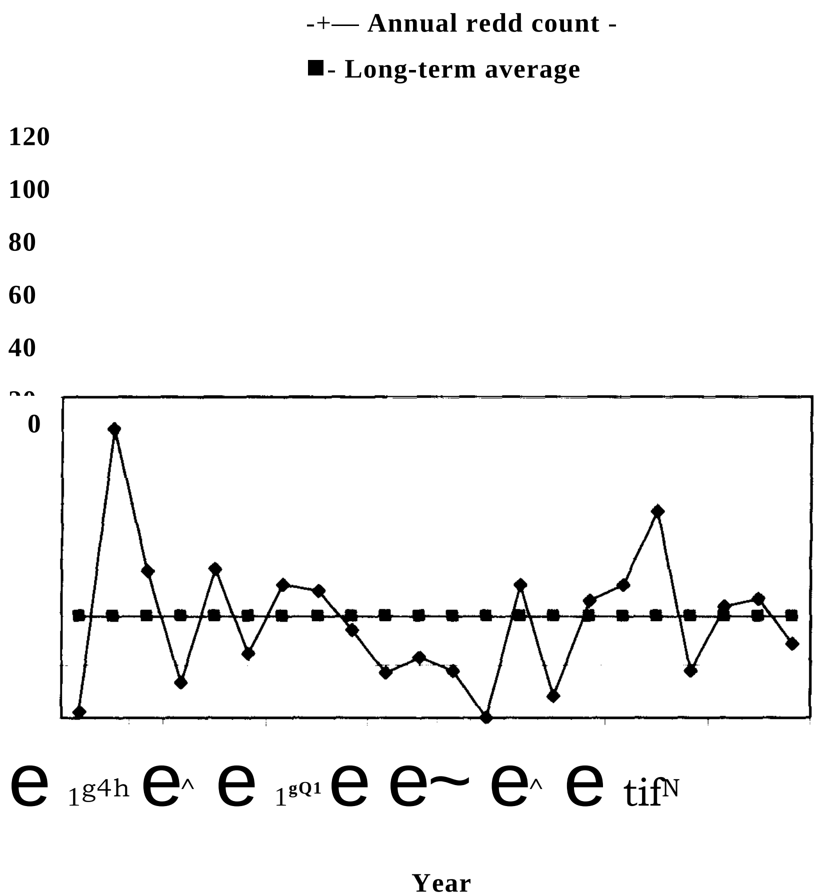


Figure 18. Annual Grouse Creek bull trout redd counts and average redd count, 1983 through 2004, Lake Pend Oreille, Idaho.

DISCUSSION

Six tributaries (index streams; Johnson, E. Fk. Lightning, Trestle, Grouse, N. Gold, and Gold creeks) have been surveyed consistently on an annual basis since 1983, and the 2004 redd count for these six streams combined (462) is lower than the long-term average of 505 redds. Total redd count numbers in the "index streams" have declined over the past three years. However, the apparent declines have been driven by low counts in two streams, Trestle and Gold creeks, which due to the large spawning runs they support, have a large influence over this pooled count. From 1983 to 2004 these two streams have accounted for an average of 73% of the total of the "index streams" count. Trestle and Gold creeks also have a large influence on the total number of redds counted in the entire LP() system. From 1983 to 2004, Trestle and Gold creeks together accounted on average for the majority (60%) of the total number of redds counted in the LP() system. 'Freud analysis that lumps all of the populations together is likely to be heavily influenced by the trends in these two streams. There appears to be a high degree of population structuring among local bull trout populations (Spruell et al. 1999; Neraas and Spruell 2001) and for this reason it is important to maintain as many local populations as possible to reduce the likelihood of extinction, as well as to preserve genetic diversity. Spruell et al. (1999) estimated straying rates between LPO bull trout populations at one individual/year based on genetic analysis. Evaluating trends at the local population level is more appropriate to understand the population dynamics of hull trout in LPO. This is the approach taken in The Lake Pend Oreille Bull Trout Conservation Plan (PHI AT 1998). Over the length of the full data set, 12 of 16 populations we analyzed appear to have undergone long-term declines in abundance. However, over the shorter 10-year time frame we chose to look at for shorter-term trends, the majority of populations (12 of 16) had positive correlation values suggesting a stable or increasing trend.

We identified two statistically significant correlations (trends) at the a = 0.05 level among the 16 streams analyzed in the full data set (1983 to 2004) due to the large variability in redd numbers within the data set. This is not unexpected as previous authors using similar data sets predicted it may take over 100 years of continuous redd count data collection before a statistically significant trend can be detected (Rieman and Myers 1997). Gold Creek maintains a relatively strong population and likely benefits from very cold summer water temperatures (Downs et al. 2003; Downs and Jakubowski 2003; USFS, unpublished data), along with high-quality complex spawning and rearing habitat. Although most of the spawning habitat in Gold Creek is located on private property, the riparian area has not been developed for residential construction to date. This is likely due to the steep topography of the riparian zone, and the remoteness of the drainage. However, development pressures will likely continue to expand around LPO and efforts to protect the riparian zone along Gold Creek through habitat acquisition should continue. Additionally, brook trout *Salvelinus fontinalis,* which pose competition and hybridization risks for bull trout, are not known to be present in Gold Creek. Porcupine Creek has apparently undergone a statistically significant bull trout population decline over time. Possible explanations for this may include limited woody debris recruitment/retention to the stream channel, less than optimal water temperatures during the summer and fall (USFS, unpublished data), and the presence of exotic brook trout. Investigating the factors responsible for the decline of bull trout in Porcupine Creek would help identify population restoration options.

Due to its drainage area, apparent numerous physical habitat problems, and the presence of at least five genetically distinct bull trout populations (Spruell et al. 1999) the Lightning Creek drainage offers the greatest opportunity to increase bull trout numbers in the LPO system. Several tributaries in Lightning Creek continue to have low numbers of bull trout spawners returning annually (Char, Porcupine, mainstem Lightning, Savage, and Wellington creeks). This, coupled with a high degree of reproductive isolation, places them at an increased risk of local extinction (Spruell 1999). A watershed assessment funded by Avista was recently completed in the Lightning Creek drainage to identify impairments to stream channel function, as unstable channels are believed to be one of the most significant habitat problems in the drainage (PBTAT 1998). Channel intermittency due to excess bedload is an obvious problem in Rattle, E.F. Lightning, Savage, and mainstem Lightning creeks in many years. This channel intermittency causes direct loss of juvenile bull trout through stranding and predation in drying pools in late summer, and reduces the amount of physical rearing habitat available. This situation is most obvious in Rattle Creek where a section of stream channel in the middle of the bull trout spawning and rearing area, approximately 1 km in length, currently goes dry in late summer. Adult bull trout become stranded either within the intermittent reaches, or upstream of them, and are unable to reach spawning areas or outmigrate following spawning until fall rains occur. This may not occur until late October and stranded fish likely experience higher mortality as a result. In sonic years, mainstem Lightning Creek flows subsurface in the vicinity of the town of Clark Fork and all spawning bull trout remain stranded in Lightning Creek until flows increase in response to fall precipitation.

Redd counts in the mainstem Pack River for the past three years have averaged 26. This is an improvement over redd counts in 1999 and 2000, where redd counts of zero and eight were recorded, respectively. Fine sediment, lack of large woody debris, and elevated water temperatures resulting from loss of shade are believed to be significant limiting factors to bull trout in the mainstem Pack River (PBTAT 1998). A stream channel assessment was recently 'ti

completed (Golder Associates 2003) on the mainstem Pack River that should assist in identification of stream channel restoration opportunities to benefit bull trout. In addition, the Pack River Watershed Council is working to complete a Watershed Management Plan with the objective of improving water quality and aquatic habitat in the Pack River drainage. If both of these efforts translate into on the ground enhancement or conservation projects, and changes in land use practices in the drainage, bull trout should benefit.

LPO is close to meeting recovery objectives of the U.S. Fish and Wildlife Service (USFWS) Bull Trout Draft Recovery Plan (Plan) (USFWS 2002). LPO met the criteria of having six local populations with greater than 100 individuals in each (seven in 2004), and is very close to the threshold population size established in the Plan of 2,500 adults (estimated at 2,400 in 2004). This estimate of the total number of adults is based on expanding redd counts by the average ratio of 3.2 fish/redd observed across multiple streams and years of this program. A third criteria in the Plan is an increasing trend in abundance. Abundance trend results depend on the time frame examined. The longest-term view available still suggests many populations have trended downward, while shorter-term analysis suggests bull trout numbers are increasing in the majority of tributaries.

Changes in fishing regulations may be partially responsible for the increases in adult escapement. A trophy regulation was enacted in 1994 that allowed for harvest of only one fish greater than 500 mm (IDFG 1994), and the fishery was closed to harvest in 1996 (IDFG 1996). This likely allowed more fish to reach maturity, and increased the number of fish that survive to repeat spawn. Bull trout harvest opportunities may exist currently in some populations where adult escapement is adequate to fully seed the available rearing habitat. This situation may currently exist in Trestle Creek. The apparent high degree of fidelity of local bull trout populations (Spruell et al. 1999; Neraas and Spruell 2001) may afford some opportunity to selectively harvest from healthy populations.

Rieman and McIntyre (1996) suggested that year-class variation within adfluvial bull trout populations is more likely related to tributary spawning and rearing conditions than the lake environment. Differing trends observed in redd counts between individual tributaries to LPO lend support to this idea. If the majority of population regulation is currently occurring within tributaries, it will be difficult to detect positive trends once populations reach juvenile carrying capacity, which may be the case in tributaries such as Trestle and Gold creeks. Tributary habitat protection in these spawning streams (and all others) should remain the highest priority conservation action for bull trout in the LPO system at this time. In addition, watershed restoration aimed at restoring the physical template that produced healthy bull trout populations in the past should he a high priority in other drainages, such as Lightning Creek and the Pack River.

It is possible that predation/competition from the rapidly increasing introduced lake trout *Salve/inns namaxcush* population will overcome the ability of individual tributaries to produce enough juveniles to support current adult escapement levels, even in Trestle and Gold creeks, and conservation priorities may need to shift. Lake trout have been identified as the biggest existing threat to hull trout persistence in the LP() system (PBTAT 1998). Donald and Alger (1993). and Fredenberg (2002), have documented the incompatibility of sympatric bull and lake trout populations in numerous lake systems. Efforts to assess the feasibility of lake trout control in LPO are currently underway.

C

G

ACKNOWLEDGEMENTS

We wish to thank Joe DuPont, Mark Liter, Ned Horner, Bill Harryman, and Sharon Delsack of IDFG, as well as Ryan Weltz of Avista and Scott Deeds of the USFWS for assistance with bull trout redd counts. We would also like to thank Mark Gamblin and Ned Horner of the Idaho Department of Fish and Game, Joe DosSantos of Avista Corp., Laura Katzman of Montana Fish, Wildlife, and Parks, and Larry Lockard of the U.S. Fish and Wildlife Service for their reviews of this report.

LITERATURE CITED

Daniel, W.W. 1990. Applied nonparametric statistics. PWS-KENT Publishing Company. Boston, Massachusetts.

Donald, D.B. and D.J. Alger. 1993. Geographic distribution, species displacement, and niche overlap for lake trout and bull trout in mountain lakes. Canadian Journal of Zoology 71:238-247.

Downs, C., R. Jakubowski, and S. Moran. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 1999-2001 Progress Report. Project 1, Johnson and Rattle creeks bull trout trapping; Project 2, Bull trout redd counts and escapement estimates 1999-2001; Project 3, Clark Fork River fishery assessment 1999-2001; Project 4, Lake Pend Oreille tributary instream flow evaluation, Idaho Tributary Habitat Acquisition and Recreational Fishery Enhancement Program, Appendix A. Report of the Idaho Department of Fish and Game and Avista Corporation to Avista Corporation, Spokane, Wa.

Downs C., and R. Jakubowski. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2002 Progress Report. Project 2, 2002 bull trout redd counts; Project 3, 2002 Clark Fork River fishery assessment progress report; Project 5, 2000-2002 Trestle and Twin creeks bull trout outmigration and Lake Pend Oreille survival study; Project 6, 2002 Johnson and Granite creeks bull trout trapping; Project 7, 2002 Twin Creek restoration monitoring progress report, Idaho Tributary Habitat Acquisition and Recreational Fishery Enhancement Program, Appendix A. Report of the Idaho Department of Fish and Game and Avista Corporation to Avista Corporation, Spokane, Wa.

Dunham, J., B. Rieman, and K. Davis. 2001. Sources and magnitude of sampling error in redd counts for bull trout. North American Journal of Fishery Management 21: 343-352.

DuPont, J. and N. Homer. In press. Regional Fisheries Management Investigations. Idaho Department of Fish and Game. Federal Aid in Fish Restoration F-71-R-28, Job C-3, 2003. Job Performance Report. Boise, Idaho.

Fredenberg, W. 2002. Further evidence that lake trout displace bull trout in mountain lakes. Intermountain Journal of Sciences 8:143-15I.

Golder Associates. 2003. Pack River Stream Channel Assessment Final Report. Report to Avista Corporation by Golder Associates, Redmond, Wa.

Idaho Department of Fish and Game. 1994. 1994-1995 Fishing Seasons and Rules. Idaho Department of Fish and Game. Boise.

Idaho Department of' Fish and Game. 1996. 1996-1997 Fishing Seasons and Rules. Idaho Department of Fish and Game. Boise.

Neraas, L.P. and P. Spruell. 2001. Fragmentation of riverine systems: the genetic effects of dams on hull trout (Salvelinus confluentus) in the Clark Fork River system. Molecular Ecology 1 0: 1153-1 164.

Panhandle Bull Trout Technical Advisory Team. 1998. Lake Pend Oreille key watershed bull trout problem assessment. Report to the Lake Pend Oreille Watershed Advisory Group and the State of Idaho.

Pratt, K. 1984. Pend Oreille trout and char life history study. Report to the Idaho Department of Fish and Game and the Lake Pend Oreille Idaho Club. Boise, Idaho.

Pratt, K. 1985. Pend Oreille trout and char life history study. Report to the Idaho Department of Fish and Game and the Lake Pend Oreille Idaho Club. Boise, Idaho.

Rieman, B.E. and D.L. Myers. 1997. Use of redd counts to detect trends in bull trout (Salvelinus confluentus) populations. Conservation Biology 11:1015-1018.

Rieman, B.E. and J.D. McIntyre. 1996. Spatial and temporal variability in bull trout redd counts. North American Journal of Fisheries Management 16:132-141.

Spruell, P. B.E. Rieman, K.L. Knudsen, F.M. Utter, and F.W. Allendorf. 1999. Genetic population structure within streams: microsatellite analysis of bull trout populations. Ecology of Freshwater Fish 8: 114-121.

U.S. Fish and Wildlife Service. 2002. U.S. Fish and Wildlife Service Bull Trout (Salvelinus confluentus) Draft Recovery Plan. Portland, Oregon.

O

APPENDICES

'..a' '"a'

Appendix A. Annual bull trout redd counts (1983-2004) for tributaries to Lake Pend Oreille, Idaho.

Table A. 1. Bull trout redd counts for Lake Pend Oreille, Idaho, basin tributaries, 1983-2004.

Stream	**1983'' "**	**1984'**	**1985'**	**1986**[h]	**1987**[h, "]	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Clark Fork R.										2	8	17	18
Lightning Cr.	28	9	46	14	4	--	--	--	--	11	2	5	O[h]
E. F. Lightning Cr.	110	24	132	8'	59	79	100	29	--	32	27	28	3h
Savage Cr.	36	1 2	29	--	0	--	--	--	--	1	6	6	0 h
Char Cr.	18	9	11	0	2	--	--	--	--	9	37	13	2[h]
Porcupine Cr.	37'	52	32	1 '	9	--	--	--	--	4	6	1	2[h]
Wellington Cr.	21	18	15	7	2	--	--	--	--	9	4	9	l b
Rattle Cr.	51	32	21	10'	35	--	--	--	--	10	8	0	
Johnson Cr.	13	33	23	36	10	4	17	33	25	16	23	3	4[h]
Twin Cr.	7	25	5	28	0	--	--	--	--	3	4	0	5[h]
Morris Cr.													
North Shore													
Trestle Cr.	298	*272*	*298*	147	230	236	217	274	220	134	304	276	140[h]
Pack River	_ 34	37	49	25	14	--	--	--	--	65	21	22	O[h]
Grouse Cr.	2'	108	55	1 3 '	56	24	50	48	33	1 7	23	18	0[h]
Strong Cr.													
East Shore													
Granite Cr.	3	81	37	37	30'	--	--	--	--	0	7	11	9[h]
Sullivan Springs	9	8	14	--	6	--	--	--	--	0	24	31	9
North Gold Cr.	16	37	52	8	36	24	37	35	41	41	32	27	31
Gold Cr.	131	124	11	78	62	111	122	84	104	93	120	164	95
Lower Priest R.													
M.F. East River													
Ueda Cr.							--	--	--	--	--	--	--
Total 6 index streams` "	570	598	571	290	453	478	543	503	423'	333	529	516	273[h]
Total of all streams	814	881	830	412	555	478	543	503	423°	447	656	631	320[h]

W U T

W W W W vv vat, saw "ow wto law 'W W W W W W W W Table A.1. Continued.

Table A.1. Continued.

Stream	1996	1997	1998	1999	2000	2001	2002	2003	2004
Clark Fork R.	3	7	8	5	5	6	7	8	1
Lightning Cr.	6	0	3	16	4	7	8	8	9
E. Fk. Light. Cr.	49	22	64	44	54	36	58	38	77
Savage Cr.	0	0	0	4	2	4	15	7	15
Char Cr.	14	1	16	17	11	2	8	7	14
Porcupine Cr.	0	0	0	4	4	0	0	5	10
Wellington Cr.	5	2	1	22	8	7	7	8	7
Rattle Cr.	10	2	15	13	12	67	33	37	34
Johnson Cr.	5	27	17	31	4[e]	34	31	0	32
Twin Cr.	16	6	10	19	10	1	8	3	6
Morris Cr.	--	--	--	1	1	0	7	1	1
North Shore									
Trestle Cr.	243	221	330	253	301	331[e]	333[e]	361	102[e]
Pack River	6	4	17	0	8	28	22	24	31
Grouse Cr.	50	8	44	50	77	18	42	45	28
Strong Cr.	2						0		0
East Shore									
Granite Cr.	47	90	49	41	25	7	57	101	149
Sullivan Springs	15	42	10	22	19	8	15	12	14
North Gold Cr.	39	19	22	16	19	16	24	21	56
Gold Cr.	100	76	120	147	168	127	204	126	167
Lower Priest R.									
M.F. East River	--	--	--	--	--	4 ti	8 h	21	
Uleda Cr.						3	4 k	3	
6 index streams`	486	373	597	541	631	562	692	591	462
Total of all streams	608	527	726	705	732	706	891	836	753

Table A.1. Continued.

Represents a partial count due to early snow fall because E. Fk. Lightning was not counted.
h Observation conditions impaired by high runoff.
Head-cut barrier prevented access to most of the spawning area.
Index streams include Gold, N. Gold, Trestle, Johnson, Grouse, and E. Fk. Lightning creeks.
Approximately 0.5 km of stream was added to the upstream end of the historic
Trestle Creek redd count section in 2001 because the debris jam barrier collapsed. Accounted for four redds in both 2001 and 2002, and two in 2003.
Three additional redds observed in Dry Gulch.
Data from Pratt (1985).
Data from Hoelscher and Bjornn (1989).
h Data from Irving (1986).
Partial survey and count of varying amounts. See Pratt (1985) and Holescher and Bjornn (1989) for details.
Partial counts.

k

Project 3: 2004 Clark Fork River Fishery Assessment Progress Report

ABSTRACT

The objective of this project is to measure the intended benefits of increasing the minimum flow from Cabinet Gorge Dam from 84.9 cubic-meters-per-second (cms) (3,000 cubicfeet-per-second) to 141.5 cms (5,000 cfs) in the Clark Fork River, Idaho. Mark-recapture population estimates were conducted in the spring of 2004 to estimate the abundance of mountain whitefish *Prosopium williamsoni* and brown trout *Salrno trutta.* We estimated 8,210 mountain whitefish and 245 brown trout greater than 200 mm total length in the study reach during the spring sampling period in 2004. The short-term nature of the data set, a lack of an obvious trend in the abundance estimates, and the lack of population estimate data prior to increasing the minimum flow in the Clark Fork River, limits our ability to draw conclusions regarding the benefits of the increased minimum flow at this time. In general, based on population estimates and catch-per-unit-effort (CPUE), mountain whitefish are the most abundant salmonid species in the Clark Fork River, with the exception of periodic seasonally strong runs of kokanee *Oncorhvnchus nerka.* Although population estimates suggest low abundance of trout in the Clark Fork River, proportional stock density (PSD) values continue to remain high, with an estimated PSD for brown trout and mountain whitefish in the spring of 2004 of 74.2% and 80.2%, respectively. This indicates a large majority of the electrofishing catch was greater than 305 mm. We sampled Foster Bar side-channel in 2003 and 2004 with backpack electrofishing equipment, in response to a habitat enhancement project to restore perennial flow to the side-channel. The only salmonid species captured in the side-channel was brown trout, and we captured a total of three individuals. We also captured six non-salmonid species of juvenile fish. In addition to electrofishing, the side-channel was surveyed for kokanee spawning activity on December 12, 2003 and November 30, 2004, but none was observed.

Authors:

Christopher C. Downs
Senior Fishery Research Biologist
Idaho Department of Fish and Game

Robert Jakubowski
Natural Resource Technician
Avista Corporation

INTRODUCTION

Avista Corporation (Avista; formerly Washington Water Power (WWP)) recently relicensed two of its hydroelectric facilities on the Clark Fork River in Idaho and Montana in 1999. Cabinet Gorge Dam is located just inside the Idaho border and Noxon Rapids Dam is located approximately 32 km upstream in Montana (Figure I).

Minimum flows in the Clark Fork River were one issue of particular concern to the local stakeholders involved in a collaborative relicensing process conducted by Avista. Photo documentation was used to estimate the minimum flow needed to provide a meaningful increase in permanently wetted perimeter of the Clark Fork River (Beak 1997). A new minimum Bow was negotiated for Cabinet Gorge Dam as part of the relicensing agreement, which increased the base flow from 84.9 ems to 141.5 ems (Avista 1999). Cabinet Gorge Dam is operated as a "peaking" facility, and daily flow fluctuations ranged from 84.9 cros to 1,010.3 cms prior to the increased minimum discharge. The objective of the increased minimum flow was to increase the amount of permanently wetted river habitat to benefit the aquatic resources of the Clark Fork River.

In addition, Avista modified the Foster Bar side-channel inlet to provide perennial flow into the approximately 2 km-long side-channel at the new minimum discharge elevation from Cabinet Gorge Dam. It was anticipated this would provide valuable off-channel rearing habitat for salmonids, which is in limited supply in the Idaho reach of the Clark Fork River. The project also was intended to improve recreational fishing opportunities for adult salmonids in the side-channel.

Limited quantitative information exists relative to the fishery resources of the Clark Fork River in Idaho. Several studies have investigated river use by adfluvial fish from Lake Pend Oreille, as well as the fish community composition over the course of an entire year (Heimer 1965, Anderson 1978, WWP 1995 and 1996). Avista, in preparation for their hydropower license renewal. conducted investigations into relative abundance of fish species present in the ('lark Fork River in Idaho (WWP 1995 and 1996). The information contained in these Avista reports adds to our baseline knowledge of fish populations in the Clark Fork River: In combination, the earlier Avista work and the first several years of this investigation will form the baseline from which we will gauge the effects of the increased minimum flow.

Previous work (Downs et al. 2003) suggested sampling in alternating years, in the spring for fall spawning salmonids and the fall for spring spawning salmonids, would help isolate the effect the new minimum flow was having on river fish, by avoiding spawning migration periods of fish from the lake. The target salmomd species in the overall assessment are brown trout *Salem trutta,* mountain whitefish *Pro.sopiwn williant.soni,* rainbow trout *Oncorh nchus nmrkic.c,* and westslope cutthroat tout O. *rarki lerri.si.* In addition, catch-per-unit-effort (CPl1E) information would be collected during fall sampling periods to examine changes in the relative proportions of salmonids and non-salmonids, as well as monitor changes in abundance of nonsalmonid species resulting from the increase in minimum flow

In addition to enhancing minimum flows in the ('lark Fork Riser. Avista and the Idaho Deportment of Fish and Game completed a project to provide perennial flow through Foster Bar side-channel to enhance fish habitat. This involved lowering several hydraulic control points svithm the side-channel so that water would flow through the side-channel oser the range of discharges from Cabinet Gorge Dam. Until the relicensing, when discharge from Cabinet Gorge Dam dropped below approximately 311.3 cms (84.9 cms was the minimum flow prior to relicensing), the side-channel would become a series of un-connected pools until flows increased beyond 311.3 cms again.

STUDY AREA

The Clark Fork River is the largest tributary to Lake Pend Oreille, contributing an estimated 92% of the annual intlow (Frenzel 1991). It drains approximately 59,324 km^2 of western Montana (Lee and Lunetta 1990). Four tributaries enter the Clark Fork River downstream of Cabinet Gorge Dam: Twin, Mosquito, Lightning, and Johnson creeks (Figure 1). Peak flows in the Clark Fork River typically occur as a result of snow melt in May or June (PBTAT 1998).

The study area encompasses approximately 6.6 km of river habitat (Figure 1). Physical habitat in the Clark Fork River below Cabinet Gorge Dam can be characterized as primarily low gradient laminar flow, with three major riffles and several deep pools (to 23 m in depth) (WWP1995). Riffles are located near the mouths of Twin and Lightning creeks, as well as at Foster side-channel. Substrate composition in the river has been described as gravel (26.3%), fines (22.2%), boulder (17.9%) and cobble (16.2%), (WWP 1995).

Foster Bar side-channel is located approximately 1.9 km downstream of the confluence of Twin Creek with the Clark Fork River (Figure 1). The side-channel is approximately 2.45 km in length. During periods of winter drawdown of Lake Pend Oreille, the side-channel functions as a lotic system. During periods of high summer lake levels, about half of the side-channel is influenced by a backwater effect from Lake Pend Oreille, and streamtlow through the side-channel is greatly slowed.

METHODS

Population Estimates and Catch-Per-Unit-Effort

Mark-recapture population estimates were conducted in the spring of 2004 for brown trout and mountain whitefish (target species) greater than 200 mm total length (TL) in the approximately 6.6 km long reach of the Clark Fork River from the USGS gauging station below Cabinet Gorge Dam downstream to the inlet of Foster side-channel (approximately river km 234 – 241). Distances and river km's were initially estimated from previous Avista GIS work (Parametrix 2000a). We previously estimated a total surface area of the study reach at 120.7 ha (Downs and Jakubowski 2003) using the earlier Avista GIS work. We validated this estimated area by measuring twenty-five wetted widths along the estimate section, as well as the total length of the section (25 sub-section lengths for a total estimated length of 6.61 kin), using a laser rangefinder. Using this method, we estimated the surface area at 114.8 ha at approximately 906 cms (32,000 cfs) discharge from Cabinet Gorge Dam. We estimated the surface area at this discharge because it is close to the upper operating limit of the project (approximately 990.5 ems), and flows often fluctuate widely during the actual population estimates. By using the higher flow to calculate surface area, we would end up with a more conservative estimate of density for comparison with other populations. In 2004, we conducted our marking runs from March 29 through March 31, and our recapture runs from April 5 through April 7.

Boom-type electrofishing was conducted at night using two crews in 6 m-long jet boats. The electrofishing setup in each boat consisted of a Coffelt VVP-I5 electroshocker powered by a 5000 watt Honda generator. Smooth DC current was employed to minimize risk of injury to trout (Dalbey et al. 1996). Typically, electrofishing settings were set to generate 4 to 12 amps at I50-250 volts.

Electrofishing boats floated in fast flow areas, or motored slowly in areas of very slow flow downstream, parallel with the shoreline While electrofishing, we attempted to keep the anode closest to shore in approximately 0.6 m of water depth. Each boat typically made a single pass down each shoreline, and multiple passes along the shorelines in the Whitehorse Rapids area (to increase sample size in productive areas) each night. The "marking" period was conducted over a three-night period in the first week of sampling, and the "recapture" period was conducted over a three-night period the following week. We continued with recapture runs until we captured at least three previously marked fish of each target species to reduce probability of statistical bias in our estimates (Ricker 1975).

Stunned fish were netted out of the electrofishing field and placed into a livewell for recovery. We attempted to net all salmonids stunned by electrofishing during the spring sampling. We used these data to conduct the mark-recapture population estimates for brown trout and mountain whitefish, and also to estimate CPUE for all salmonids encountered during the first night of spring sampling. Captured fish were anesthetized with clove oil and checked for fin clips. Larger fish were weighed to the nearest 10 g on a top loading spring scale and smaller fish to the nearest I g on a digital scale, measured (total length (TL), mm), marked with a fin clip, and released. Any captured bull trout *Sals'elinus confluent)/ s*, and westslope cutthroat trout were also scanned for the presence of a Passive Integrated Transponder (PIT) tag. CPUE was estimated for all salmonid species from data collected from both banks on the first night of electrofishing, over the entire study reach.

Population estimates were calculated using the modified Petersen method for sampling without replacement (any individual can only be counted once) (Krebs 1989) as:

N =UUMM+I)1('+l)/IR+I))- /

(1)

Where: N Estimated population

Al = Number of individuals marked in the first sample

(' = Total number of individuals captured in the second sample

R = Number of individuals in second sample that are previously marked

Binomial confidence intervals were estimated as recommended by Seber (1982) using the relationship between the F and the binomial distribution (Zar 1996). Poisson confidence intervals were developed where appropriate using the tables and recommendations provided in Krebs (1989).

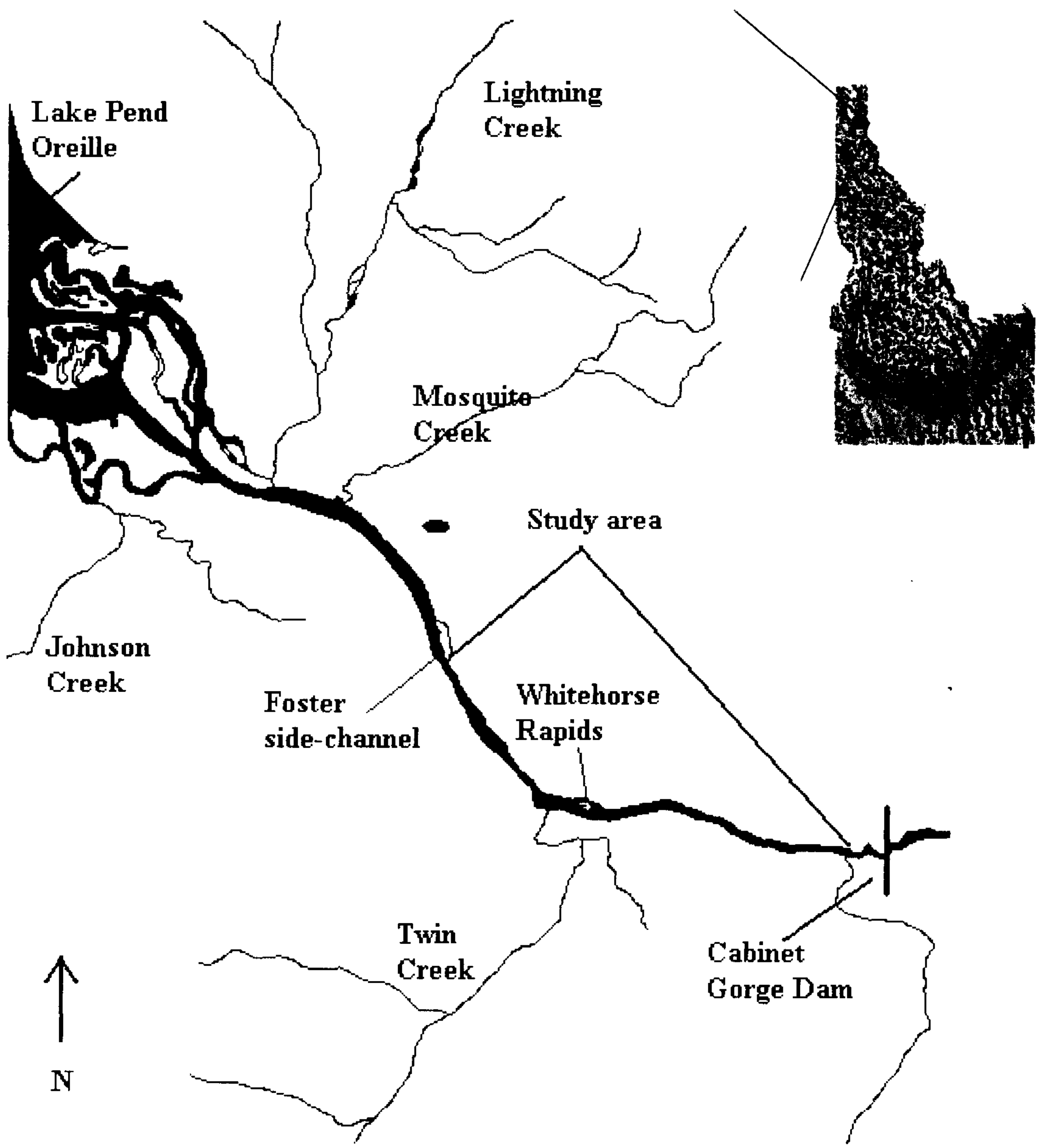


Figure I . Fishery evaluation study area on the Clark Fork River, a tributary to Lake Pend Oreille, Idaho.

Population Size Structure and Condition

Relative weight *(Wr)* (Anderson and Neumann 1996) was calculated to assess salmonid condition. Proportional stock density (PSD) (Anderson and Neumann 1996) was calculated to examine population size structure. PSD for salmonids was separated into two classes; proportion > 305 mm (PSD) and the proportion > 406 mm (Quality Stock Density, QSD) using 200 mm (TL) as stock length (Schill 1991). We used 250 mm as stock length for walleye *Sander r'itrerrs* (Anderson and Neumann 1996) and 400 and 500 mm for PSD and QSD estimates, respectively.

Foster Bar Side-channel Monitoring

We utilized backpack electrofishing equipment to sample near-shore areas of the side-channel for the presence of juvenile salmonids. We sampled June 30, 2003 and November 4, 2004. We sampled three sections located along the longitudinal gradient of the stream channel (Figure 2). Electrofishing was conducted walking upstream netting stunned fish as they were captured in the electrofishing field. Pulsed DC current was employed to capture fish with a typical setting of 400 volts. We recorded time and distance sampled to estimate CPUE. All fish were anesthetized, identified to species, measured, weighed and released. IDFG personnel walked the entire length of the side-channel on December 12, 2003 and on November 30, 2004 looking for kokanee spawning activity.

RESULTS

Population Estimates and Catch-Per-Unit-Effort

We estimated 245 brown trout and 8,210 mountain whitefish greater than 200 mm total length occupied the study reach during the spring sampling period in 2004 (Table 1). CPUE for all salmonids captured during the first night of the marking run reflected a dominance by mountain whitefish (Table 2). Bull trout and hrook trout *Sa/velinn.s fontinulic* were the rarest fish in our catch based on CPUE Over the entire sampling period, one suspected cutthroat trout hybrid (376 nun). three lake trout S. *nainaveush* (660, 688 and 772 mm), two yellow perch *Perea tlaveseens* (231 and 234 mm), two smallmouth bass *tt1ieropterns drrlr~nrieui* (327 and 328 nun), and two walleye (500 and 517 mm) were also captured Upon subsequent laboratory examination. both of' the walleye were determined to he mature males. and dorsal spines and scales were collected for future ageing.

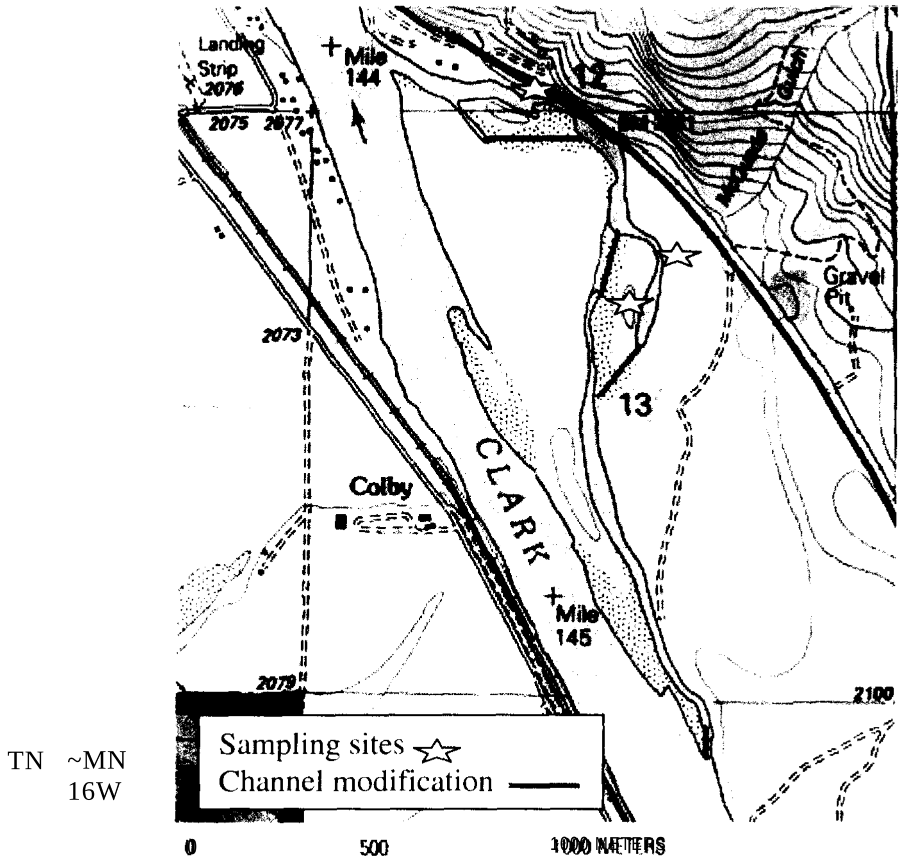


Figure 2. Locations of the three backpack sampling sections in Foster Bar side-channel as well as areas of channel modification to achieve perennial flow through the side-channel over the operational discharges from Cabinet Gorge Dam.

Table I. Population estimate statistics for mountain whitefish and brown trout >200 mm captured in the 6.6 km study reach of the Clark Fork River, Idaho, below Cabinet Gorge Dam, during the last week of March and first week of April, 2004.

Species	**M**	**C**	**R**	**Population estimate**	**Lower 95%** CI	**Upper 95%** CI
Mountain whitefish	610	644	47	8,210	6,446	1 1,243
Brown trout	128	73	38	245	200	318

Table 2. Electrofishing catch-per-unit-effort (CPUE) (fish/minute and fish/ 1000 m) for salmonid species captured along both banks in the 6.6 km study reach of the Clark Fork River, Idaho, during the first night of marking in March 2004.

Species	**Number captured**	**Time electrofished (minutes)**	**CPUE (fish/minute)**	**CPUE (fish/1000 m)**
Brook trout	1	353.32	0.003	0.08
Brown trout	73	353.32	0.207	5.53
Bull trout	1	353.32	0.003	0.08
Kokanee	2	353.32	0.006	0.15
Lake whitefish'	_	353.32	0.006	0.15
Mountain whitefish	234	353.32	0.662	17.73
Rainbow trout	16	353.32	0.045	1.21
Westslope cutthroat trout	23	353.32	0.065	1.74

" Lake whitefish *Coregonu.s rluheafoonis*

Population Size Structure and Condition

During the report period, average length-at-capture across all salmonid species ranged from 215 mm (brook trout) to 706.7 mm (lake trout) (Table 3; Figures 3 through 9). Walleye averaged 508.5 mm in length and 1,300 g in weight (Table 3). PSD's (proportion of catch > 305 mm) for all salmonid species except lake whitefish ranged from 58.8 for westslope cutthroat trout to 87.7 for rainbow trout. QSD's (proportion of the catch > 406 mm) ranged from 2.5 for mountain whitefish to 21 for rainbow trout across all salmonid species (Table 4). Estimated relative weight *(Wr)* for salmonids ranged from 75.8 for brown trout to 95.7 for westslope cutthroat trout (Table 5). Mean Wr for walleye was estimated at 91.2 (Table 5).

Table 3. Mean total length TL (mm), mean weight (g), and standard deviation (SD), for salmonid species and walleye inhabiting the 6.6 km long study reach on the Clark Fork River, Idaho, during the last week of March and first week of April, 2004.

Species	Mean TL (mm) (SD)	Length range (mm)	Sample size of lengths	Mean weight (g) (SD)	Sample size of weights
Brook trout	215.0 (N/A)	N/A	1	_	1
Brown trout	359.2 (84.8)	127-700	167	404.8 (315.5)	109
Bull trout	499.8 (161.1)	282-670	4	1,447.5 (1128.7)	4
Kokanee	275.4 (21.3)	255-310	5	141.7 (28.5)	3
Lake trout	706.7 (58.3)	660-772	3	3,416.7 (1193.0)	3
Lake whitefish	399.2 (25.0)	342-452	23	_ 470.0 (70.7)	2
Mountain whitefish	330.1 (44.8)	128-470	1,245	314.0(120.3)	228
Rainbow trout	354.2 (69.8)	134-591	83	481.1 (384.0)	46
Westslope cutthroat trout	321.1 (36.1)	256-450	68	325.4 (144.6)	51
Walleye	508.5 (12.0)	500-517	2	1,300.0 (127.3)	2

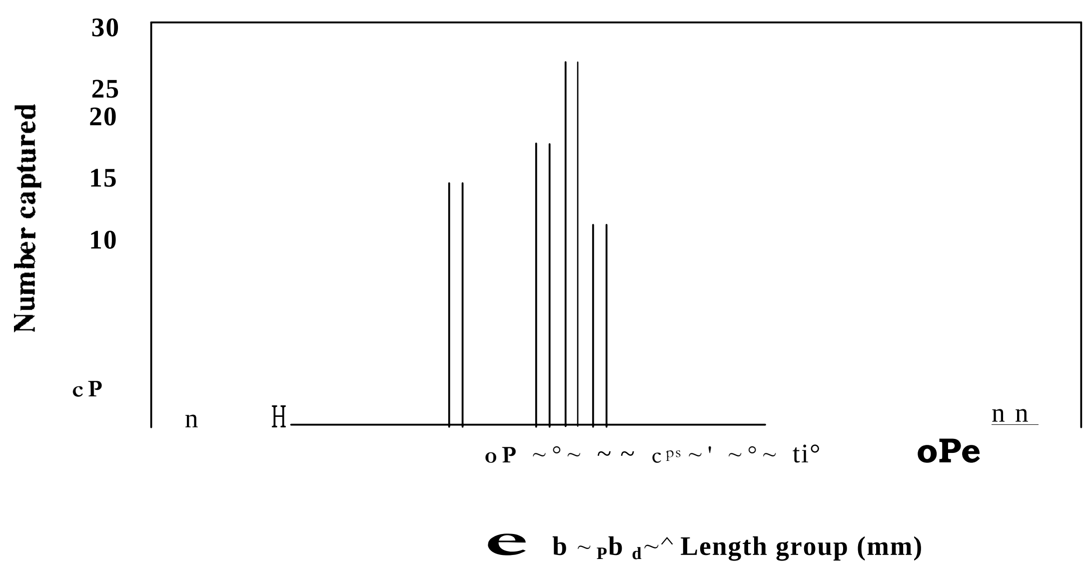


Figure 3. Length frequency histogram for brown trout (n=167) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the last week of March and first week of April, 2004.

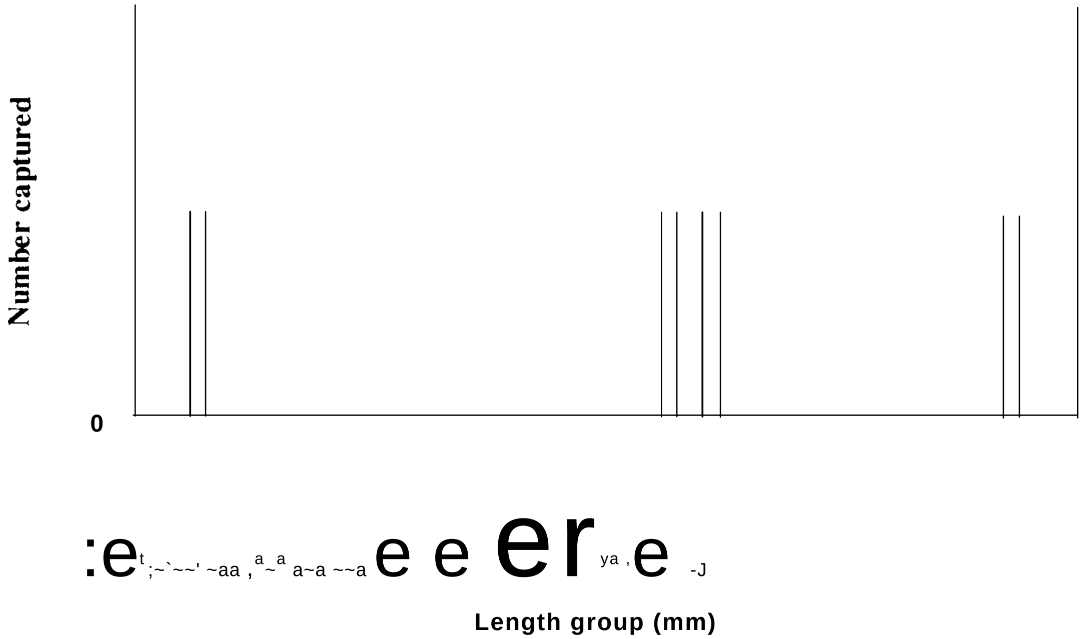


Figure 4. Length frequency histogram for hull trout (n=4) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the last week of March and first week of April, 2004.

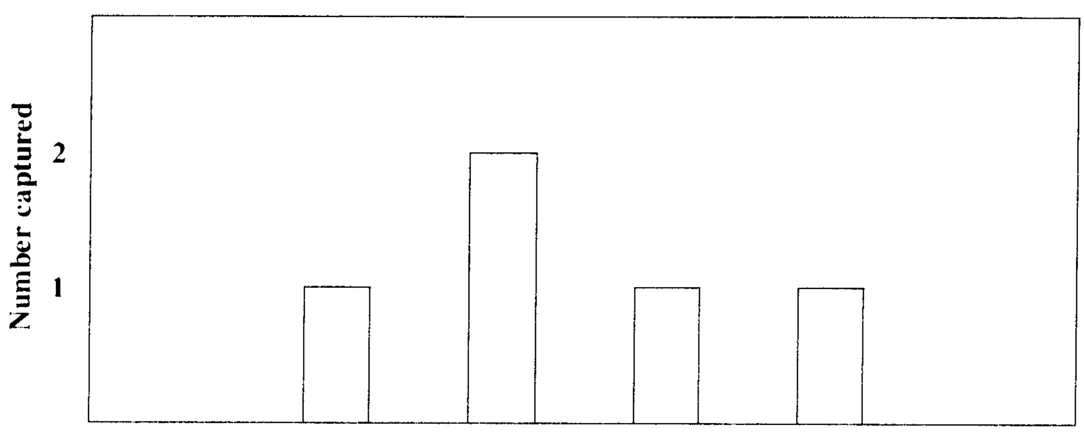


Figure 5 Length frequency histogram for kokanee (n=5) captured in the 6.6 kin long study each of the Clark Fork River. Idaho, during the last week of Mardi and first week of April 2004.

3
0

Length group (mm)

~[a] c[a]

^ti ti~

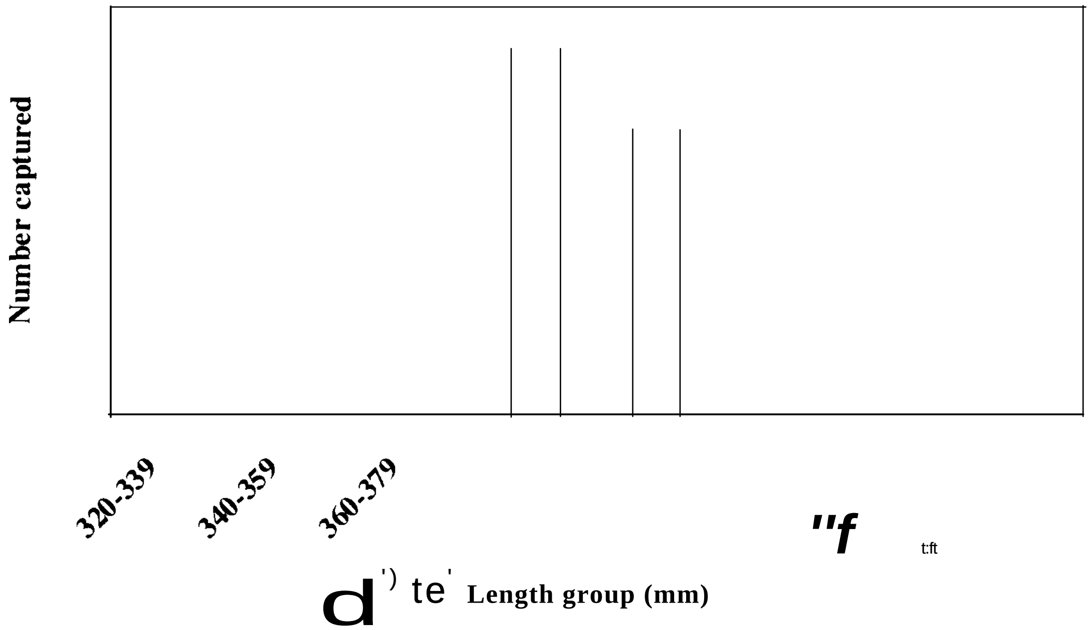


Figure 6. Length frequency histogram for lake whitefish (n=23) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the last week of March and first week of April, 2004.

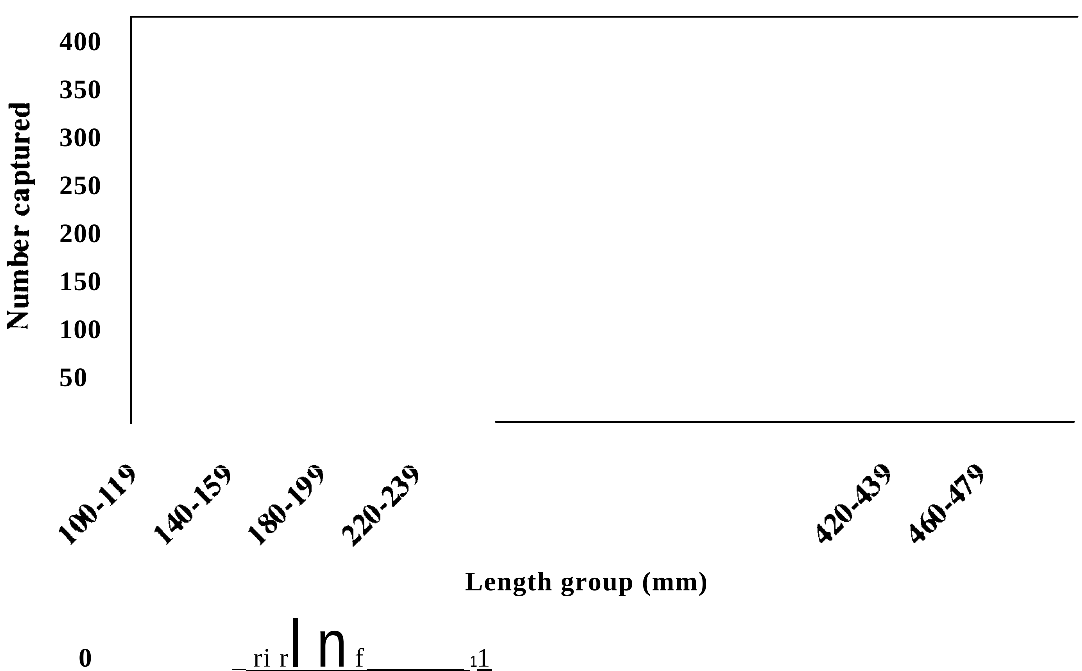


Figure 7. Length frequency histogram for mountain whitefish (n=1,245) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the last week of March and first week of April, 2004.

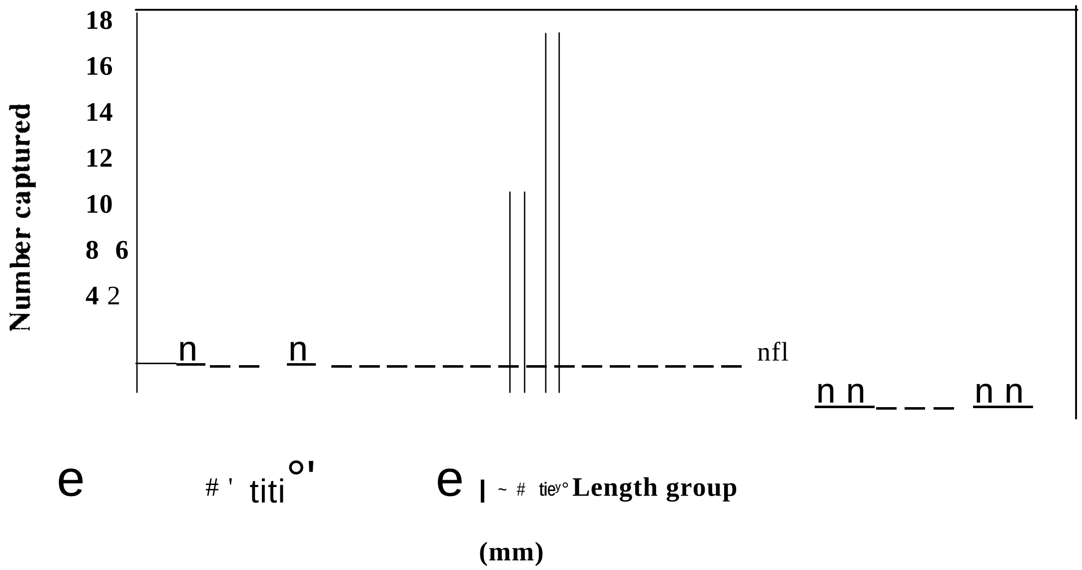
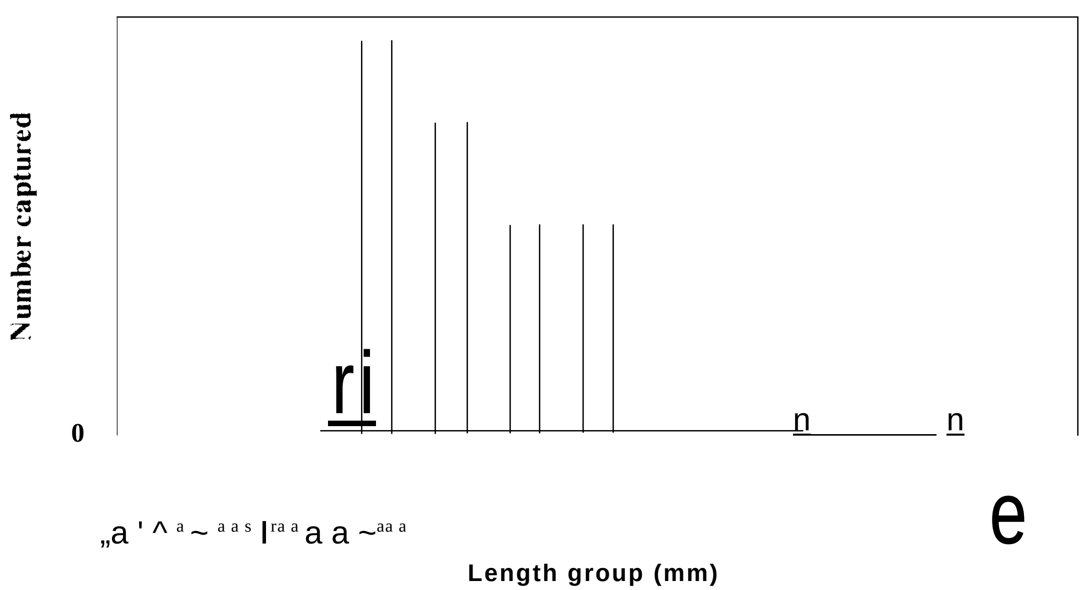


Figure 8. Length frequency histogram for rainbow trout (n=83) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the last week of March and first week of April, 2004.



Fi^g^ure 9. Length frequency histogram for westslope cutthroat trout In=681 captured in the 6.6 km lon^g^ study reach of the Clark Fork River, Idaho, durin^g^ the last week of March and first week of April. 2004.

Table 4. Proportional (PSD) and quality (QSD) stock densities for target salmonid species from the 6.6 km long study reach of the Clark Fork River, Idaho, during the last week of March and first week of April, 2004.

PSD >305 mm (QSD > 406 mm), stock length = 200 mm		
Species	**PSD** (%)	**QSD** (%)
Brown trout	74.2	18.4
Mountain whitefish	80.2	2.5
Rainbow trout	87.7	21.0
Westslope cutthroat trout	58.8	2.9

Table 5. Mean relative weights *(Wr)* for the captured salmonid species and walleye, from the 6.6 km long study reach of the Clark Fork River, Idaho, during the last week of March and first week of April, 2004.

Species	**Mean Wr (SD)**	**Wr range**	**Sample size**
Brown trout	75.8 (10.3)	50.8-1 14	109
Lake trout	89.8 (6.9)	82.8-96.5	_
Mountain whitefish	87.5 (15.8)	57.3-166.3	225
Rainbow trout	94.5 (17.5)	56.6-163.6	45
Westslope cutthroat trout	95.7 (15.5)	72.3-142.6	51
Walleye	91.2 (2.1)	89.8-92.7	2

Foster Bar Side-channel Monitoring

We captured seven species of juvenile fish while electrofishing the Foster Bar side-channel. Of these, the only salmonid species encountered was brown trout. In 2003, mean juvenile brown trout length was 51 mm, and ranged from 45 to 56 mm. The mean weight was 1.7 g, and ranged from 1 to 2 g. No brown trout were captured in 2004. In addition to juvenile brown trout, we also captured largemouth bass *Micropterus salmoides*, northern pikeminnow *Ptvchocheilus oregonensis,* peamouth *Mvlocheilus caurinus,* pumpkinseed *Lepornis gihhosus,* redside shiner *Richarc/onius balteatus,* and sucker *Catostomus sp.* (Table 6). Water temperature during sampling was 16.5° C and 8° C in 2003 and 2004 respectively.

IDFG personnel walked the entire length of the side-channel on December 12, 2003 and on November 30, 2004 looking for kokanee spawning activity. Despite what appeared to be an abundance of appropriate size spawning gravel in the side-channel, no kokanee were observed.

Table 6. Mean total length TL (mm), mean weight (g), standard deviation (SD), and length range for species captured in the Foster side-channel during 2003 and 2004.

Species	Year	Mean length (SD)	Length range	Mean weight (SD)	Weight range	Sample size
Brown trout	2003	51.0 (5.6)	45-56	_	1-2	3
	2004	N/A	N/A	N/A	N/A	N/A
Largemouth bass	2003	N/A	N/A	N/A	N/A	N/A
	2004	77.0 (N/A)	N/A	8.0 (N/A)	N/A	1
Northern pikeminnow	2003	98.4 (45,3)	40-139	11.8 (10.5)	1-23	5
	2004	49.7 (12.4)	38-90	1._5 (1.2)	1-6	23
Peamouth	2003	N/A	N/A	_	N/A	N/A
	2004	53.0 (N/A)	N/A	1.0 (N/A)	N/A	_
Pumpkinseed	2003	N/A _	N/A	N/A	N/A	N/A
_	2004	74.5 (23.3)	58-91	9.0 (8.5)	3-15	
Redside shiner	2003	72.2 (26.2)	37-108	4.5 (3.7)	1-12	14
	2004	72.0 (5.7)	_	3.5 (0.7)	3-4	2
Sucker .sp.	2003 _	56.4 (4.2)	51-62	2.6 (0.5)	2-3	5
	2004	59.5 (21.9)	43-175 _	_	1-51	40

DISCUSSION

Population Estimates and Catch-Per-Unit-Effort

Population estimates for brown t[r]out in 2004 were higher than observed in either 2000 or 2002 (Figure 10). Confidence intervals do not overlap between the 2002 and 2004 estimates, suggesting the increase is statistically significant. The 2000 estimate, although it provides a point of reference for comparisons with other years, will have !United utility in determining population trends because the variability around the estimate is high. The population point estimate for mountain whitefish has remained relatively constant from 2002 to 2004, but was considerably greater than that observed in 2000 (Figure I I). Overlapping confidence intervals suggest the estimates are not statistically significantly different. Additionally, very low numbers of recaptures (3) may have biased the population estimate in 2000. Annual variability is high in the population estimates overall, making detecting a statistically si[g]nificant change difficult without dramatic changes in abundance Spring CPUF for brown trout increased from 0.06 to 0.2I fish/minute of electrofishing from 2002 to 2004, respectively. This is consistent with the increase observed in the population estimate Spring CPUF for mountain whitefish decreased from I 18 to MI6 fish/minute of electrofishing from 2002 to 2004, and suggests a decline in mountain whitefish abundance However. the population estimates are similar for these years and the differences in CPUE may reflect to a large degree the patchy distribution of mountain whitefish in the Clark Fork River. Slight differences in electrofishing effort/technique can result in considerable differences in catch of mountain whitefish in the Clark Fork River. It is not possible at this time to draw meaningful conclusions regarding the effectiveness of the increased minimum flow to increase salmonid populations due to high variability in the estimates of population size, short-term nature of the data set, and the lack of pre-treatment population estimates. However, it may take a number of years for any benefits resulting from improving rearing conditions to express themselves in terms of adult abundance. This would allow us to use the first couple of years of population estimates as our baseline. Appendix T of the Clark Fork Settlement Agreement (Avista 1999) calls for evaluation of the increased minimum flow over the first 10 years of the agreement. We will continue to sample in the fall to monitor westslope cutthroat and rainbow trout, and in the spring to monitor brown trout and mountain whitefish, in alternating years, to identify trends in abundance resulting from the increased minimum flow in the Clark Fork River.

a

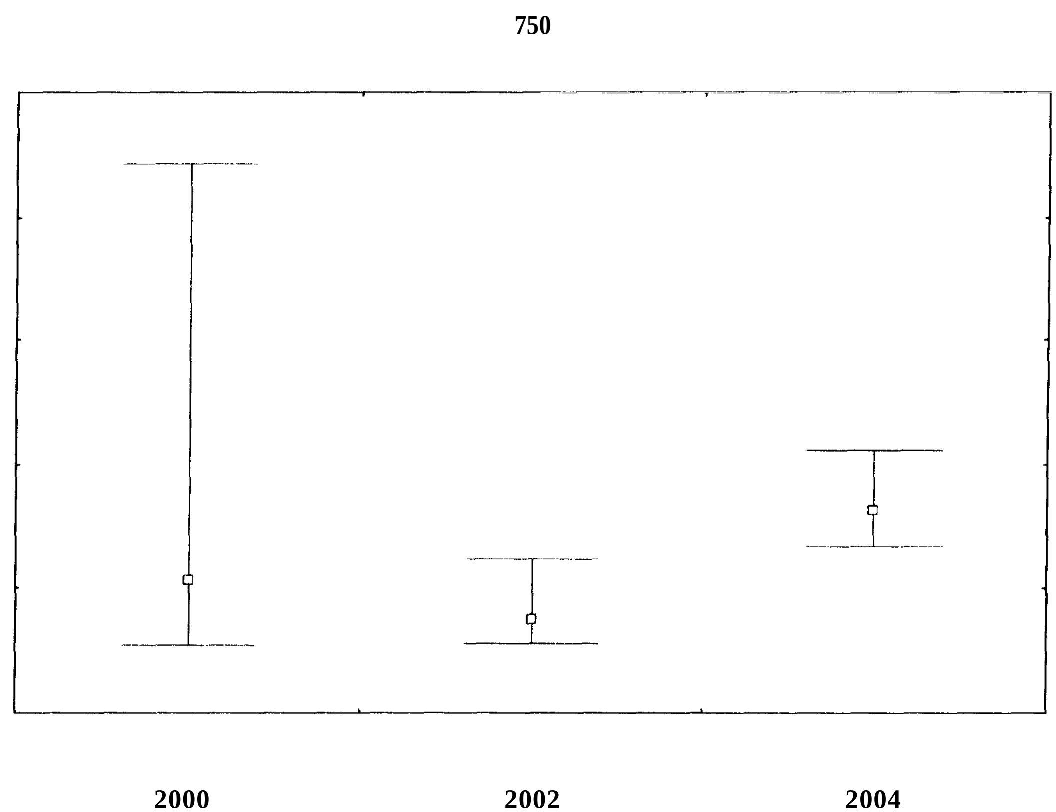


Figure 10. Comparison of population estimates and associated 95% confidence intervals, conducted for brown trout in the 6.6 km long study reach of the Clark Fork River. Idaho, 2000 through 2004.

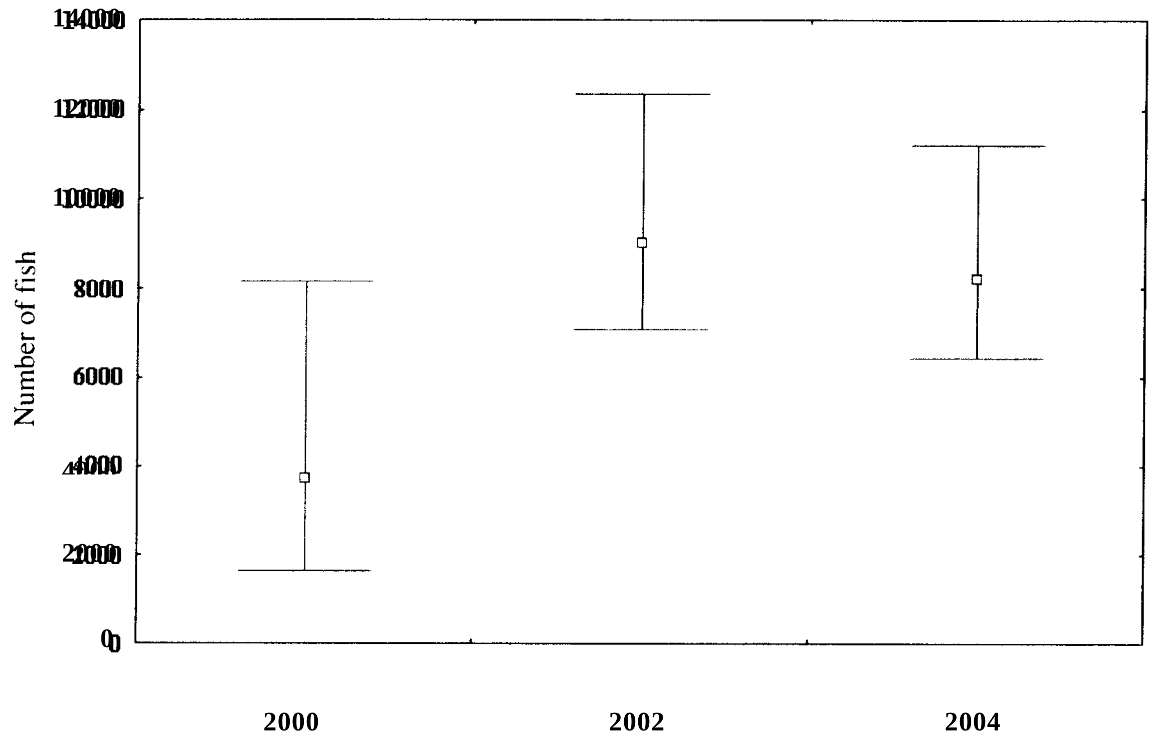


Figure I I. Comparison of population estimates and associated 95% confidence intervals, conducted for mountain whitefish in the 6.6 km long study reach of the Clark Fork River, Idaho, 2000 through 2004.

Population Size Structure and Condition

Population size structure for brown trout appears to be shifting to smaller individuals. From 2000 to 2004, the proportion of individuals in the population greater than 305 mm has remained relatively constant. However, the proportion of individuals in the population greater than 406 mm has consistently declined over time (Table 7). This shift is consistent with the increased abundance we have been observing and may reflect strong recruitment of smaller fish into the population, along with the loss of some of the larger fish observed in earlier sampling years from the river area. Larger brown trout may be targeted by anglers in the river and harvested, or may move to the lake environment to maximize their feeding and growth efficiency. Mountain whitefish population size structure appears to be improving, with the proportion of individuals captured in the larger size classes increasing slightly (Table 7).

Mean length for brown trout does not appear to show a consistent trend, although the mean value observed in 2004 was the smallest of the three years compared (Table 8; Figure 12). Mean length for mountain whitefish suggests an increasing trend, but overlapping confidence intervals suggest the differences may not be statistically significant (Table 8; Figure 13).

Table 7 Proportional stock density (>305) and quality stock density (>406) estimated for brown trout and mountain whitefish captured in the Clark Fork River, Idaho, during spring sampling from 2000 through 2004. Stock length is 200 mm.

	Mountain whitefish		**Brown trout**	
	PSD	**QSD**	**PSD**	**QSD**
2000	67.1	0.7	73.3	43.1
2002	79.3	1.5	86.3	32.9
2004	80.1	2.4	74.2	18.4

Table 8. Mean total length (TL; mm) estimated for brown trout and mountain whitefish captured in the Clark Fork River, Idaho, during spring sampling from 2000 through 2004.

	Mountain whitefish		**Brown trout**	
	Mean TL (SD)	**Sample size**	**Mean TL (SD)**	**Sample size**
2000	323.6 (39.3)	282	386.6 (107.3)	52
2002	328.6 (40.7)	177	387.1 (71.5)	70
2004	330.1 (44.8)	1,245	359.2 (84.8)	167

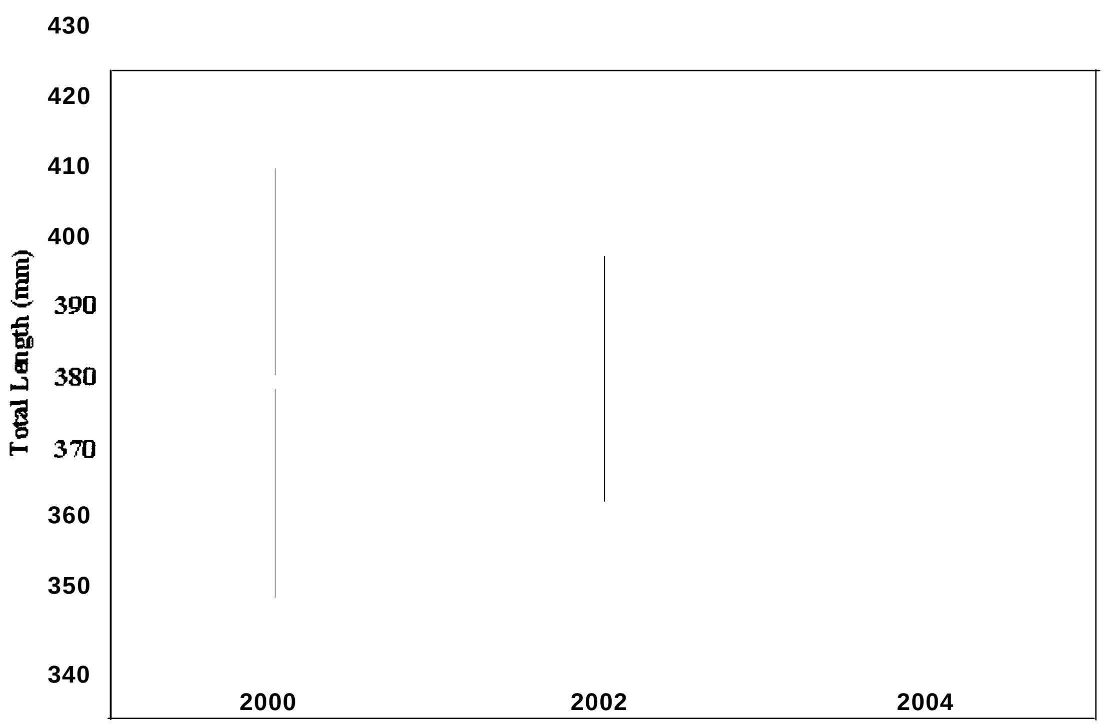


Figure 12 . Mean total lengths estimated for brown trout captured in the Clark Fork River. Idaho, during March and April, 2000 through 2004.

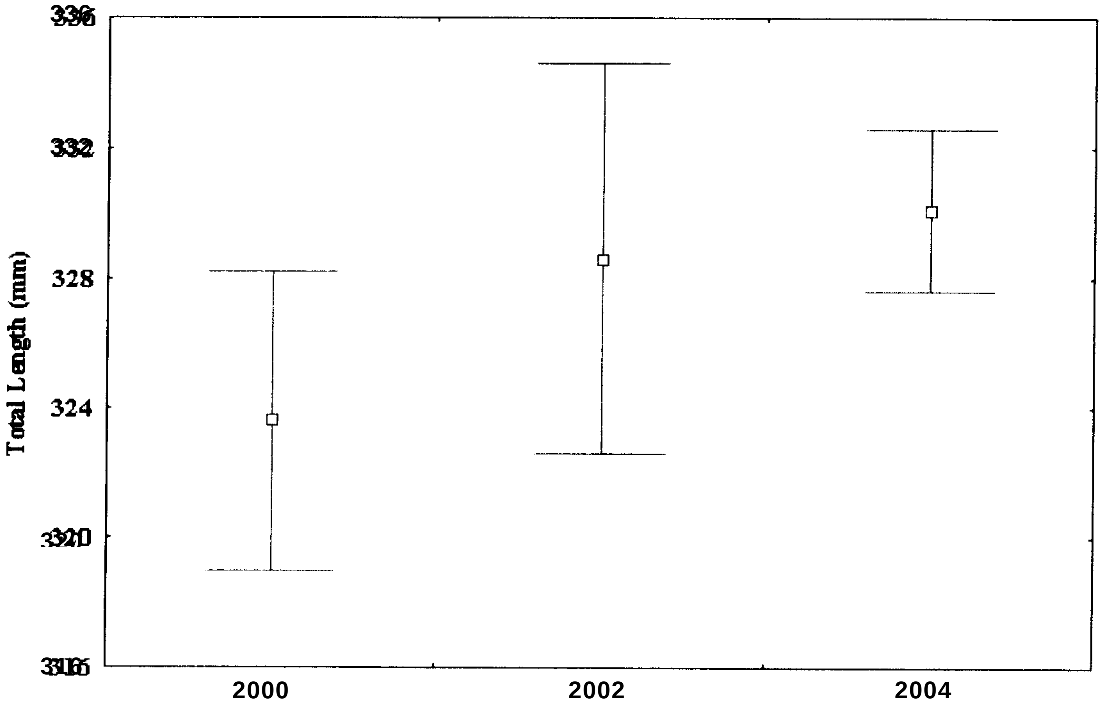


Figure 13. Mean total lengths estimated for mountain whitefish captured in the Clark Fork River, Idaho, during March and April, 2000 through 2004.

A basic premise of *Wr* is that the value of 100 represents the shape of a fish of that species in good condition. When *Wr's* are consistently well below 100, problems may exist in food or feeding (Anderson and Neumann 1996). Our observed values for both mountain whitefish and brown trout are consistently lower than 100, suggesting less than optimum foraging conditions may exist in the Clark Fork River (Table 9). However, the timing of fish capture would potentially influence the *Wr* values. Sampling for fall spawning salmonids (brown trout and mountain whitefish) occurs in very early spring, at a time when fluvial fish would be expected to be in their poorest condition. *Wr* values estimated at different times of the year may yield different results.

Mean *Wr* values for brown trout appear to have declined since 2000, but overlapping 95'7r confidence intervals suggest the difference may not be statistically significant (Figure 14). Mean *Wr* values for mountain whitefish do not suggest a consistent trend, but the *Wr* in 2004 was the highest of the three years compared (Figure 15).

Table 9. Mean relative weight *(Wr)* estimated for brown trout and mountain whitefish captured in the Clark Fork River, Idaho, during spring sampling from 2000 through 2004.

	Mountain whitefish		**Brown trout**	
	Mean *Wr* (SD)	**Sample size**	**Mean *Wr* (SD)**	**Sample size**
2000	83.2 (11.8)	67	80.2 (9.9)	27
2002	82.4 (8.1)	51	78.4 (10.4)	24
2004	87.5 (15.8)	225	75.9 (10.3)	108

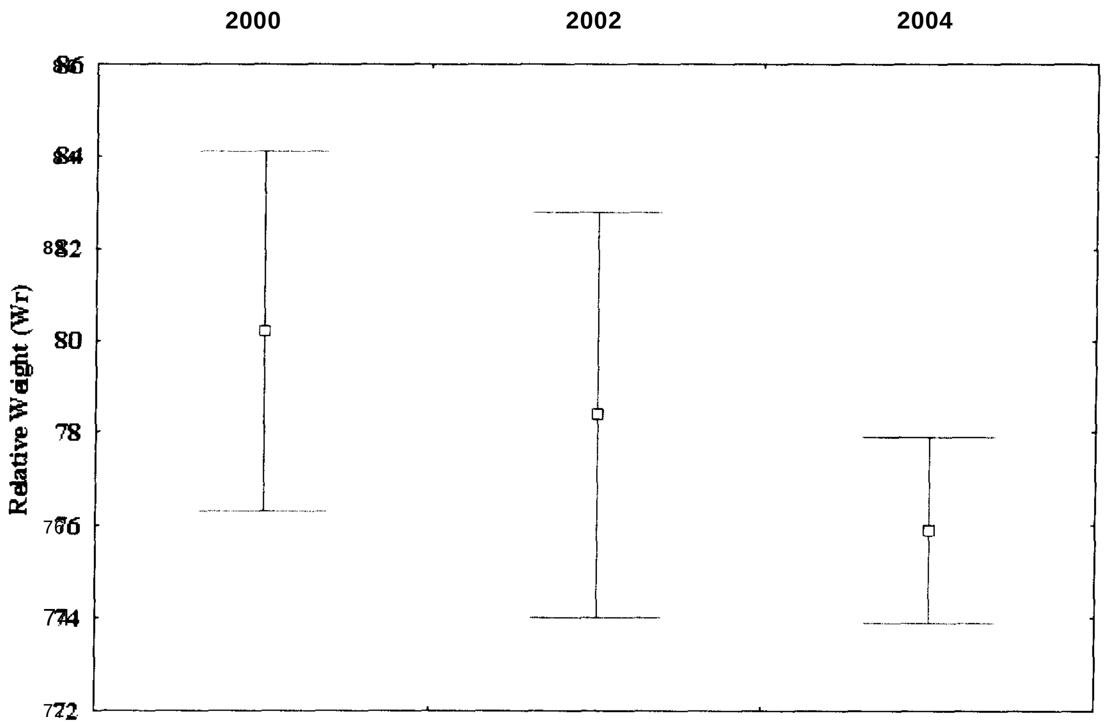


Figure I4. Mean Wr estimated for brown trout captured in the Clark Fork River, Idaho, during March and April, 2000 through 2004.

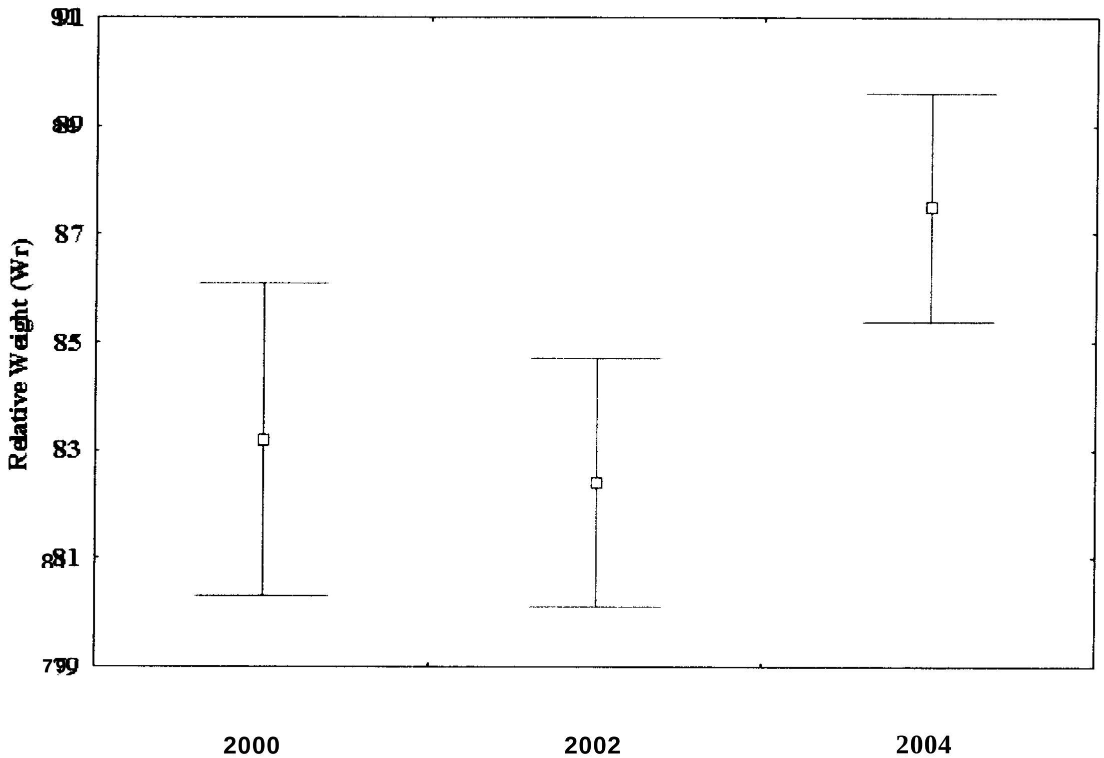


Figure 15. Mean Wr estimated for mountain whitefish captured in the Clark Fork River, Idaho, during March and April, 2000 through 2004.

A number of factors acting in combination may be regulating salmonid abundance and condition in the Clark Fork River. These include low habitat diversity (only one section of riffle habitat in the study area), limited tributary spawning and rearing habitat (Twin Creek), relatively warm summer water temperatures (21°C recorded on July 24, 2002) (C. Downs, IDFG, personal communication), elevated total dissolved gas levels in most years (Parametrix 2000b), and continued power-peaking.

Foster Bar side-channel

We have attempted to sample Foster Bar side-channel during several different times of the year with different sampling gears. Sampling with jet boat electrofishing equipment in July, 2002, was halted due to elevated water temperatures. Backpack sampling is hampered by widely varying flow conditions into the side-channel. Attempts to walk the side-channel looking for spawning kokanee have been a successful sampling approach, but no kokanee have been observed.

Few juvenile salmonids have been captured in the side-channel during our sampling. This may he the result of very low density, or the result of inadequate sampling to date. We recommend sampling the side channel using a combination of the three techniques described above, but with modifications to their timing and technique. Backpack electrofishing is likely to be more effective at capturing juvenile salmonids in the side-channel and should be continued. The number of sites and their distribution should be expanded to collect a more representative sample of the species present in the side-channel. Sampling should take place during lower flow periods of the spring or early summer to avoid periods of warmer water temperatures. A single pass down the entire length of the side-channel with the electrofishing jet-boat during a similar time period is recommended to provide information on adult fish use. Continued periodic stream walking of the side-channel will be useful to document any future use of the side-channel by kokanee. Once a baseline of fish use is established after two years of sampling, we will reduce the sampling frequency to longer intervals (e.g. every five years, or as needed).

ACKNOWLEDGEMENTS

Thanks to Sean Moran, Jeremy Stover, John Suhfras, Shana Bernal], Ryan Weitz, Kevin Duffy, and Tom Hardy of Avista, as well as Idaho Department of Fish and Game Bayview field office fishery staff for assistance with field work. We would also like to thank Mark Gamblin and Ned Horner of the Idaho Department of Fish and Game, Joe DosSantos of Avista Corp., Laura Katzman of Montana Fish, Wildlife, and Parks, and Larry Lockard of the U.S. Fish and Wildlife Service for their reviews of this report.

LITERATURE CITED

Anderson, R.O. and R.M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 *in* Fisheries Techniques, 2nd Edition, American Fisheries Society, Bethesda, Maryland.

Anderson, R. 1978. Age and growth of Pend Oreille Lake Kamloops. Idaho Department of Fish and Game. Federal aid to Fish and Wildlife Restoration. Lake and Reservoir Investigations Project F-53-R-12 and 13. Boise.

Avista Corporation. 1999. Volume III, Clark Fork Settlement Agreement. Spokane, Washington.

Beak Consultants, Inc. 1997. Photo documentation of flows in the lower Clark Fork River. Report to Washington Water Power. Portland, Oregon.

Dalbey, S.R., T.E. McMahon, and W. Fredenberg. 1996. Effect of electrofishing pulse shape and electrofishing induced spinal injury on long-term growth and survival of wild rainbow trout. North American Journal of Fisheries Management 16:560-569.

Downs C., and R. Jakubowski. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2002 Progress Report. Project 2, 2002 bull trout redd counts; Project 3, 2002 Clark Fork River fishery assessment progress report; Project 5, 2000-2002 Trestle and Twin creeks bull trout outmigration and Lake Pend Oreille survival study; Project 6, 2002 Johnson and Granite creeks bull trout trapping; Project 7, 2002 Twin Creek restoration monitoring progress report. Avista Corporation. Spokane, Washington.

Downs, C.C., R. Jakubowski, and S. Moran. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 1999-2001 Progress Report. Project 1, Johnson and Rattle creeks bull trout trapping; Project 2, Bull trout redd counts and escapement estimates 1999-2001; Project 3, Clark Fork River fishery assessment 1999-2001; Project 4, Lake Pend Oreille tributary instream flow evaluation. Avista Corporation. Spokane, Washington.

Frenzel, S.A. 1991. Hydrologic budgets, Pend Oreille Lake, Idaho 1989-90. U.S. Geological Survey. Boise, Idaho

Helmer, J.T., 1965. A supplemental Dolly Varden spawning area. M.S. Thesis, University of Idaho. Moscow.

Krebs, C.J. I989. Ecological Methodology. Harper-Collins Publishers, Inc. New York, New York.

Lee, K.H., and R.S. Lunetta. 1990. Watershed characterization using Landsat Thermatic Mapper 1m satellite imagery, Lake Pend Oreille, Idaho. U.S. EPA Environmental Monitoring Systems Lab. Las Vegas, Nevada.

Panhandle Bull Trout Technical Advisory Team. 1998. Lake Pend Oreille Key Watershed Bull Trout Problem Assessment. Idaho Department of Environmental Quality. Boise.

Parametrix, Inc. 2000a. Gas bubble disease lower Clark Fork River. Final Report to Avista Corporation, Spokane, Wa.

Parametrix, Inc. 2000h. Total dissolved gas monitoring Cabinet Gorge and Noxon Rapids hydroelectric projects. 2000. Final Report to Avista Corporation. Spokane, Wa.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research hoard of Canada Bulletin 171.

Schill. D.J. 1991 River and stream investigations. Sub project 2 Study 4: Wild trout investigations. Job 1: Statewide data summary. Job 2: Bull trout ageing and enumeration. Job 3: Bait hooking mortality. Job 4: Electrophoresis sampling. Job Performance Report. Project F-73-R- I3. Idaho Department of Fish and Game. Boise.

Scher. G.A.F. 1982. The estimation of animal abundance and related parameters, 2nd edition. Griffin, London.

Washington Water Power. 1995 Evaluation of Fish Communities on the Lower Clark Fork River, Idaho. Spokane, Wa.

Washington Water Power. 1996. 1994-1995 Evaluation of Fish Communities on the Lower Clark Fork River, Idaho: A Supplemental Report. Spokane, Wa

/ar, J.H. I996. Biostastical analysis, 3rd edition. Simon and Shuster, Upper Saddle River, New Jersey.

Project 5: Trestle and Twin Creeks Bull Trout Outmigration and Lake Pend Oreille Survival Study Progress Report - 2004.

ABSTRACT

We utilized a rotary screw trap and weirs to capture juvenile bull trout *Salve/thus con/luentus* from Trestle and Twin creeks, Idaho in 2000 through 2002 in order to estimate their abundance, and evaluate survival rates in the tributary and lake environment. We marked 922 age-I and older outmigrating juvenile bull trout with Passive Integrated Transponder (PIT) tags from 2000 through 2002 to directly estimate survival from juvenile to mature adults in Lake Pend Oreille. We operated a remote PIT tag detection weir on Trestle Creek seasonally from 2001 through 2004 to identify bull trout upon their return as adults. We also captured and marked 245 adults in 2002 with PIT tags to estimate the frequency of repeat spawning and annual survival of adult bull trout in the Lake Pend Oreille system. We detected the first returning adults in 2003, originally marked as juveniles in Trestle Creek in previous years. Four of the 270 juveniles originally marked outmigrating from Trestle Creek in 2000, were detected again in Trestle Creek in 2003. One of the 350 juveniles originally marked outmigrating from Trestle Creek in 2001, was detected in Trestle Creek in 2003. In 2004, 18 juveniles from the 2000 marking group were detected by the remote station as returning adults, with an additional fish found dead during the annual Trestle Creek redd count. This brings the total unique individual returns back to Trestle Creek from the 2000 juvenile marking group to 23 (8.5%). Nine of the 350 juveniles (2.6%) originally marked outmigrating from Trestle Creek in 2001 also returned in 2004. One of the nine returning adults from the 2001 marking group was the single fish detected in 2003. No returning adult bull trout have been detected from the 2002 juvenile marking group to date. Of the 245 adult bull trout marked with PIT tags in 2002, 76 were detected again in Trestle Creek in 2003, while 28 were detected in 2004. Of these 28, 12 were repeat spawners from 2003. We marked 42 juvenile bull trout with PIT tags in Twin Creek for lake survival estimation from 2000 through 2002. We have not detected any returns from the marked juvenile bull trout in Twin Creek to date. We captured 13 individual adult bull trout in 2004 at the weir on Twin Creek. Of these, two had been captured and PIT tagged in Twin Creek in a previous year (2002 and 2003).

Authors:

Christopher C. Downs
Senior Fishery Research Biologist
Idaho Department of Fish and Game

Robert Jakubowski
Natural Resources Technician
Avista Corporation

INTRODUCTION

Long-term data sets are available for bull trout *Sah'elinus con/luentus* redd counts in many Lake Pend Oreille (LPO) tributaries. Relationships have also been developed to estimate the size of adult spawning populations using observed adult bull trout to redd count ratios. An aspect of interest in the LPO system is how the number of redds observed in a tributary relates to the actual number of juvenile outmigrants and their survival back to adult escapement.

Development of juvenile bull trout outmigration estimation techniques may provide a mechanism by which we can more accurately identify trends in local bull trout populations, and identify survival problems earlier, with more specificity than simply using redd counts. In addition, quantification of juvenile return rates through recapture as spawning adults will provide an estimate of in-lake survival and insight into the role the lake environment plays in regulating local bull trout abundance, as well as its' role in recovering upstream bull trout stocks.

This study also provides a mechanism to estimate juvenile bull trout production from two Idaho tributaries heavily involved in either restoration and/or habitat protection. We will be able to measure the success of our restoration/habitat protection efforts by periodically comparing trapping results into the future.

Two streams are being used in the study, Trestle and Twin creeks. Trestle Creek, a tributary entering the northeast portion of LPO, Idaho, has consistently remained the most important producer of bull trout in the LPO system (Figure 1). Trestle Creek drains approximately 51 square-kilometers of the Cabinet Mountains and supports an annual run of 500 to over 1,000 fish, representing 30-50% of the bull trout spawning escapement from LPO (Downs et al. 2003). We are unaware of any other individual stream in the U.S. that supports an annual run of bull trout spawners as large as Trestle Creek. The LPO Key Watershed Bull Trout Problem Assessment (PBTAT 1998) recognized Trestle Creek as the highest priority tributary stream in the LPO watershed. While rating Trestle Creek's bull trout population as having the highest probability of persistence of any stream in the LPO watershed, the assessment also noted that bull trout have highly specific habitat requirements and high sensitivity to human-induced disturbance. S

Physical habitat conditions were generally considered to be good in Trestle Creek. Legacy effects from past logging and road construction, and potential impacts from future timber harvest and road construction, have been largely addressed in the watershed (PBTAT 1998). The Trestle Creek Local Working Committee developed and adopted site-specific forestry best management practices under the Idaho Forest Practices Act. In 1995, the Forest Service completed a comprehensive Trestle Creek watershed restoration project that was designed to mitigate the potential adverse watershed impacts from decades of road construction and logging (USDA Forest Service 1993). That project was considered to have significantly reduced the threats to bull trout habitat in the upper watershed (PBTAT 1998). In addition, the Idaho Tributary Habitat Acquisition and Enhancement Program funded by Avista Corporation, under the ('lark Fork Settlement Agreement, has purchased four riparian properties on "Trestle Creek totaling 46. I ha, reducing the risk of residential development.

Twin ('reek is a spring-fed tributary to the lower Clark Fork River in Bonner County, Idaho, and drains approximately 28.5 km` of the Bitterroot Mountains. Twin Creek is used for spawning by hull trout and westslope cutthroat trout *Oncorhtnchus c/arki lewisi,* as well as brown trout *Salmo truth'*, mountain whitefish *Prosopium williamsoni*, rainbow trout O. *,nykiss*, and kokanee O. *nerka* migrating from the Clark Fork River and LPO (Figure 1). Brook trout *Salve/inns f,ntinalis* are also present. Construction of Cabinet Gorge Dam in 1952, located several km's upstream of Twin Creek, blocked upstream migrations of fish from LPO to tributaries in Montana. During the mid-1950's, biologists documented between 50 and 80 bull trout redds each fall in the lower 1.6 km of Twin Creek. Recent estimates of bull trout spawner to redd ratios for LPO tributaries suggest an average of 3.2 bull trout spawn for every redd constructed (Project 6 in this report), or that approximately 160 to 256 adults were entering Twin Creek annually to spawn. In the early 1950's, much of lower Twin Creek was channelized for agricultural purposes, resulting in a significant reduction in actual stream length, and a loss of habitat diversity. The stream channel was relatively straight, wide, and shallow, with depths rarely exceeding 15 cm during the summer/fall low flow period. Livestock grazing occurred throughout most of the summer, and streamside vegetation was limited to grasses and a few alders along approximately 30 percent of the channel length. Since 1992, the average number of bull trout redds counted in this reach was six. The low number of redds suggests this population is at risk of extinction.

A project was initiated in 1999 to move much of Twin Creek back into its original channel, restore the natural meander pattern, and reconstruct the habitat diversity. The primary goal of the restoration project was to restore numbers of spawning bull trout using Twin Creek to levels observed prior to channelization of the stream.

Our work on Trestle and Twin creeks in 2004 marks the fifth year of what is anticipated to be an eight-year study into the life-history and survival of bull trout inhabiting LPO tributaries. The first three years of the study (2000-2002), involved the capture and marking of bull trout, and the subsequent five years will involve recapture of marked individuals to estimate the desired survival rates and life-history parameters.

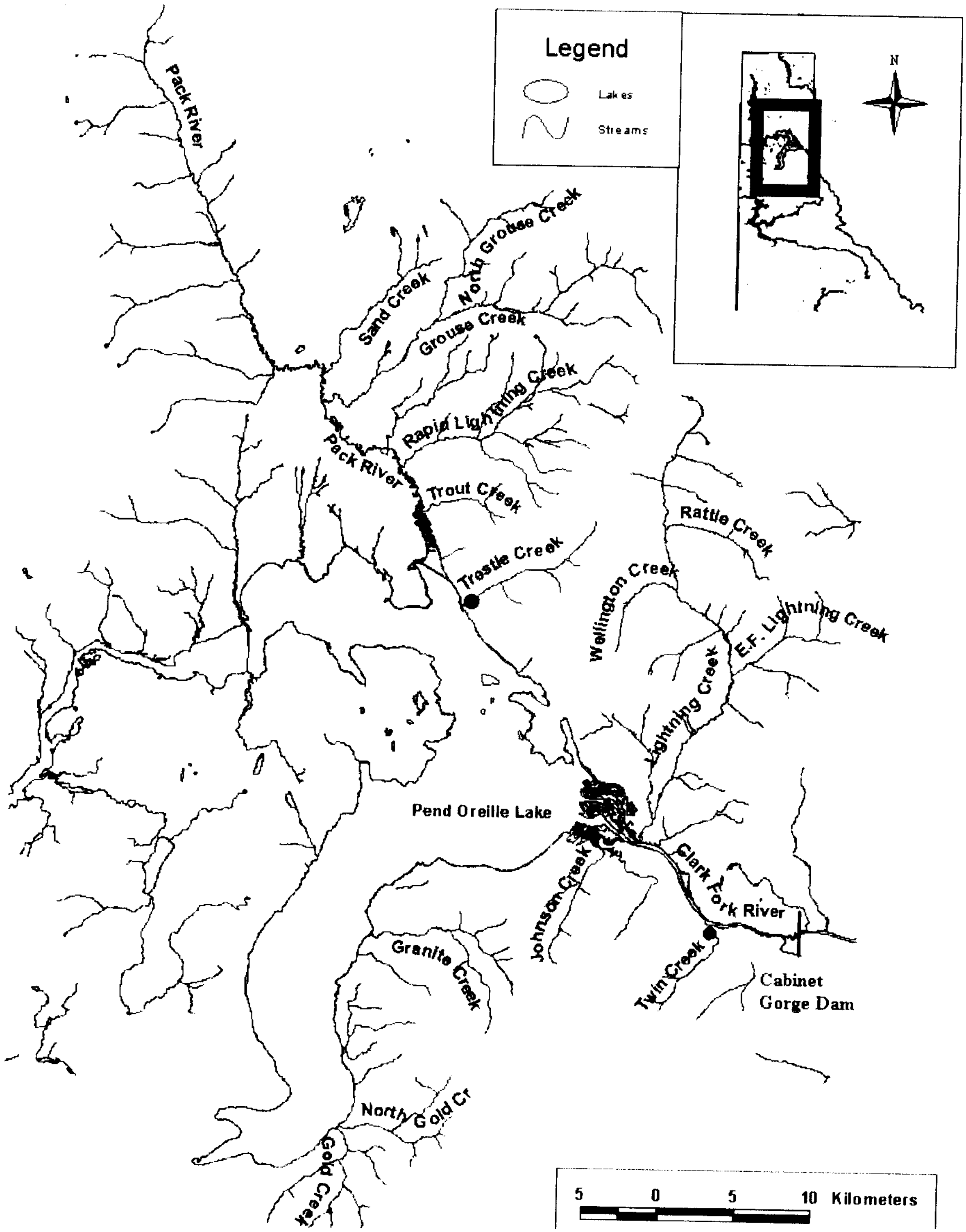


Figure I. Trap locations on Trestle and Twin creeks, Idaho, tributaries to Lake Pend Oreille and the ('lark Fork River, Idaho, below Cabinet Gorge Darn.

METHODS

Survival Estimation Trestle Creek

In 2001, we developed and installed a remote Passive Integrated Transponder (PIT) tag detection weir near the mouth of Trestle Creek to reduce the labor needed to handle hundreds of adult bull trout moving in Trestle Creek, and reduce fish stress (Downs and Jakubowski 2003). The setup consisted of a picket weir and modified trap box. Fish were guided by the weir panels, into a conical shaped entrance in a metal frame trap box covered with 6 mm black plastic mesh. The cone funneled down to an opening approximately 175 mm in diameter, surrounded by a waterproof PIT tag reading antennae. As PIT tagged fish passed through the antennae, the frequencies were recorded on a FS-2001 PIT tag reader (full-duplex tag reading system) enclosed in a protective ammo can mounted on top of the trap box. We utilized a 12-volt Deep Cycle battery or 120-volt AC to power the system. Data was downloaded from the PIT tag receiver to a laptop computer for storage and analysis. We tested the efficiency of the PIT tag detection system for cheek tagged adult bull trout by comparing the number of PIT tagged adults captured moving downstream in the screw trap, with the number of these fish subsequently detected at the remote PIT tag receiving station (Downs and Jakubowski 2003).

From 2000 through 2002, 922 juvenile, and 674 adult bull trout were marked for survival estimation using PIT tags in Trestle Creek (Downs and Jakubowski 2003). Juvenile bull trout were tagged in each year, but adult bull trout were only PIT tagged in 2000 and 2002. In 2004, the remote PIT tag detection weir was installed in Trestle Creek on June 22 and removed on October 18. Due to occasional damage to the weir caused by high water and debris, it operated for 114 out of a possible 117 nights.

A minimum annual survival rate (S) from 2000 to 2001 was estimated as the proportion of individual adult bull trout marked in Trestle Creek in 2000, which have been detected in subsequent years (to date) in Trestle Creek (Ricker 1975) as:

S - N,.,/N,

where:

N, = Number of fish alive at time t (marked in 2000)
N, / Number of fish alive at time t+1 (cumulative detections of unique marked fish in subsequent years)

Survival Estimation Twin Creek

On July 8, 2004, we installed a weir on Twin Creek with both upstream and downstream trap boxes to capture migrating adult hull trout. The weir consisted of steel pickets with 25.4 cm spacing in a metal frame, with 1.22m x 0.91m x 0.91m steel frame trap boxes wrapped in 6.35 mm black plastic mesh used to capture the fish (Downs and Jakubowski 2003). This configuration was used for the downstream trap box until it was removed on November 3. However, on October 21, the upstream trap box was removed. A picket weir was installed in its place by Idaho Fish and Game Cabinet Gorge Fish Hatchery staff to capture upstream moving adult kokanee for egg taking purposes.

Captured bull trout were anesthetized, examined for marks, scanned for the presence of a PIT tag, and measured (total length (TL); mm). If a PIT tag was not already present in a captured adult bull trout, a 11.5 X 2.1 mm 134.2 khtz PIT tag was inserted into the soft tissue of the cheek, oriented approximately parallel with the dorsal-ventral plane of the fish. If a PIT tag was not already present in a juvenile bull trout (< 300 mm), a PIT tag was inserted into the abdomen of individuals greater than 75 mm. All fish were allowed to recover their equilibrium in fresh water for several minutes. All other fish were anesthetized, identified to species, measured (TL; mm) and weighed (g). In 2004, an electronic temperature recorder was installed in Twin Creek on July 16 and removed on November 3.

RESULTS and DISCUSSION

Trestle Creek

Four of the 270 juveniles originally marked outmigrating from Trestle Creek in 2000, were detected in Trestle Creek in 2003 (1.5 %). In 2004, 18 additional juveniles originally marked outmigrating in 2000 were detected at the remote station in Trestle Creek. An additional fish from the 2000 juvenile marking group, not detected at the remote weir, was found dead during the annual redd count survey conducted on Trestle Creek. To date, a total of 23 bull trout, originally marked in 2000, have been detected in Trestle Creek as returning adults (8.5%). One of the 350 juveniles originally marked outmigrating from Trestle Creek in 2001, was detected in Trestle Creek in 2003 (0.3%). This fish was originally captured in the screw trap on May 11, 2001 at 205 mm and PIT tagged, and subsequently detected downstream at the remote weir on July 8 of the same year. This individual was detected returning to Trestle Creek on October 23, 2003. In 2004, nine returning adults from the 2001 juvenile marking group were detected (2.6%). One of those nine was the same fish detected in 2003 from the 2001 marking group. No returning adult hull trout have been detected from the 2002 juvenile marking group to date.

The four individual hull trout detected in 2003 in Trestle Creek from the 2000 juvenile marking group spent three years in the lake, while the 19 detected in 2004 spent four years, including the year in which they outmigrated, before returning to spawn in Trestle Creek. The average length of the individuals at tagging marked in 2000 that returned in 2003 was 178.5 mm (range 163-191, s.d. = 14.2), compared to 169.6 mm (range 127-220, s.d. 21.7) for those that returned for the first time in 2004. The length at marking data suggests these fish were age-2 and older when they outmigrated (Downs and Jakubowski 2003). The average length at tagging for the nine individuals returning in 2004 from the 2001 marking group was 183.7 mm (range
151-223, s.d. - 25.5). It is too early in the study, and sample sizes are too small, to draw conclusions regarding survival from the return data thus far. We anticipate increasing adult

returns from the 2000 and 2001 juvenile marking groups, as well as the first returning adults from the 2002 juvenile marking group, will be detected at the remote weir in 2005.

Between June 7 and December 5, 2002, we captured 310 unmarked adult bull trout in the screw trap. We marked 245 of those with PIT tags (Downs and Jakubowski 2003) and subsequently detected 76 of them at the remote PIT tag station (31%) in 2003 (Downs and Jakubowski 2005). Twenty-eight of the original 245 were detected again in Trestle Creek in 2004, with 12 of these being repeat spawners from 2003. This is a lower proportion than observed earlier in this study, when 429 individual adult bull trout were marked in 2000, and 237 (55.3%) returned to Trestle Creek in 2001, 161 in 2002 (with 143 of these being repeat spawners from 2001), and 89 in 2003 (with 85 being repeat spawners from either 2001 or 2002) (Downs and Jakubowski 2005). Thirty adults from the 2000 marking group were again detected in Trestle Creek in 2004. Two of these adults had not been detected in Trestle Creek since 2000. Overall, of the 30 individuals detected returning from the 2000 adult marking group, 17 were detected in all five years of the study. Using the return data from the 2000 marking group through the 2004 spawning season, we estimate a minimum survival rate (S) from 2000 to 2001 at 0.608 (60.8%). It appears as though the survival rate of the 2002 marking group will be considerably lower when calculated in the future. To date, after two years of return, the minimum estimated survival rate for the 2002 adult marking group stands at 0.376 (37.6%). It should also be noted that we continued to see relatively low numbers of new (not detected in Trestle Creek since originally marked) adults from the 2000 marking group returning in 2003 and 2004. If this pattern holds true for the 2002 adult marking group as we expect, return rates for that group will continue to increase to some degree. This will result in an increasing estimate of survival for the 2002 marking group. The variation currently observed in the survival rates estimated to date between the 2000 and 2002 adult marking groups is likely due to some combination of actual variability in annual mortality rates, variability in tag loss between marking years, or variability in the frequency of repeat spawning. Additionally, a small branch of Trestle Creek avoids our PIT tag weir. This branch has been enlarged by removing large rocks near its mouth, and now takes a significant amount of flow. Some fish may have avoided detection by using this channel. We will block this channel with a weir in the future to ensure we sample as many adults as possible.

Twin Creek

We captured 10 species of juvenile fish in the weir moving upstream and/or downstream in Twin Creek from July 8 to November 3 in 2004 (Table 1). Brook trout and sculpin *Coitus sp.* are included with the juvenile data due to uncertainty about their age and level of sexual maturity. Three juvenile hull X brook trout hybrids (97, 117 and 125 mm) were also captured, but are not included in the species total (Tables 2 and 3). Unidentified juvenile *Oncorhvnchus sp.* were the most abundant fish in both the upstream and downstream trap box (Tables 2 and 3). Average lengths of juvenile salmonids ranged from 53.2 mm for unidentified *Oncor/n •nchus sp.* to 237.5 mm for brook trout. (Tables 2 and 3; Figures 2-9).

Table I. Species captured in Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

Species	**Abbreviation**
Bull trout *Salvelinus confluentus*	BLT
Brook trout *Salvelinus Jontinalis*	BRK
Brown trout *Salmo trutta*	BRN
Kokanee *Oncorhynchus nerka*	KOK
Mountain whitefish *Prosopium williamsoni*	MWF
Northern pikeminnow *Pti chocheilus oregonensis*	NPM
Oncorhynchus species (unidentified)	ONC
Rainbow trout *Oncorhynchus m}'kiss*	RBT
Sculpin *Cottus Spp.*	SCL
Sucker *Catostomus Spp.*	UNS
Westslope cutthroat trout *Oncorhynchus clarki letirisi*	WCT

We captured two species of adult fish moving upstream and/or downstream in Twin Creek during 2004; bull trout and kokanee (Table 4; Figures 10-12). A total of 13 individual adult bull trout were captured moving upstream between July 9 and September 30. Nine of the 13 had not been previously tagged and were subsequently PIT tagged. Of the four fish previously tagged as adults, one had been PIT tagged in Twin Creek in 2003, while another had been tagged in Twin Creek in 2002 and had returned in both 2003 and 2004. A third fish captured in Twin Creek in 2004, had been captured and PIT tagged in the East Fork Bull River in Montana during 2002. The remaining fish, a female captured on September 28, had previously been captured and PIT tagged while electrofishing in the lower Clark Fork River in front of the Cabinet Gorge Hatchery ladder on June 27, 2004.

Table 2. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for juvenile species captured in the upstream weir on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	122.0 (55.3) (4)	80-202	25.3 (36.0) (4)
BRK	237.5 (0.7) (2)	237-238	134.5 (13.4) (2)
BRN	149.0 (N/A) (1)	N/A	30.0 (N/A) (l)
MWF	173.0 (N/A) (1)	N/A	44.0 (N/A) (l)
NPM	261.0 (N/A) (1)	N/A	142.0 (N/A) (1)
ONC	55.5 (5.2) (41)	47-68	1.5 (0.5) (39)
RBT	108.8 (38.9) (12)	70-172	17.7 (16.9) (l I)
SCI.	56.0 (37.9) (4)	21-98	3.8 (3.8) (4)

O
O
O
O

Table 3. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), length range, and catch-per-unit-effort (CPUE) for juvenile species and bull X brook trout hybrids (BBHY) captured in the downstream weir on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)	CPUE (fish/trap night)
BLT	143.6 (48.8) (14)	69-227	35.0 (32.4) (14)	0.13
BBHY	113.0 (14.4) (3)	97-125	13.0 (3.5) (3)	0.03
BRN	128.0 (43.2) (7)	72-206	25.6 (28.0) (7)	0.07
KOK	65.1 (11.5) (39)	47-98	2.4 (1.5) (39)	0.37
MWF	100.5 (19.2) (52)	79-190	8.8 (9.3) (52)	0.49
NPM	64.5 (3.5) (2)	62-67	2.0 (0.0) (2)	0.02
ONC	53.2 (6.2) (1013)	40-69	1.5 (0.6) (1006)	9.56
RBT	105.2 (32.9) (217)	70-219	14.9 (15.2) (217)	2.05
SCL	57.9 (24.7) (40)	11-108	3.5 (3.5) (40)	0.38
UNS	131.1 (52.9) (7)	76-207	33.4 (34.8) (7)	0.07
WCT	146.1 (49.6) (18)	46-217	36.3 (27.0) (18)	0.17

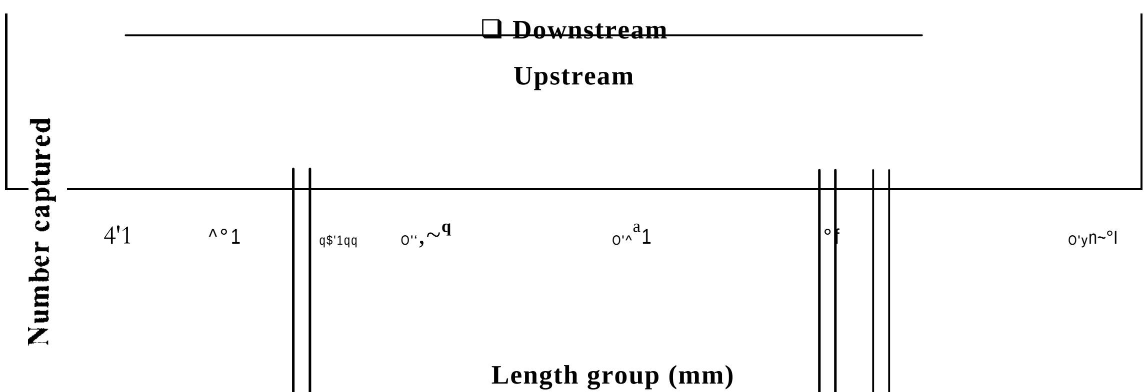


Figure 2. Length frequency histogram for juvenile bull trout captured in the upstream (n 4) and downstream (n-14) weirs in Twin Creek, a tributary to the Clark Fork River, Idaho. during 2004.

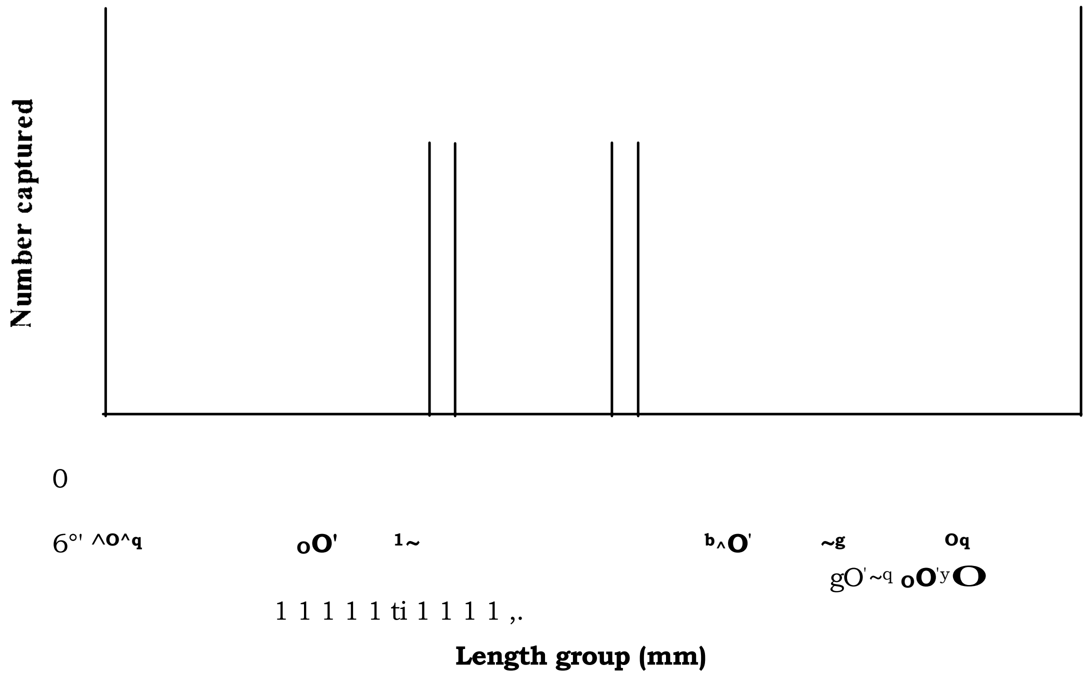


Figure 3. Length frequency histogram for juvenile brown trout (n=7) captured in the downstream weir in Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

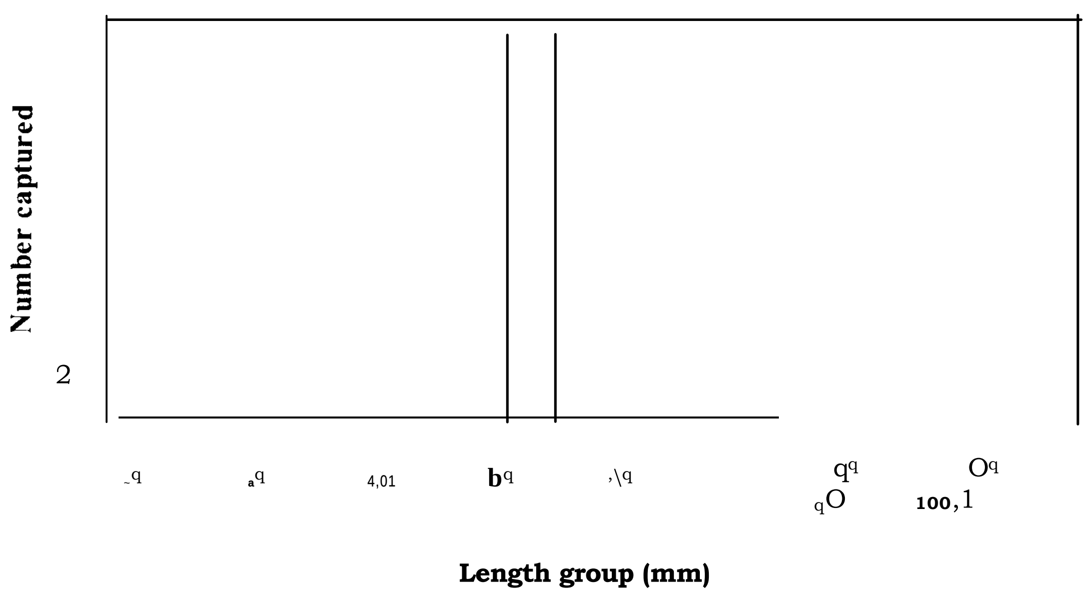


Figure 4. Length frequency histogram for juvenile kokanee (n--39) captured in the downstream weir in Twin ('reek, a tributary to the Clark Fork River, Idaho, during 2004.

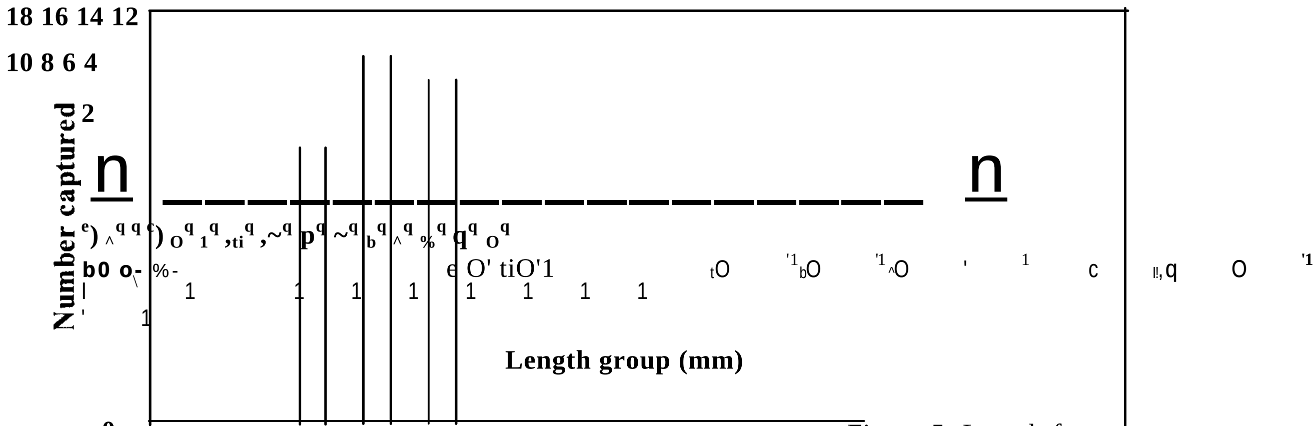


Figure 5. Length frequency histogram for juvenile mountain whitefish (n=52) captured in the downstream weir in Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

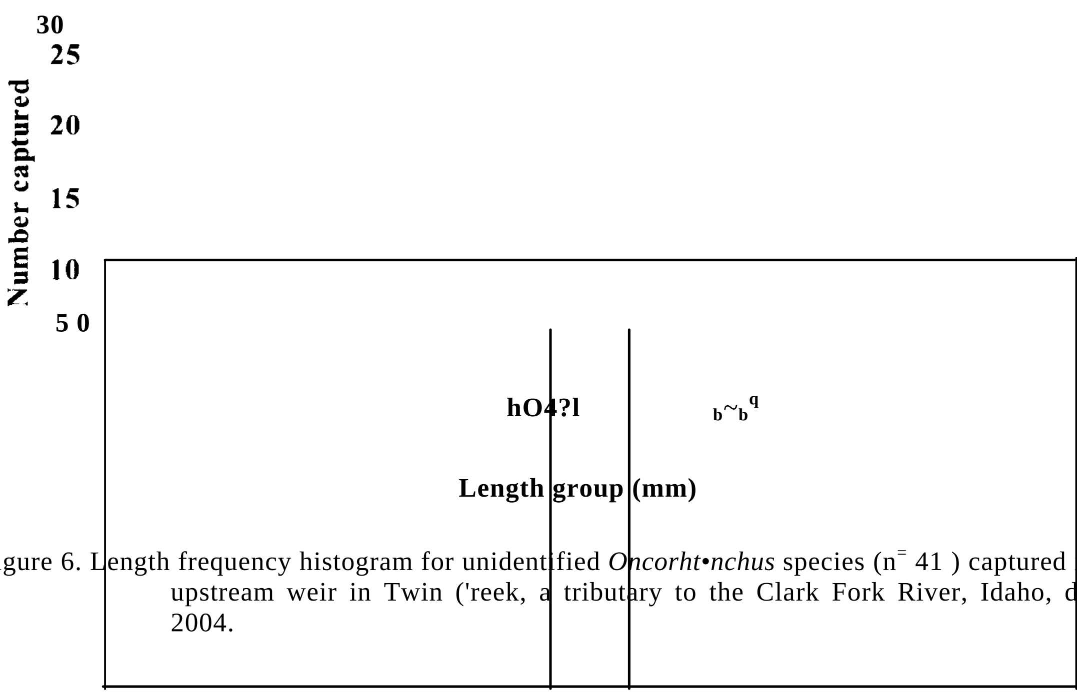


Figure 6. Length frequency histogram for unidentified *Oncorht•nchus* species (n= 41) captured in the upstream weir in Twin ('reek, a tributary to the Clark Fork River, Idaho, during 2004.

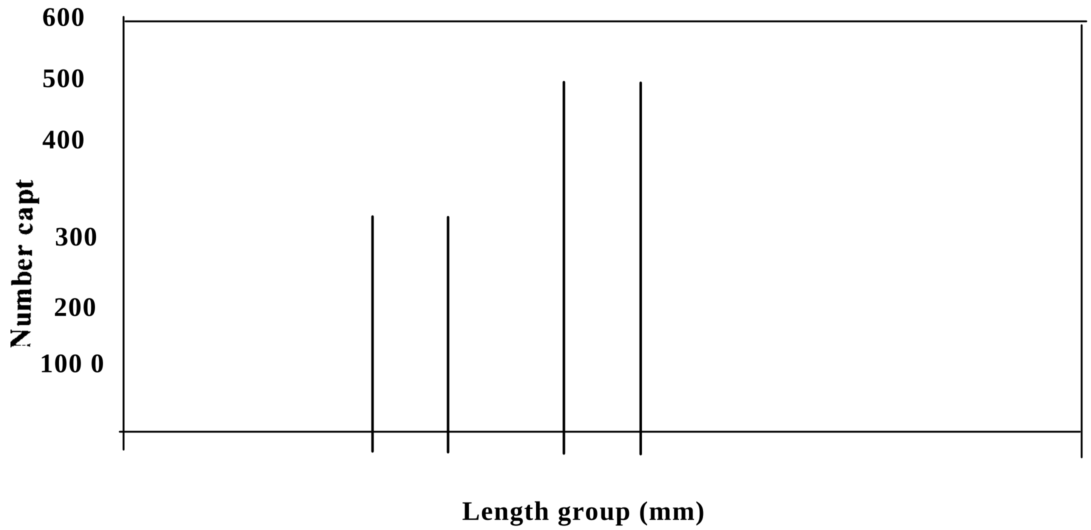


Figure 7. Length frequency histogram for unidentified *Oncorhynchuc* species (n=1,013) captured in the downstream weir in Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

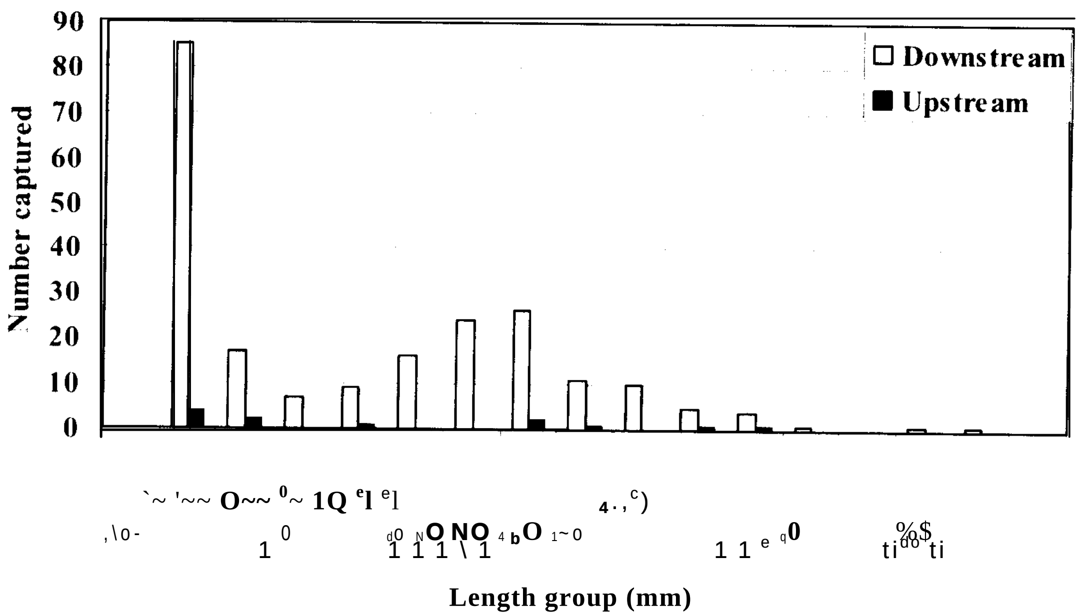


Figure 8. Length frequency histogram for juvenile rainbow trout captured in the upstream (n= 12) and downstream (n217) weir in Twin ('reek, a tributary to the Clark Fork River, Idaho, during 2004.

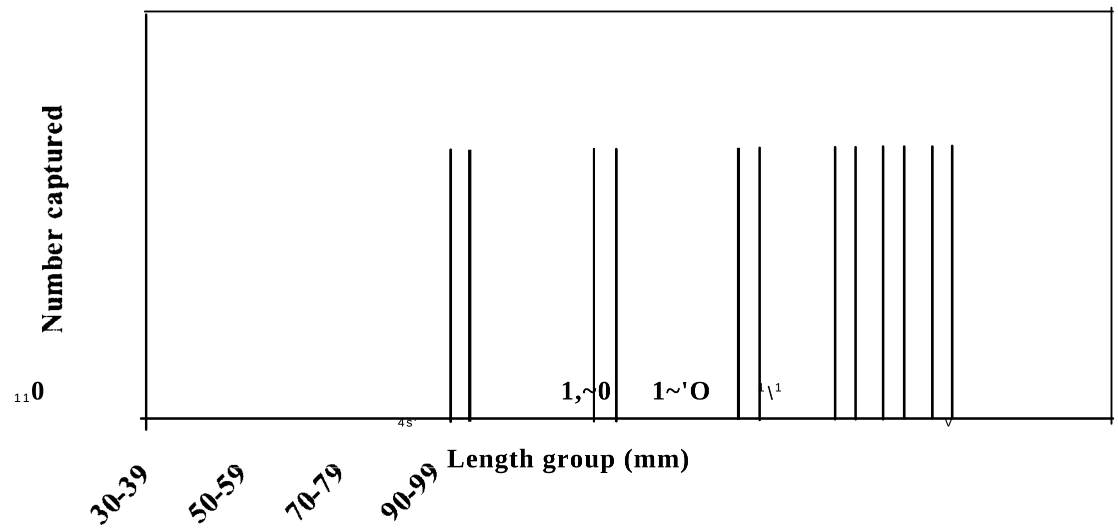


Figure 9. Length frequency histogram for juvenile westslope cutthroat trout (n=18) captured in the downstream weir in Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

Table 4. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for adult bull trout captured in the upstream weir and adult kokanee captured in the upstream and downstream weir combined, on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
BLT	577.1 (95.7) (13)	374-698	1,803.5 (790.6) (13)
KOK	280.9 (23.3) (160)	245-378	189.1 (40.3) (160)

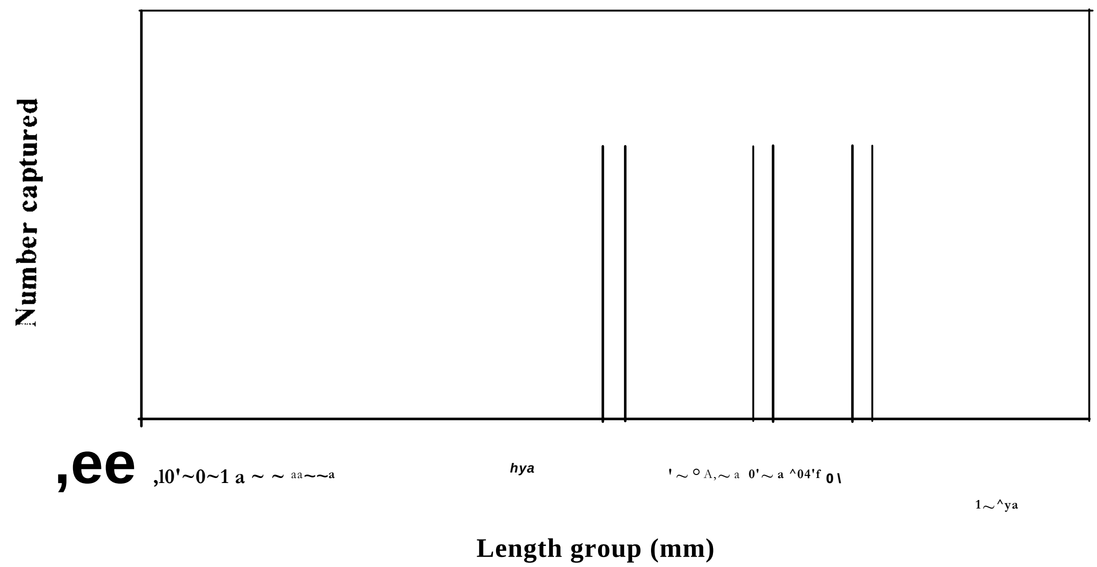
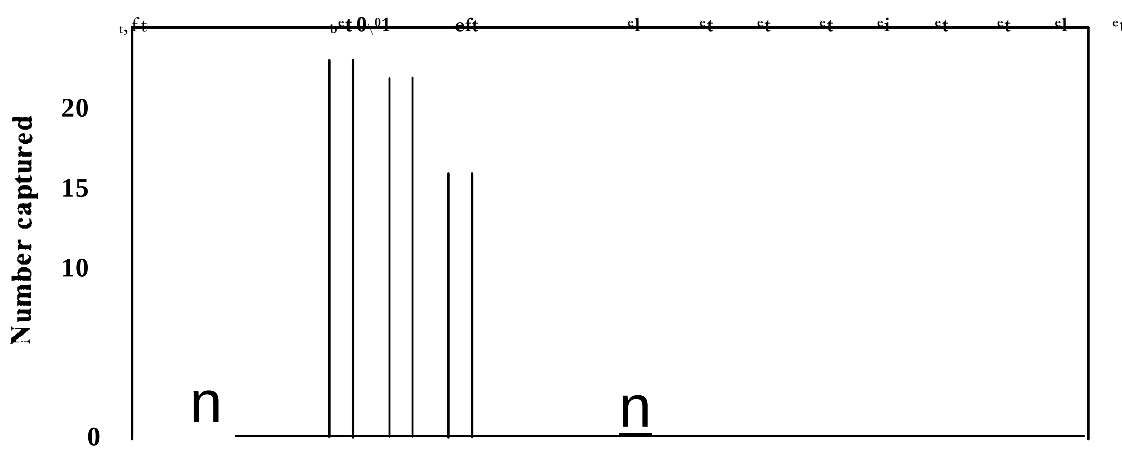


Figure 10. Length frequency histogram for adult bull trout (n=13) captured in the upstream weir on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.



m0O t0:\ :

~ 0• 10• ,tiO• "0' O• 0' kp'

Length group (mm)

Figure I L Length frequency histogram for adult kokanee (n 95) captured in the upstream weir on "I win Creek, a tributary to the Clark Fork River, Idaho, during 2004.

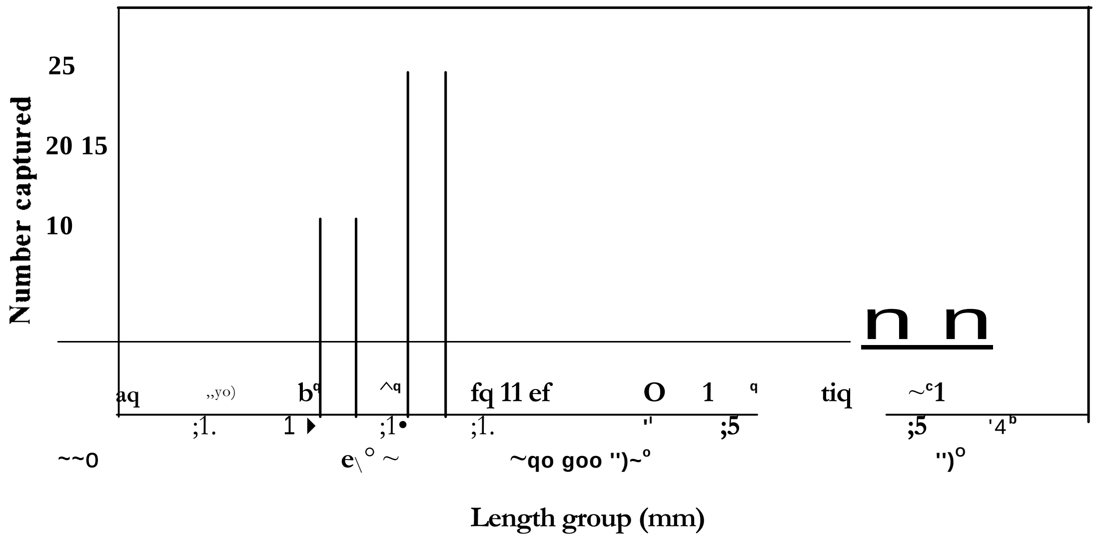


Figure 12. Length frequency histogram for adult kokanee (n=65) captured in the downstream weir on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2004.

Timing of upstream migration of bull trout in Twin Creek is later than that of other tributaries, with most upstream movement occurring from late September and early October (Downs et al. 2003, Downs and Jakubowski 2003). In 2004, we observed a continuation of this trend (Figure 13). However, one individual migrated upstream on July 9, while another was captured moving upstream on July 16, which would be consistent with our observations on other LPO tributaries (Downs and Jakubowski 2003). In general, this upstream movement pattern is considerably later than upstream spawning movements observed in other LPO tributaries (Downs and Jakubowski 2003), lending support to the idea that some of the spawners in Twin Creek are individuals who are unable to return to their natal streams due to Cabinet Gorge Dam. Additionally, previous years trapping and PIT tagging work in Twin Creek and the Clark Fork River (Downs and Jakubowski 2003) suggests that some adult bull trout entering Twin Creek are individuals trying unsuccessfully to pass Cabinet Gorge Dam to reach natal streams in Montana. An alternative explanation for late entry into Twin Creek could be water temperature, which may be warmer than that desired by bull trout, until early September. Genetic evidence does support Twin Creek as a unique population of bull trout, as genetic assignment rates back to the tributary of origin were higher for Twin Creek than for 39% of the other 17 tributaries to LPO and the lower Clark Fork River studied (Neraas and Spruell 2001). Efforts should be made to use caution when electrofishing to collect bull trout from the Clark Fork River for upstream passage to avoid "mining" individuals from this population, and other small populations downstream of Cabinet Gorge Dam. Redd counts in recent years have been low in Twin Creek (averaging five annually from 2001-2004) despite relatively strong catches of adult bull trout using electrofishing in the Clark Fork River, and trapping in Cabinet Gorge Hatchery ladder (118 unique adults captured in 2003) (Gillen and Haddix 2003). Recent advances in rapid response genetic testing have made it possible to identify the tributary of origin for hull trout collected in the Clark Fork River in Idaho which should minimize this concern. (L. Lockard, USFWS, personal communication). Use of this technique will facilitate the selective passage of upstream bull trout stocks until trapping facilities are completed at Cabinet Gorge Dam.

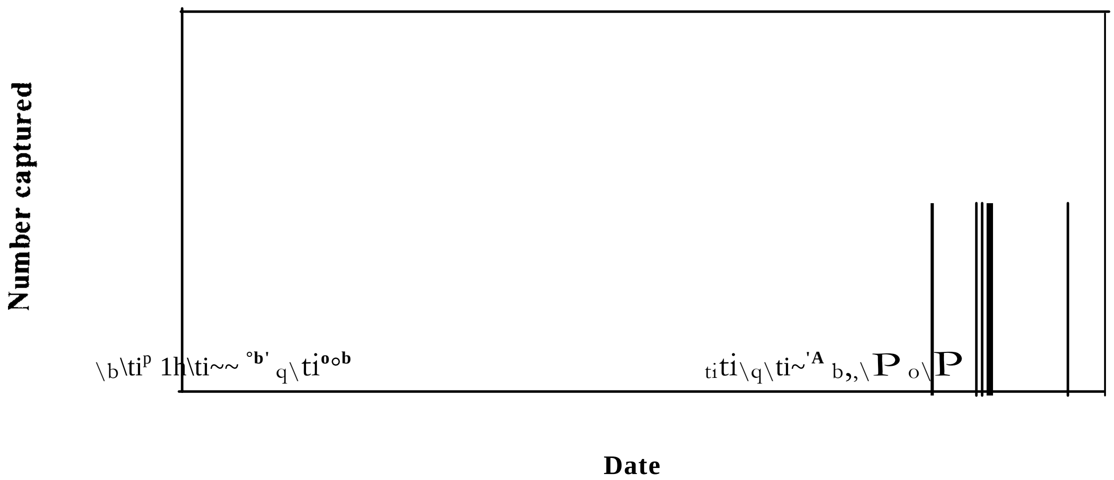


Figure 13. Timing of upstream migration of adult bull trout (n=13) in Twin Creek, a tributary to the Clark Fork River, Idaho, in 2004.

In 2000, upstream migration of adult kokanee began as early as September 8, and continued through November 1 (n=117). Despite trapping during the same time period in 2001, we only captured 13 adult kokanee. In 2002, upstream migration of adult kokanee began on August 20 and ended on October 20 (n=108). The peak of the run occurred in early to mid-September in all previous years (Downs and Jakubowski 2003). In contrast, in 2003, upstream migration of adult kokanee began on September 10, but peaked more than a month later in the season (Downs and Jakubowski 2003). These fish would have been progeny from Sullivan Springs planted in Twin Creek in 2000, which typically spawn later in the year. The kokanee captured in 2000 through 2001 may have come from Idaho Department of Fish and Game (IDFG) hatchery releases of early spawning kokanee into Spring Creek, a tributary to Lightning Creek, during the late I990's (Bruce Thompson, IDFG, personal communication). In 2004, upstream migration of adult kokanee began on September 11, and ended on October 19 (n=95). The peak of the run occurred the last week of September, with an additional surge of fish occurring in mid-October (Figure 14). This run of kokanee was likely a combination of hatchery fish planted in Twin Creek by IDFG in 2001, and wild fish produced in Twin Creek from the 1999 and 2000 spawning runs.

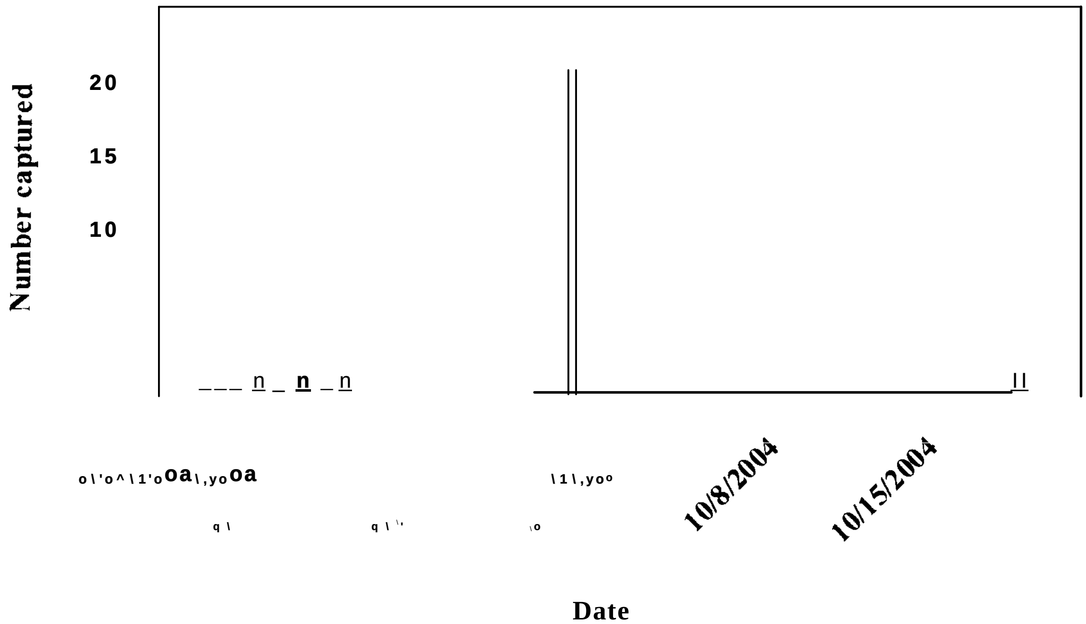


Figure 14. Timing of upstream migration of adult kokanee (n=95) in Twin Creek, a tributary to the Clark Fork River, Idaho in 2004.

Twin Creek Water Temperature

Water temperature was recorded using an electronic temperature logger from July 17 through November 3, 2004. The maximum daily water temperature observed over the course of the trapping season in 2004 was 18.0 ° C on July 23 (Figure 15). In comparison, the maximum daily water temperature observed in 2000 was 17.3 ° C on August 1; 20.0 ° C on August 3, 2001; 16.8 ° C on July 10, 2002; and 18.8 ° C measured on July 22, 2003. We would anticipate maximum temperatures to decline over time as vegetation continues to grow and shade the restored channel of Twin Creek.

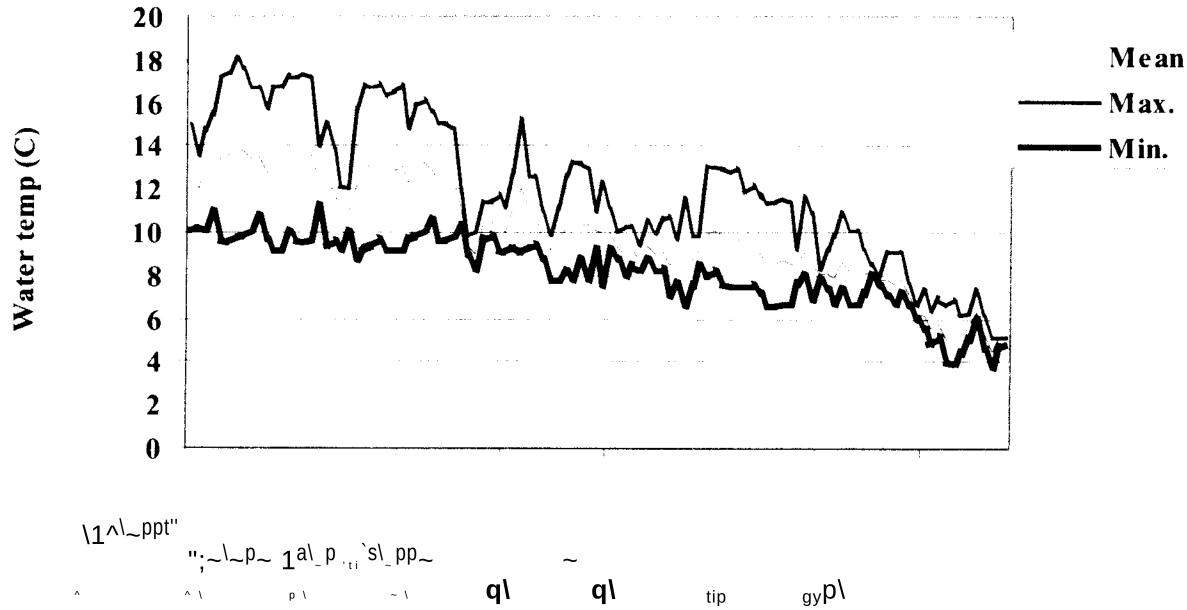


Figure 15. Mean daily water temperatures recorded by thermograph for Twin Creek, a tributary to the Clark Fork River, Idaho, in 2004.

0

ACKNOWLEDGEMENTS

The authors wish to thank John Suhfras, Christina Suhfras, and Tyler Long of Avista Corporation for their contributions to field data collection. We would also like to thank Mark Gamblin and Ned Homer of the Idaho Department of Fish and Game, Joe DosSantos of Avista Corp., Laura Katzman of Montana Fish, Wildlife, and Parks, and Larry Lockard of the U.S. Fish and Wildlife Service for their reviews of this report.

LITERATURE CITED

Downs, C., R. Jakubowski, and S. Moran. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 1999-2001 Progress Report. Project 1, Johnson and Rattle creeks bull trout trapping; Project 2, Bull trout redd counts and escapement estimates 1999-2001; Project 3, Clark Fork River fishery assessment 1999-2001; Project 4, Lake Pend Oreille tributary instream flow evaluation. Avista Corporation. Spokane, Washington.

Downs C., and R. Jakubowski. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2002 Progress Report. Project 2, 2002 bull trout redd counts; Project 3, 2002 Clark Fork River fishery assessment progress report; Project 5, 2000-2002 Trestle and Twin creeks bull trout outmigration and Lake Pend Oreille survival study; Project 6, 2002 Johnson and Granite creeks bull trout trapping; Project 7, 2002 Twin Creek restoration monitoring progress report. Avista Corporation. Spokane, Washington.

Downs, C., and R. Jakubowski. 2005. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2003 Progress Report. Project 2, 2003 Lake Pend Oreille bull trout redd counts; Project 3, 2003 Clark Fork River fishery assessment progress report; Project 5, 2003 Trestle and Twin creeks bull trout outmigration and Lake Pend Oreille survival study progress report; Project 6, 2003 Johnson and Granite creeks bull trout trapping; Project 7, 2003 Twin Creek restoration monitoring progress report. Report to Avista Corporation from the Idaho Department of Fish and Game. Boise, Idaho.

Gillen, G. and T. Haddix. 2003. Final Report: Cabinet Gorge Fish Hatchery Ladder Bull Trout Pheromone Study, 2003. Report from GEI Consultants to Avista Corporation. Missoula, MT.

Neraas, L.P. and P. Spruell. 2001. Fragmentation of riverine systems: the genetic effects of dams on bull trout (Salvelinus confluentus) in the Clark Fork River system. Molecular Ecology 10:1153-1164.

Panhandle Bull Trout Technical Advisory Team (PBTAT). 1998. Lake Pend Oreille key watershed problem assessment. Idaho Department of Environmental Quality. Boise.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 171.

U.S.D.A. Forest Service. 1993. Trestle ('reek Watershed Improvement Environmental Assessment. Idaho Panhandle National Forest. Sandpoint Ranger District.

D

Project 6: 2004 Johnson and Granite creeks bull trout trapping

ABSTRACT

D

In 2000, the Idaho Department of Fish and Game and Avista Corporation identified a head-cut in the Johnson Creek channel that was blocking the upstream spawning migration of adult adfluvial bull trout *Salvelinus confluentus* from Lake Pend Oreille. We installed a trap box to capture the spawners and transport them over the head-cut to provide access to the known spawning area in 2001 through 2004. A total of 35 adult bull trout were captured and transported above the barrier in 2004. Of the 35 adult bull trout captured in Johnson Creek in 2004, eight were recaptures from Johnson Creek, tagged in a previous year. The number of adult bull trout captured in Johnson Creek in 2004 is far greater than returned and were trapped in 2003, when only three were captured. Thirty-two redds were counted in Johnson Creek during the October 11, 2004 redd survey. This suggests some bull trout accessed the spawning area without the assistance of our transport, likely prior to the installation of our trap. The average length of adult bull trout captured in Johnson Creek in 2004 was 597 mm (range = 420-787 mm).

During flood events in the winter of 1995-96, the reach of Granite Creek between Kilroy Bay Bridge and the mouth of Sullivan Springs underwent significant changes, and now has a diffuse and largely sub-surface flow pattern during low flow conditions. Fish passage is impaired during summer/fall months, or in low flow years in this location on Granite Creek, reducing the numbers of bull trout that can successfully reach their spawning areas. During 2001, we counted only seven bull trout redds in Granite Creek, all of which were located downstream of the intermittent reach and associated channel head-cut. We deployed an upstream and downstream trap system to capture adult bull trout and transport them around the intermittent reach in 2002 through 2004. A total of 223 adult bull trout were captured in 2004, and transported above the barrier. Of these, 181 were unmarked, 172 of which were subsequently PIT tagged. Mean length of adult bull trout captured moving upstream was 518 mm (range = 347-762 mm). We subsequently captured and transported downstream 210 adult bull trout after spawning, 105 of which were previously PIT tagged. Sixty-two of those had been captured and tagged while moving upstream in 2004. We derived a mark-recapture population estimate of 425 adults (95% CI - 377-490). We subsequently counted 149 redds in Granite Creek in 2004, the highest count on record. A stream restoration design has been completed on Granite Creek and we plan to implement a stream restoration project in 2005. The project should restore natural fish passage to the lower reaches of Granite Creek.

Authors:

('hristopher C. Downs
Senior Fishery Research Biologist
Idaho Department of Fish and Game

Robert Jakubowski
Natural Resource Technician
Avista Corporation

INTRODUCTION

Johnson Creek

Johnson Creek is an important adfluvial bull trout *Salvelinus confluentus* spawning tributary within the Lake Pend Oreille (LPO) system located in northern Idaho (Figure 1). Bull trout spawning has been documented with annual redd counts from 1983 through 2004, with an average count of 19 redds. In 2000, a head-cut was observed in the lower reaches of Johnson Creek, approximately 50 meters (m) upstream of its mouth. The barrier was approximately 1 m high and consisted of a dense mat of tree roots (Figure 2). A jump pool was absent below the head-cut, and the combination of shallow water depth and the dense root mass likely prevented upstream access during lower flow periods (July — August). In 2000, four bull trout redds were observed below this head-cut in the channel, but none were observed above it, suggesting it was an impassable barrier to migrating bull trout. By virtue of its location approximately 50 m upstream of the mouth of Johnson Creek, the head-cut prevented access to the approximately 1.6 km of historical spawning habitat in Johnson Creek.

The stream channel in this reach of Johnson Creek lies in a depositional zone and shows evidence of repeated channel shifts. As bedload is transported from upstream reaches it is likely the channel will shift again in the future. The head-cut will likely move with repeated spring flows, roots will decompose, and spawner access will be restored naturally. In order to ensure access to the spawning area in 2004, a temporary trap box was installed below the barrier and captured bull trout were released upstream of the head-cut.

Granite Creek

Granite Creek is an east shoreline tributary to LPO (Figure 1). The LPO Key Watershed Bull Trout Problem Assessment (Panhandle Bull Trout Technical Advisory Team (PBTAT 1998) recognized Granite Creek as high priority for bull trout restoration/conservation actions. Redd counts have been conducted from 1983 to 1987, and from 1992 through 2004, and have averaged 43 annually. During flood events in the winter of 1995-96, the reach of Granite Creek between Kilroy Bay Bridge and the mouth of Sullivan Springs underwent significant changes, and consequently now has a diffuse and largely sub-surface flow pattern during low flow conditions (PBTAT 1998). Fish passage is impaired due to the subsurface flow and a head-cut in the channel during summer/fall months, reducing the numbers of bull trout that can successfully reach their spawning areas.

In 1997, the Idaho Department of Fish and Game (IDFG) moved nearly 100 adult bull trout around the intermittent reach to provide access to the majority of the spawning habitat in Granite ('reek. Subsequent recapture of downstream moving adult bull trout following spawning yielded a mark-recapture population estimate of between 400 and 500 adults (PBTAT 1998), suggesting most of the spawning run moved past the low flow barrier earlier in the year.

Figure I. Trap locations in Johnson (2001-2004) and Granite (2002-2004) creeks, tributaries to the Clark Fork River and Lake Pend Oreille, Idaho.

Figure 2. Head-cut fish passage barrier in 2001 on Johnson Creek, a tributary to the Clark Fork River, Idaho.

In 2001, IDFG and Avista failed to document any bull trout redds upstream of the low flow harrier. This suggested that adult bull trout were unable to access important spawning habitat, and an interim measure of capturing and transporting adults around the low flow barrier would be beneficial until a longer-term solution is developed. We initiated a project to capture adult and juvenile bull trout migrating upstream or downstream in Granite Creek, and transport them around the low flow barrier starting in 2002.

METHODS <u>Johnson Creek</u>

On July 7, 2004, an upstream weir box 0.92 m long, 1,22 m wide and 0.92 m high was placed in Johnson ('reek approximately 10 m below the head-cut. The trap consisted of a steel frame (25.4 mm X 2 mm angle steel) covered with 6.35 mm black plastic mesh (Nelson 1999). The bottom of the trap box consisted of a sheet of 6.35 mm mesh hardware cloth and the top of the trap box consisted of a sheet of 13 mm thick plywood with an access hatch for removing captured fish (Figures 3 and 4). The plywood top was bolted on, while the plastic mesh and hardware cloth bottom were attached with UV resistant (black) plastic tie-wraps. Fish entered the trap through a cone projecting into the box constructed of the same plastic mesh. The entrance of the cone was approximately 30 cm in diameter and the exit diameter within the box was reduced to approximately 18 cm. The entrance of the cone was near the bottom of the box and the exit of the cone within the trap box was approximately 10-15 cm above the trap box bottom. This reduced the chance of trapped fish escaping back out of the box. The trap cone design was similar to common minnow trap designs.

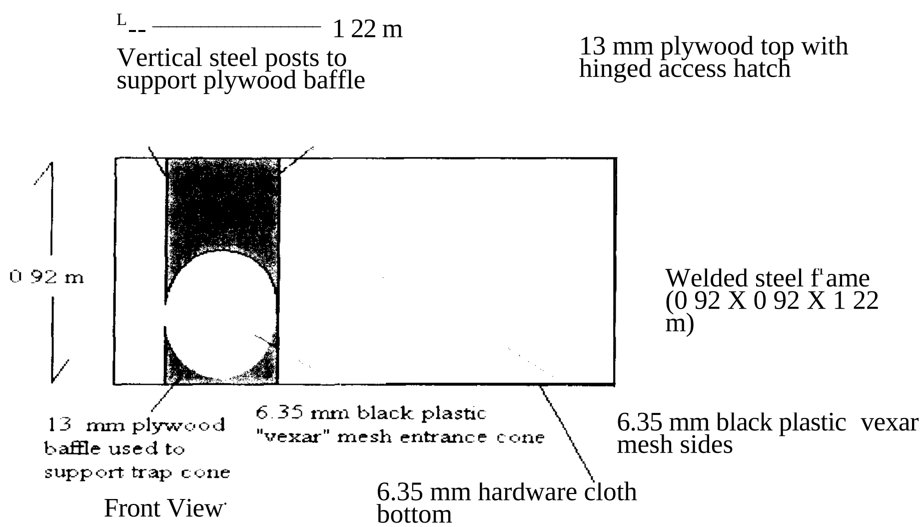


Figure 3. Front view of trap box designed to capture upstream migrating adult bull trout during 2004 in Johnson Creek, a tributary to the Clark Fork River, Idaho.

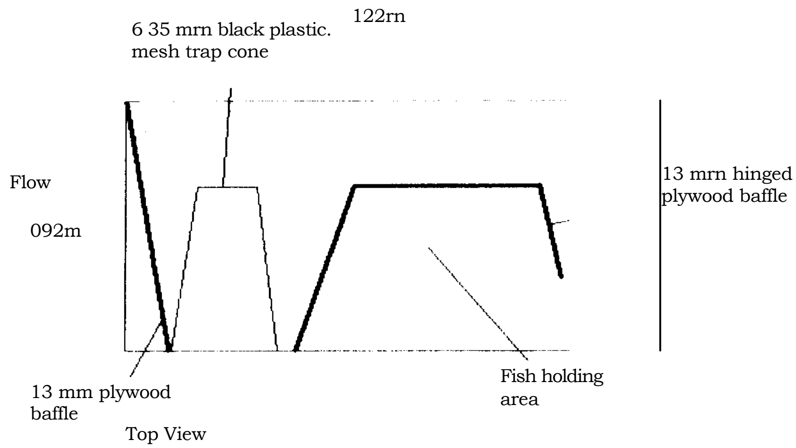


Figure 4. Plan (top) view of trap box designed to capture upstream migrating adult bull trout during 2004 in Johnson Creek, a tributary to the Clark Fork River, Idaho.

A 2.4 m wide weir panel was placed on each side of the trap box and was used to direct fish into the trap. The picket weir panel design was similar to that described by Nelson (1999), and was constructed of welded angle steel with removable support legs. We used 13 mm diameter steel conduit as pickets, with 12.7 mm spacing between pickets. A 30 cm gap was left between the end of one panel and the shoreline on the shallow side of the stream to allow for downstream movement.

All adult bull trout were tagged with 134.2 kHz Passive Integrated Transponder (PIT) tags in the cheek for identification at recapture. The procedure involved marking anesthetized adult bull trout by implanting a PIT tag into the soft tissue of the cheek along the dorsal-ventral plane, at approximately a 90-degree angle (Figure 5). Baxter and Westover (1999) marked adult bull trout using a similar methodology and reported retention rates of 89% (one-year) and 82% (two-year). A 12-gauge syringe was used to inject an 11.5 mm X 2.1 mm, 134.2kHz coded tag into the cheek. The tag was injected into either the left or right cheek from the dorsal surface (depending on the preference of the field worker), as the fish lay on its side in a large measuring board. One hand was used to gently restrain the head to prevent injury from any sudden movement. Juvenile bull trout were also PIT tagged, but the tags were inserted into the abdomen along the anterior-posterior plane, just anterior to the pelvic fins. Fish were then placed in a 76 I. plastic tub with approximately 150 mm of water depth (fresh recovery water), and transported upstream to a pool located approximately 100 m above the harrier, where they were released.

After fish were captured and passed around the head-cut on Johnson Creek, a redd count was conducted on October 1 I, 2004. Redds were located visually by walking upstream from the mouth of Johnson ('reek to Johnson ('reek Falls, a natural fish barrier located approximately 1.6 km above the mouth. Redds were defined as areas of clean gravels at least 0.3 x 0.6 m in size with gravels at least 76.2 mm having been moved, and with a mound of loose gravel downstream from a depression (Pratt 1984) (Figure 6). In areas of superimposition, each distinct depression was counted as a redd.

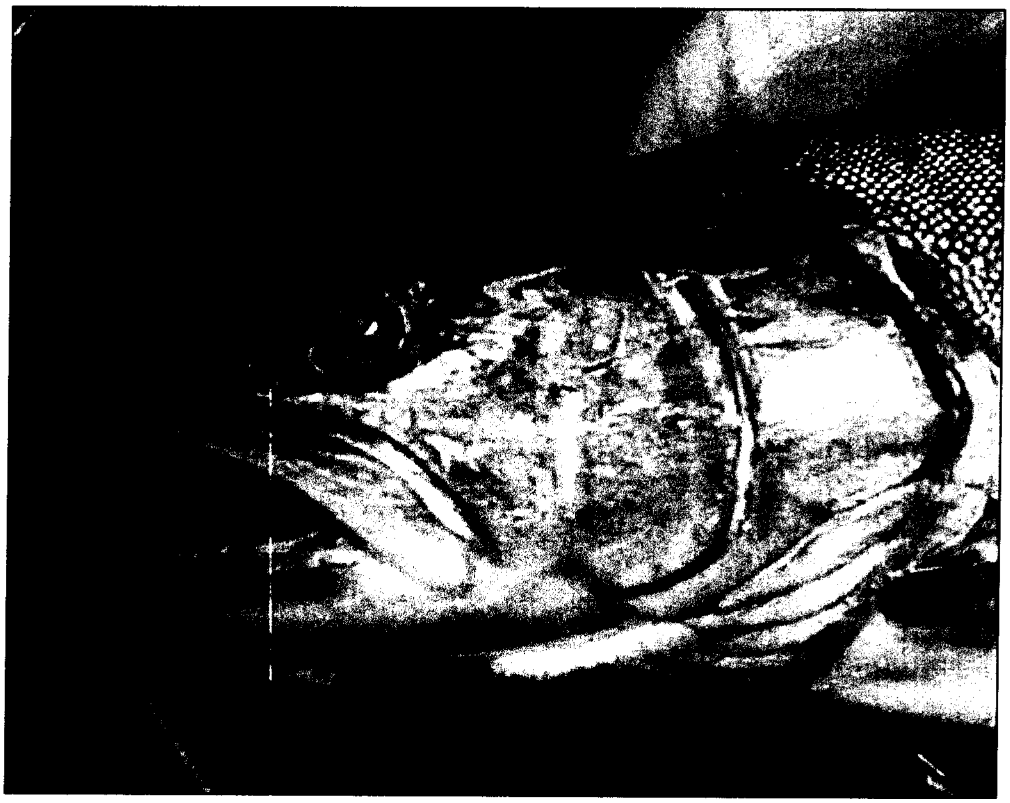


Figure 5. Location of PIT tag placement in adult bull trout.

C

Figure 6. Bull trout on a redd in Johnson Creek, a tributary to the Clark Fork River, Idaho, during October 2001.

Granite Creek

On July 6, 2004, upstream and downstream weir boxes were installed in Granite Creek. The upstream weir box was identical to the Johnson Creek trap box, and was located approximately 50 m upstream of the confluence of Granite Creek with Sullivan Springs Creek, which is used each fall by the 1DFG as a kokanee *Once rhvnehus nerka* egg-take station. The downstream weir box was located upstream of the low flow barrier immediately downstream of the Kilroy Bay Road bridge (Figure 7). Weir panels completely spanned the channel and were used to direct fish into both trap boxes. The picket weir panel design was similar to that described by Nelson (1999), and was constructed of welded angle steel with removable support legs. We used 13 mm steel conduit as pickets, with 25.4 mm spacing between pickets because we were targeting large adult hull trout. The downstream weir box design differed only slightly from the upstream box, and was constructed of the same materials. The primary difference was in the baffle design and trap box orientation in the stream (Figure 8).

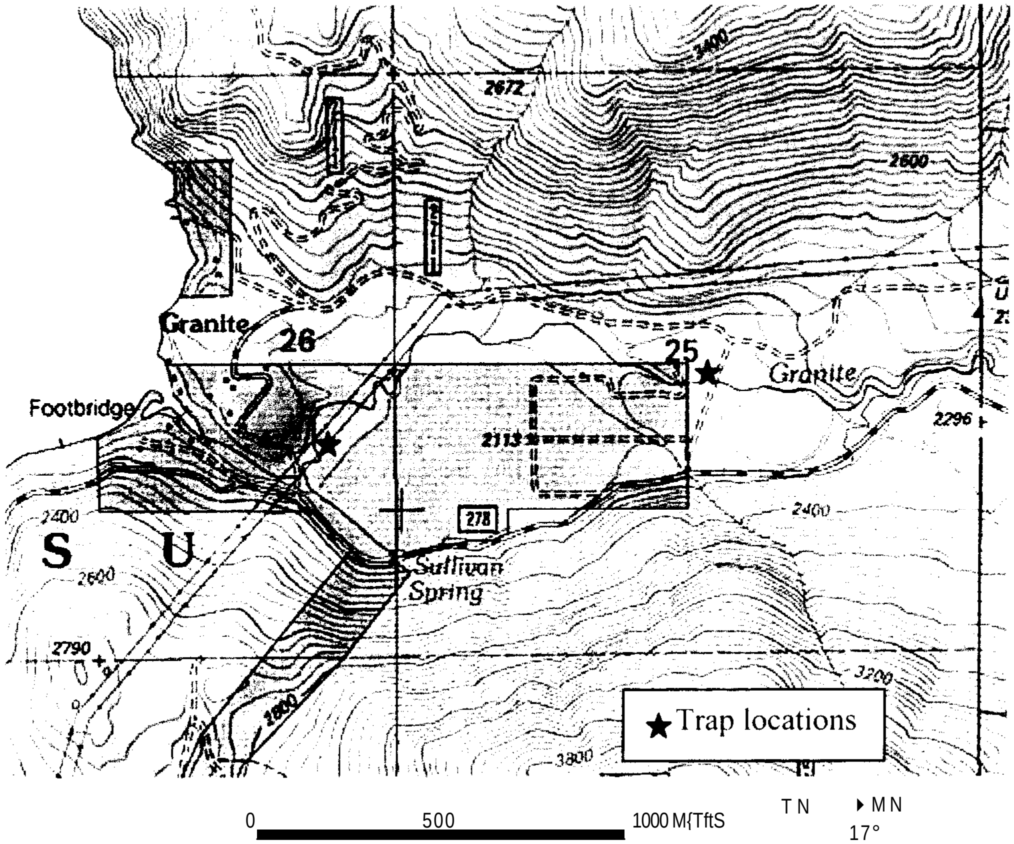
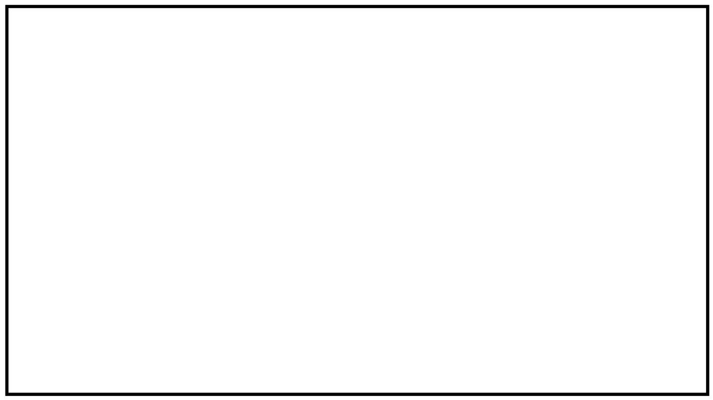


Figure 7. Bull trout trap locations on Granite Creek, a tributary to Lake Pend Oreille, Idaho.

The traps were checked each day, and water temperature (C) recorded using a hand-held thermometer. Following the protocols described for Johnson Creek, all captured bull trout were placed in a large tub, anesthetized, weighed, measured, and scanned for the presence of a PIT tag. All un-tagged bull trout were PIT tagged for identification at recapture. Adult bull trout were tagged in the cheek, while juveniles were tagged in the abdomen. Two different individuals double marked a total of 68 adult bull trout with a PIT tag and caudal tin punch to evaluate short-term tag loss.

The fish were placed in a 379 L fiberglass "stock tank" located in the bed of the truck. The tank was covered with a sheet of 13 mm thick plywood cut to the size and shape of the tank to prevent fish from jumping out during transport. l he cover was cut down the middle and a hinge installed to allow easy access. The cover was held in place by two bolts with wing nuts. The tank was fitted with a water circulation pump to aerate the water, and a I2-volt battery was used to run the pump. Fish captu'ed in the upstream weir box were then transported upstream to a release site located approximately 100 m above the weir used for downstream capture. then released in calm water. Fish captured in the downstream weir box were transported downstream in the stock tank to a release site located approximately 30 m below the weir used for upstream capture.

13 nun plywood baffles



' -----------
Trap cone

Figure 8. Trap box design for capturing downstream migrating adult bull trout.

We also used our trapping effort on Granite Creek to conduct a mark-recapture population estimate for adult hull trout in Granite Creek. We used the Petersen estimator for sampling without replacement (Krebs 1998) as:

C

$$N ((M+1)*(C+l)/(R+1)) - 1$$

where:

N population estimate

M number of individuals marked and placed upstream of the barrier

C total number of adult bull trout captured moving downstream in the weir following spawning

R the number of previously marked bull trout captured moving downstream at the weir following spawning

Approximate 95% confidence intervals were estimated using the normal approximation method (Krebs 1998).

RESULTS

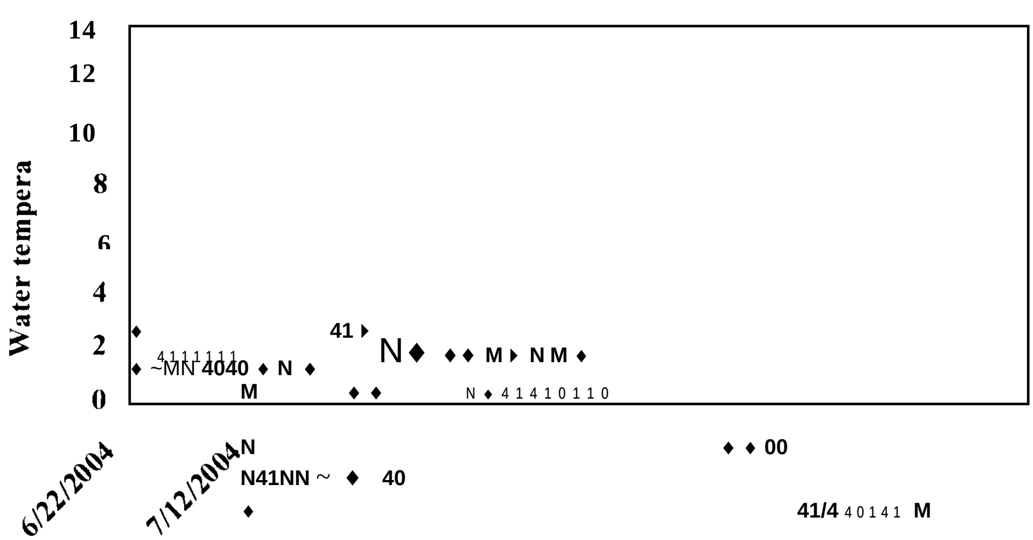
Johnson Creek

The box trap was operated from July 7 through October 20, 2004. During this time, mid-morning water temperatures ranged from 7 ° C to 12 ° C (Figure 9). A total of 35 adult bull trout were captured and transported above the barrier (Figure 10). Of those fish, 7 were identified as male, 17 as female, and 11 of undetermined sex. The mean length of all adult bull trout captured in the upstream weir was 597 mm (s.d. = 94; range = 420-787) (Figure 11). The mean weight was 2,144 g. We PIT tagged 27 adults in 2004, while 8 were recaptures that had been PIT tagged in Johnson Creek in a previous year.

A total of 31 juvenile bull trout (< 300 mm) were also captured moving upstream and transported above the barrier in 2004 (Figure 12). The mean length for those juveniles captured was 89 mm (s.d. = 29; range = 51-152) (Figure 13). Twelve of the juvenile bull trout were PIT tagged, the other 19 were not due to small size.

In addition to bull trout, 13 juvenile rainbow trout *Oncorhmnchus mvkiss,* 2 juvenile northern pikeminnow *Ptychocheilus oregonensis,* and 1 juvenile sucker *C'atostomus* sp. were captured in the 2004 Johnson Creek weir. None of the fish were passed above the head-cut.

A complete redd count was conducted in Johnson Creek from the mouth upstream to the falls on October 11, 2004. Thirty-two redds were observed during the redd count, with four located between the creek mouth and the weir (Figure 14).



Date

Figure 9. Daily water temperatures typically recorded during mid-morning trap checks in Johnson ('reek, a tributary to the ('lark Fork River, Idaho, in 2004.

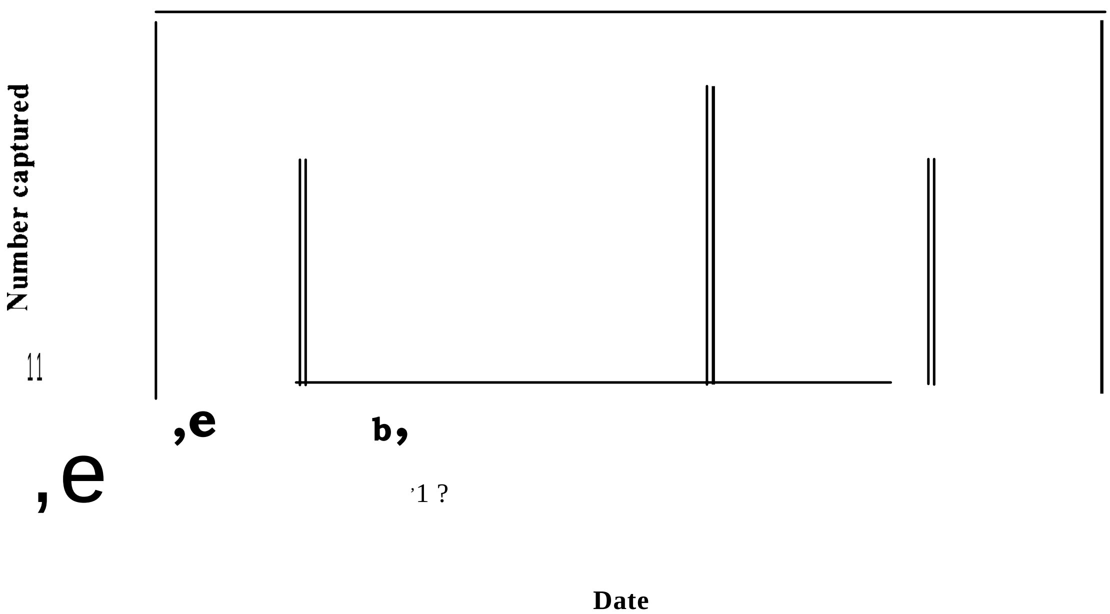


Figure 10. Timing of upstream migration of adult bull trout (n=35) in Johnson Creek, a tributary to the Clark Fork River, Idaho, in 2004.

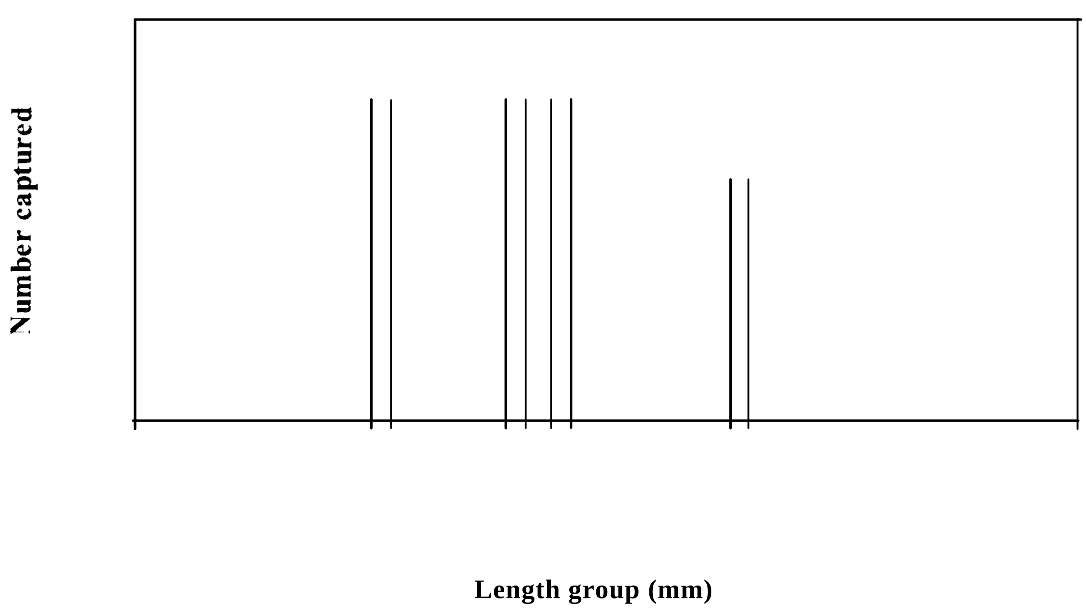


Figure 11. Length frequency histogram for adult bull trout (n 35) captured moving upstream in Johnson Creek, a t'ibutary to the ('lark Fork River, Idaho, during 2004.

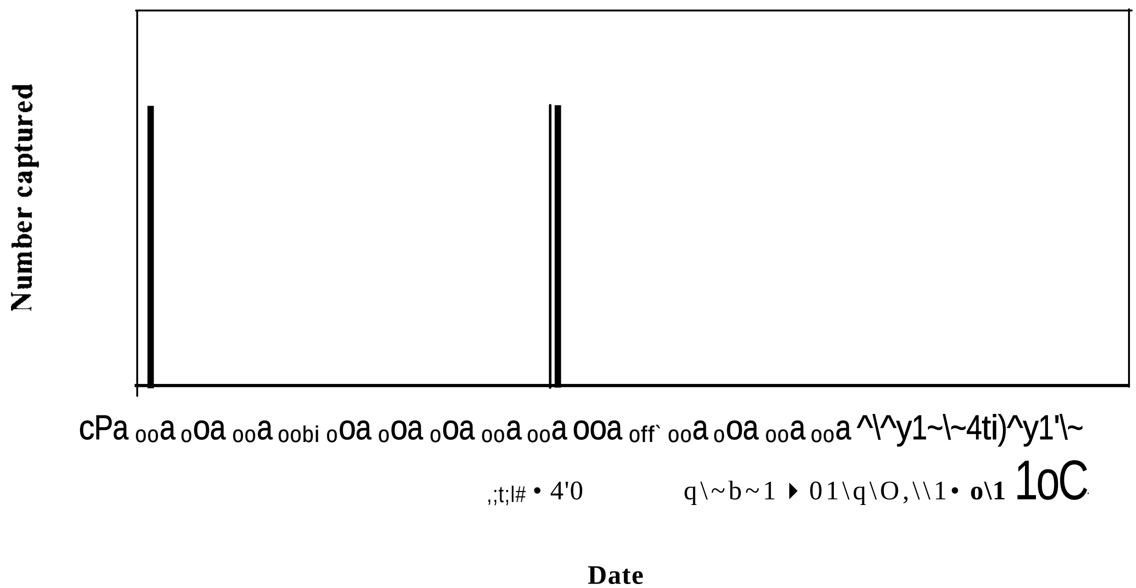


Figure 12. Timing of upstream movement of juvenile bull trout (n=31) in Johnson Creek, a tributary to the Clark Fork River, Idaho, in 2004.

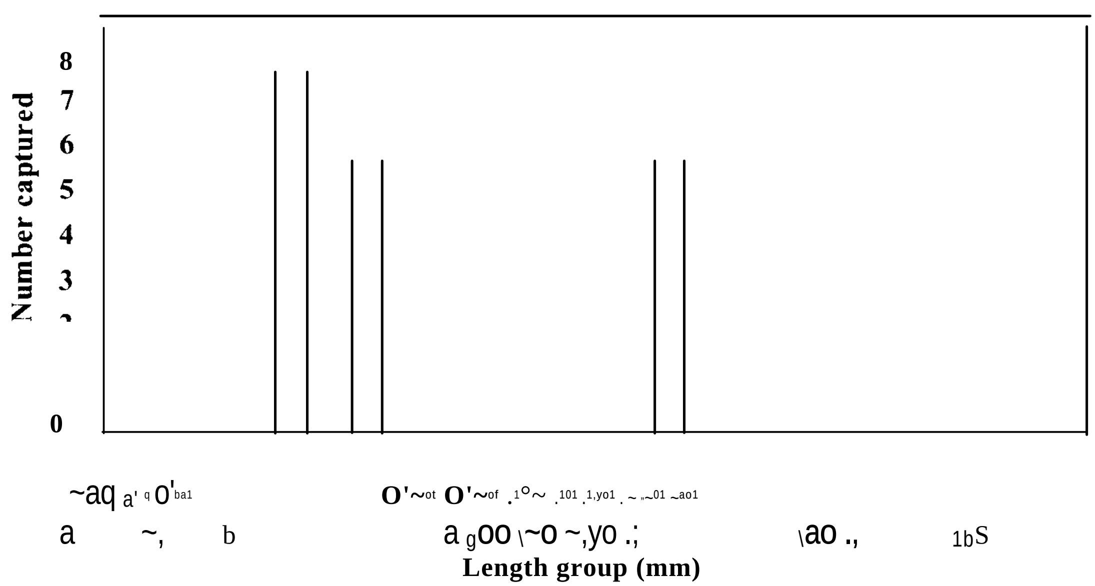


Figure 13. Length frequency histogram for juvenile hull trout (n 31) captured moving upstream in Johnson Creek, a tributary to the Clark Fork River, Idaho, during 2004.

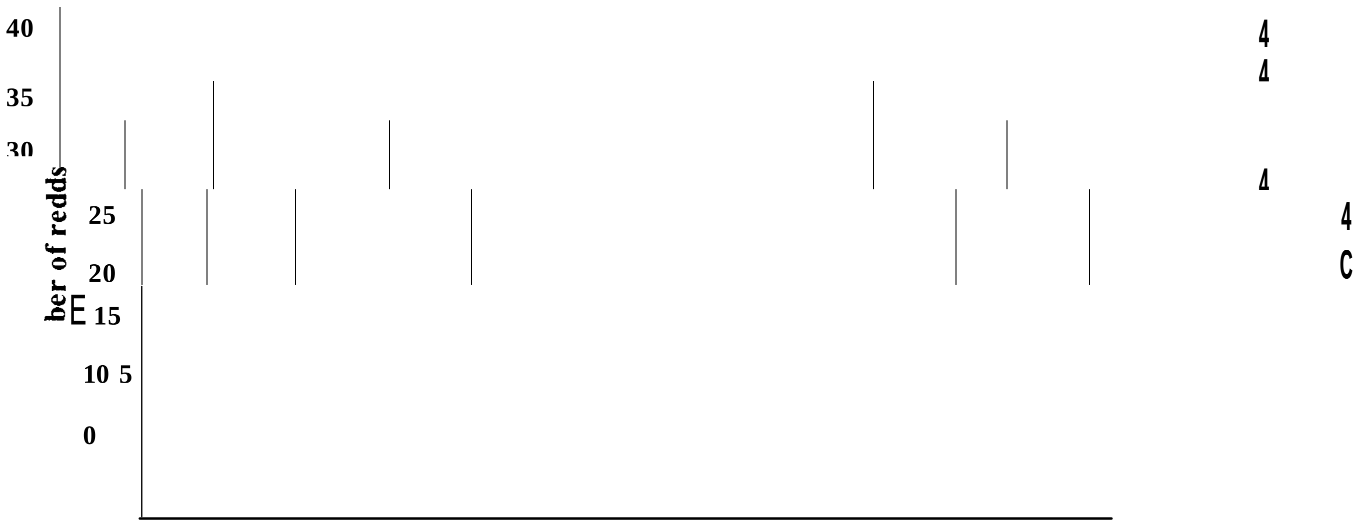


Figure 14. Bull trout redd counts in Johnson Creek, a tributary to the Clark Fork River, Idaho, from 1983 through 2004.

Granite Creek

Both the upstream and downstream weirs were installed on July 6, and removed on October 18, 2004. During this time, water temperatures taken during trap checks, typically occurring during late morning or early afternoon, ranged from 7° C to 13° C (Figure 15). In the upstream weir, a total of 223 adult bull trout were captured and transported above the barrier (Figure 16).

The mean total length for adult bull trout moving upstream was 518 mm. The mean weight was 1,326 g (Table 1; Figure 17). Of the 223 adults captured moving upstream, 37 were PIT tag recaptures tagged in Granite Creek in 2002 and 2003, while one adult was recaptured that had been tagged at the Cabinet Gorge Hatchery ladder on September 15, 2003. There were also four adults that had been captured and tagged moving downstream earlier in the season. The remaining 181 were unmarked fish, of which 172 were subsequently PIT tagged and released to spawn. Nine adults were captured but were not tagged due to equipment malfunction. In addition, 10 juvenile bull trout (< 300 mm total length) were also captured moving upstream and transported above the harrier (Table I ; Figure 18). There were also four juvenile westslope cutthroat trout *Oncnrh‣nchus (lurk/ lewisi* (mean total length 133 nun; range 72-162) and six adult kokanee (mean total length 290 mm; range 246-306) captured and transported above the harrier in 2004.

In the downstream weir, a total of 210 adult hull trout were captured and transported below the barrier after spawning (Figure 19). One hundred and five of these were previously PIT tagged. Of the 105 recaptures, 62 were fish tagged moving upstream in 2004. Ninety-three unmarked adults captured moving downstream were subsequently PIT tagged. An additional 12 adult bull trout were captured which could not be checked for the presence of a PIT tag or tagged if needed due to a problem with the scanner. An additional seven PIT tagged and eight unmarked adult bull trout were found dead in the trap and appeared to be natural post-spawn mortalities.

We derived a mark-recapture population estimate of adult escapement of 425 (95% CI: 377-490) individuals. Spawning mortality of marked adult bull trout prior to recapture likely occurred, and we assume that this mortality occurred equally for marked and unmarked individuals in our population estimate. We recaptured a total of 24 double marked adult bull trout and did not observe any short-term PIT tag loss. Two individuals PIT tagged these adults and there was minimal difference in their recapture proportions (7 of 19 (37%) and 17 of 49 (35%)).

A redd count was conducted on October 8, 2004 using the methods described by Pratt (1984). An individual walked from the mouth of Granite Creek upstream to the road culvert on USFS Road 278, counting bull trout redds. In areas of superimposition, each distinct pit was counted as a redd. A total of 149 redds were counted in 2004 (Figure 20).

A total of 341 juvenile bull trout were also captured and transported downstream below the barrier (Figure 21). One hundred twenty-nine were large enough to mark and were PIT tagged, while one was a recapture that had been tagged moving upstream earlier in the season. The mean total length for juvenile bull trout was 94 mm (range: 46-278 mm; s.d. = 38; n = 341) (Figure 22). The mean weight of downstream migrating juvenile bull trout was 10 g (range: I-196 g; s.d. 15; n = 336).

There were also 32 westslope cutthroat trout (mean total length = 117 mm; range = 50-268), one rainbow trout (total length = 78 mm), two unidentified *Oncorhynchus* sp. (total length = 51 and 54 mm), and one sculpin *Cottus* sp. (total length = 82 mm) captured and transported downstream of the barrier in 2004.

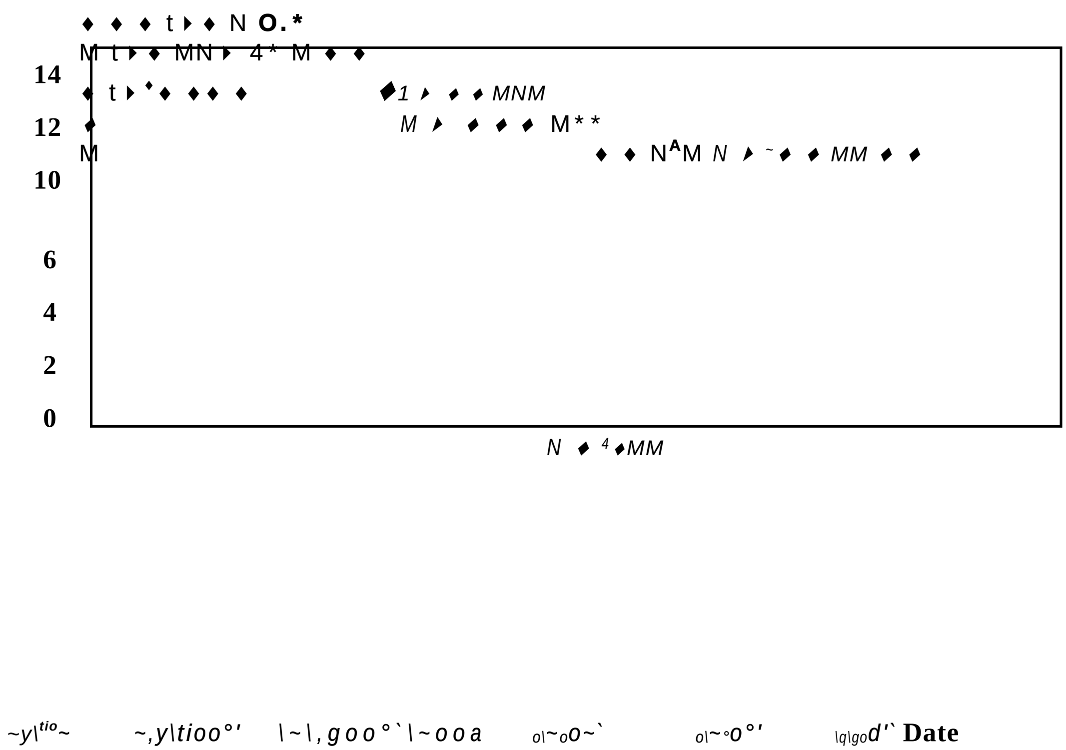


Figure 15. Daily water temperatures typically recorded during late morning/early afternoon trap

checks in Granite ('reek, a tributary to Lake Pend Oreille, Idaho, during 2004.

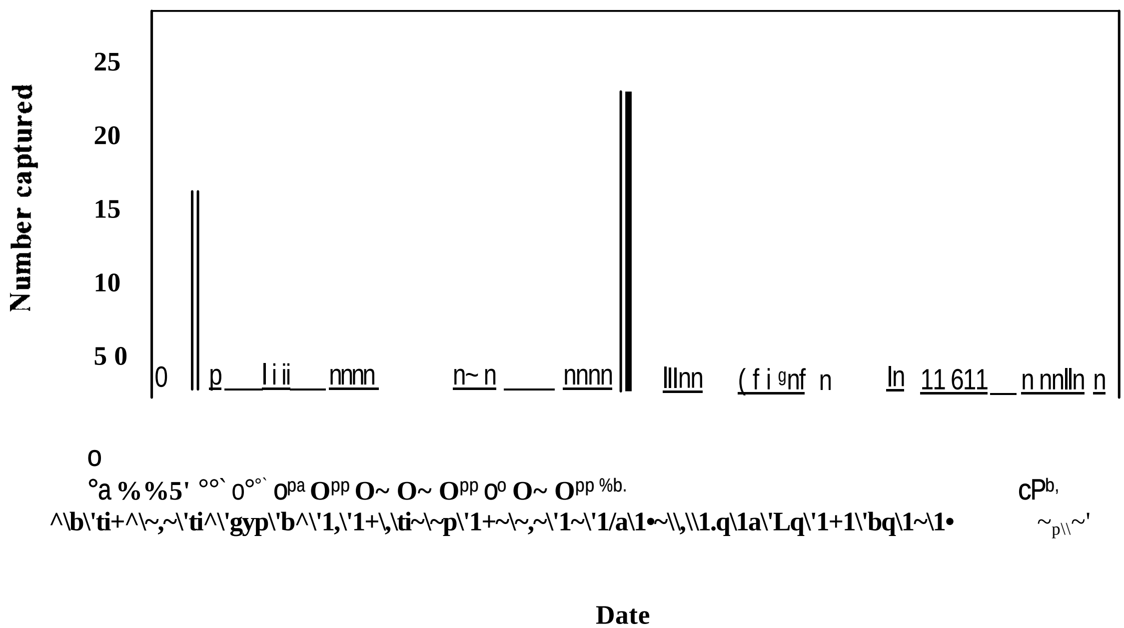


Figure 16. Timing of upstream migration of adult bull trout (n=223) in Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Table I. Summary total length (TL) and weight statistics for adult and juvenile bull trout captured in 2004 moving upstream in Granite Creek, a tributary to Lake Pend Oreille, Idaho.

	Mean TL (mm)	TL range (mm)	S.D.	Mean weight (g)	S.D.	Sample size
Adults	517.8	347-762	75.8	1,326.5	667.2	223

Juveniles	133.0	60-178	46.4	25.1	17.1	10

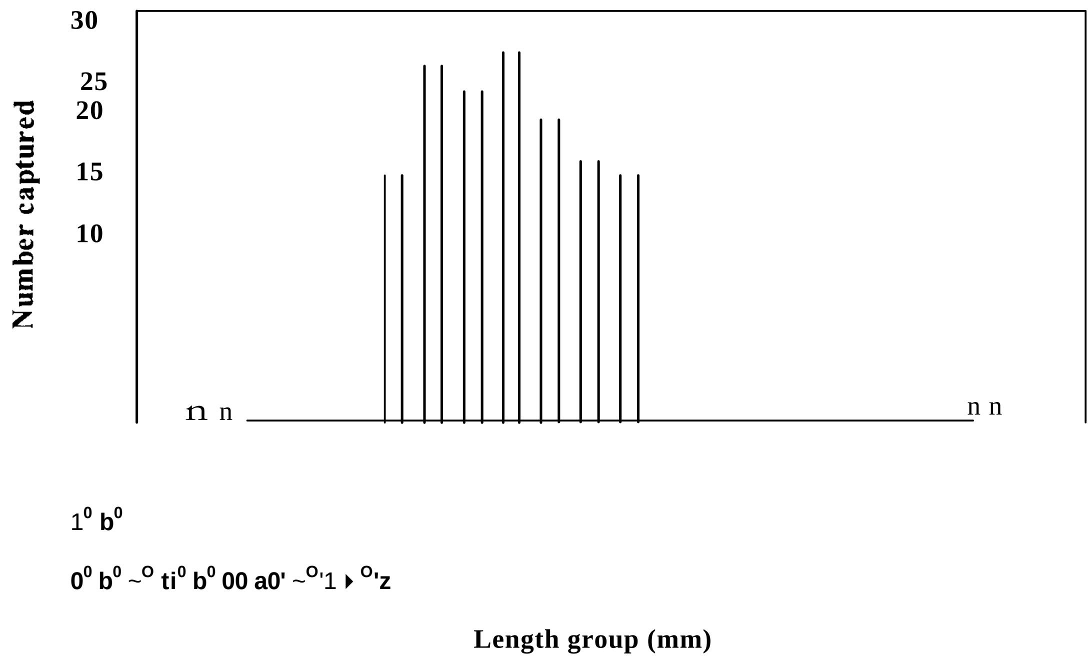


Figure 17. Length frequency histogram for adult bull trout captured moving upstream in the weir on Granite Creek (n = 223), a tributary to Lake Pend Oreille, Idaho, during 2004.

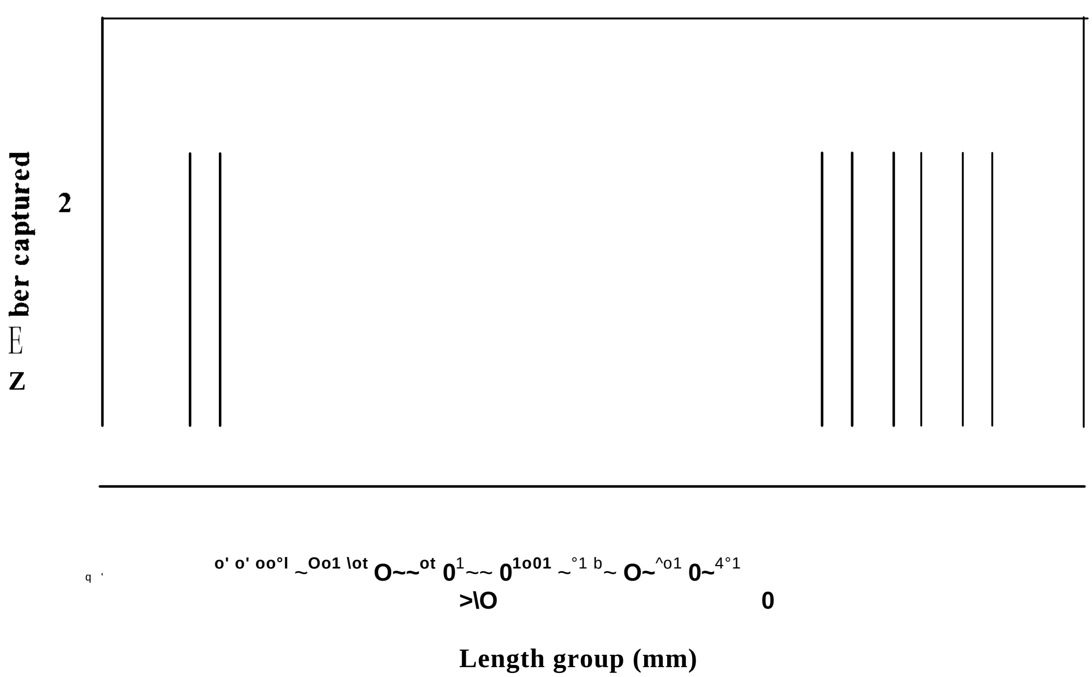
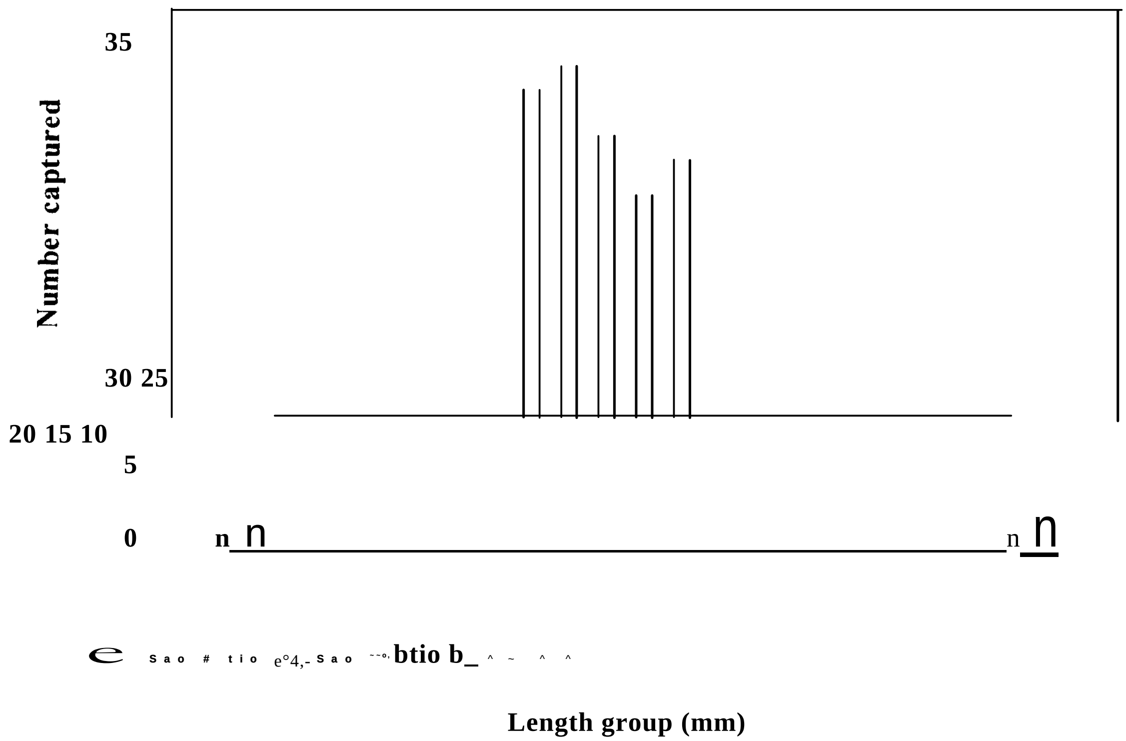


Figure 18. Length frequency histogram for juvenile bull trout (n 10) captured moving upstream

in Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.



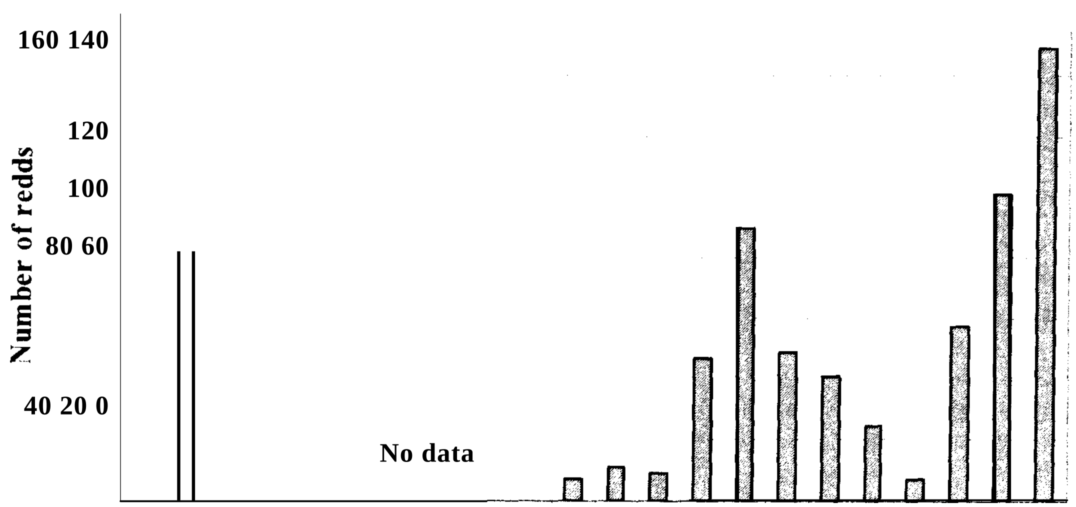


Figure 19. Length frequency histogram for adult bull trout captured moving downstream in the weir on Granite Creek (n = 225), a tributary to Lake Pend Oreille, Idaho, during 2004.

1q~ ^ ~ \ # ~~4^ \q u a '
~~ ~,~; ~,^

Figure 20. Bull trout redd counts in Granite ('reek, a tributary to Lake Pend Oreille, Idaho, from 1983 through 1987, and 1992 through 2004.

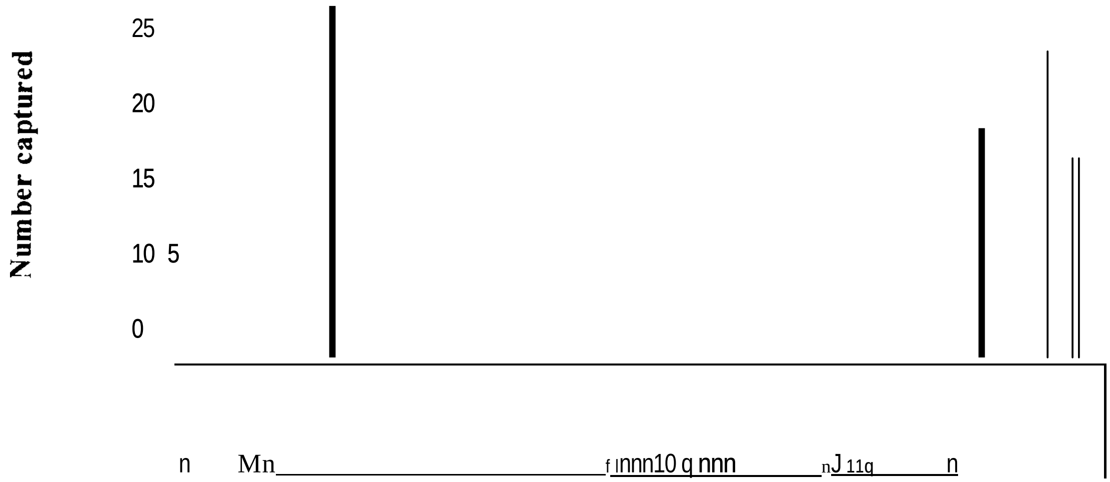


Figure 21. Timing of downstream movement of juvenile bull trout (n=341) in Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Date

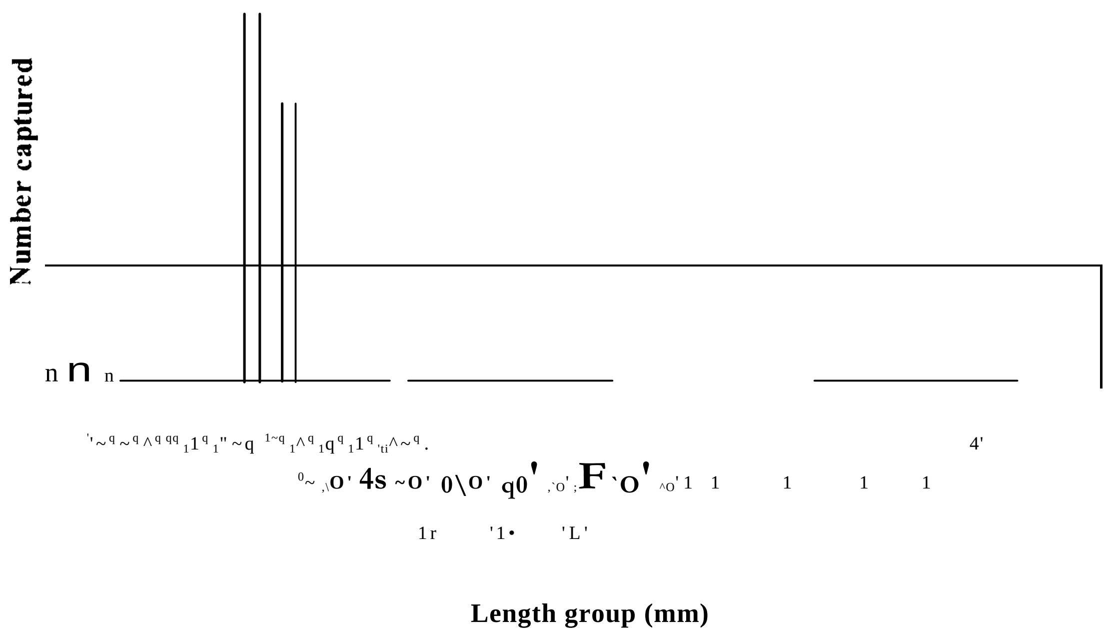


Figure 22. Length frequency histogram for outmigrating juvenile hull trout (n 341) captured in the downstream weir box in Granite ('reek, a tributary to Lake Pend Oreille, Idaho,

during 2004.

DISCUSSION

Johnson Creek

We captured far more adult bull trout in 2004 than we captured in 2003, when only three adults were captured trying to move upstream in Johnson Creek. The 35 adults captured in 2004, is more comparable to 53 and 60 captured in 2001 and 2002, respectively. In late summer 2003, flow conditions were very low near the mouth of Johnson Creek, potentially making entering the stream less attractive or more difficult. The extreme lower reaches of Johnson Creek actually became dry late in the summer 2003, which did not occur in 2001, 2002 or 2004. Upstream movement of adult bull trout in the LPO system has been shown to occur over a protracted time period, extending from as early as late May into late October (Downs and Jakubowski 2003). It is likely that relatively strong late summer stream flows in 2004 provided good access into Johnson Creek for bull trout spawning, and resulted in a greatly improved redd count over 2003.

Although we only captured and transported 35 adult bull trout, we counted 32 redds during the October 11, 2004 survey of Johnson Creek. This suggests that some fish were able to pass the headcut without our assistance prior to the installation of our trap box. Higher flows, which occur prior to the installation of the trap would improve access past the headcut area. Thirty-two redds is considered to be a very strong redd count when compared to the long-term average of 19 redds in Johnson Creek. The previous years count was zero, and this was likely at least partially the result of low water and poor migration conditions. The 2004 redd count should result in a relatively strong year class of juveniles in Johnson Creek and offset some of the 2003 spawning failure.

The head-cut barrier on Johnson Creek is located in a depositional zone near the mouth, and the channel shows evidence of repeated channel shifts. The existing head-cut is likely to be only temporary in nature and is currently held in place by tree root structure. The head-cut will likely eventually migrate upstream to a point of equilibrium, or shift again, alleviating the fish passage problem over time. We recommend ensuring fish passage past this point by annual monitoring of the head-cut, and providing interim fish passage either with a temporary ladder or continued trapping.

Granite Creek

We captured and transported 223 individual adult hull trout around the low flow harrier on Granite Creek during the summer and fall of 2004 to provide access to the majority of the spawning habitat in Granite ('reek. This number is far greater than the nearly 100 adults passed upstream past the low flow barrier in 1997, and 131 passed in 2002. It compares well with the 264 passed upstream in 2003. Based on the population estimate (425) and redd counts (149), a considerable amount of the reproduction in Granite Creek in 2004 came from the fish we captured and moved. When we compare the number of redds counted in Granite Creek between years fish were not transported against the years they were since 1996 (the year the channel changes occurred), we see the benefits of the program (Figure 23).

The 2004 population estimate of 425 (95% Cl: 377-490) adult bull trout is considerably higher than the 289 and 294 individuals estimated in 2002 and 2003, respectively. It is however, similar to the 1997 estimate of 400-500 individuals. The spawner:redd ratio of 2.9:1 estimated from the 2004 data is identical to the 2003 ratio, but lower than the 5.1:1 observed in 2002. The 2.9:1 ratio is similar to the average spawner:redd ratio for LPO as a whole (Table 2). It is also consistent with ratios from other bull trout populations across the western U.S. (range: 1.5:1 to 3.2:1; average 2.2:1) (Bonar et al. 1997).

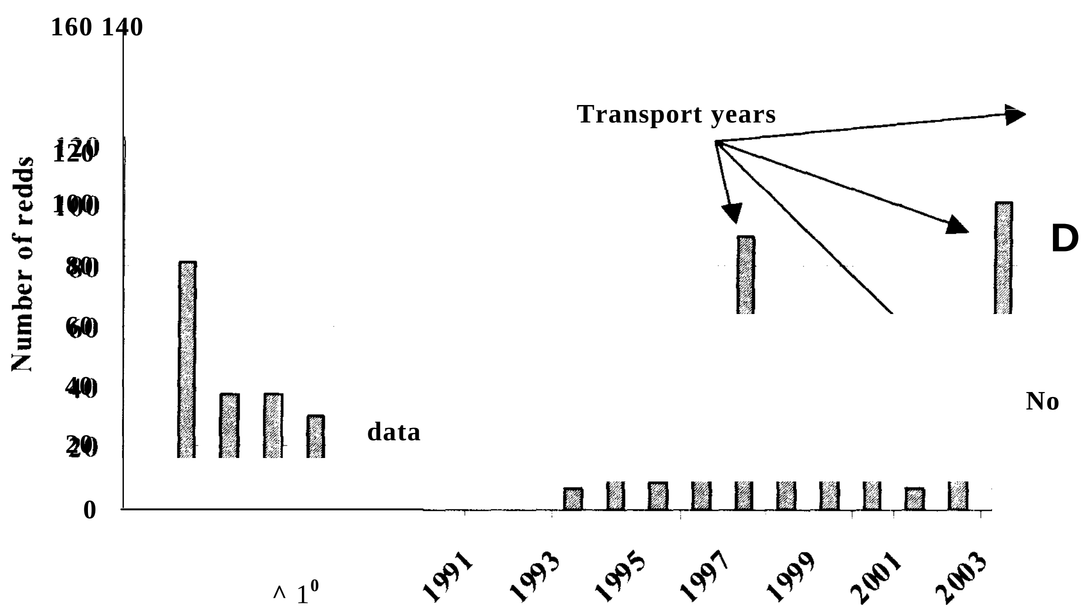


Figure 23. Annual bull trout redd counts compared to transport years on Granite Creek, a tributary to Lake Pend Oreille, Idaho.

Table 2. Bull trout spawner to redd ratios estimated for individual tributaries to Lake Pend Oreille, Idaho, sampled from 2000 through 2004.

Stream	Year	Spawner:redd ratio
Trestle Creek"	2000	3.7:1
Gold Creek°	2000	1.9:1
Granite Creek'	2002	5.1:1
Granite Creek`	2003	2.9:1
Granite Creek	2004	2.9:1
Grouse Creek"	2000	2.9:1
Average		3.2:1

" Downs et al. 2003

[b] Downs and Jakubowski 2003

Downs and Jakubowski 2004

The Granite Creek intermittent/impaired reach is located in a low gradient section of the channel and was likely historically capable of providing upstream fish passage yearlong. Because of the remote location of the site, operating a trap and haul program requires a significant investment of financial resources on an annual basis, doesn't address the cause of the problem, and doesn't address potential juvenile fish loss in the spring when flows diffuse across the floodplain at an exaggerated rate due to a lack of a defined stream channel in certain areas. This problem has persisted for six years and annually inhibits migration of relatively large numbers of bull trout. For these reasons, a long-term solution is desired. A stream channel assessment and restoration design was completed in 2003 (River Design Group 2004). We plan to implement a stream restoration project to restore yearlong natural fish passage in 2005 to this reach of Granite Creek.

ACKNOWLEDGEMENTS

The authors wish to thank John Suhfras, Christina Suhfras and Tyler Long of Avista for their contributions to completing the field work associated with this project. We would also like to thank Mark Gamblin and Ned Horner of the Idaho Department of Fish and Game, Joe DosSantos of Avista Corp., Laura Katzman of Montana Fish, Wildlife, and Parks, and Larry Lockard of the U.S. Fish and Wildlife Service for their reviews of this report.

LITERATURE CITED

Baxter, J.S. and W.T Westover. 1999. Wigwam River Bull Trout. Habitat Conservation Trust Fund Progress Report (1998). Fisheries Progress Report K054. British Columbia Ministry of Environment, Cranbrook.

Bonar, S.A., M. Divens, and B. Bolding. 1997. Methods for sampling the distribution and abundance of bull trout and Dolly Varden. Washington Dept. of Fish and Wildlife. Olympia.

Downs, C., R. Jakubowski, and S. Moran. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 1999-2001 Progress Report. Avista Corporation. Spokane, Washington

Downs C., and R. Jakubowski. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2002 Progress Report. Report of the Idaho Department of Fish and Game and Avista Corporation to Avista Corporation, Spokane, Wa.

Downs C., and R. Jakubowski. 2004. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2003 Progress Report. Report of the Idaho Department of Fish and Game and Avista Corporation to Avista Corporation, Spokane, Wa.

Krebs, C.J. 1998. Ecological Methodology. Harper-Collins Publishers, Inc. New York, New York.

Nelson, M.L. 1999. Evaluation of the potential for "resident" bull trout to reestablish the migratory life-form. MS Thesis. Montana State University, Bozeman.

Panhandle Bull Trout Technical Advisory Team. 1998. Lake Pend Oreille key watershed bull trout problem assessment. Report to the Lake Pend Oreille Watershed Advisory Group and the State of Idaho.

Pratt, K. 1984. Pend Oreille trout and char life history study. Report to the Idaho Department of Fish and Game and the Lake Pend Oreille Idaho Club. Boise.

River Design Group. 2004. Granite Creek Watershed Assessment and Restoration Design Report. Report to Avista Corporation. Whitefish, Montana.

C

Project 7: **2004 Twin Creek Restoration Monitoring Progress Report**

ABSTRACT

In 2004 we conducted depletion-removal population estimates in four sections of Twin Creek, a tributary to the Clark Fork River, Idaho, to monitor and evaluate the biological effectiveness of a large-scale habitat restoration project conducted in 2000 and 2001. Bull trout *Salrelinus con/luentus,* westslope cutthroat trout *Oncorhvnchus clarki lewisi,* and mountain whitefish *Prosopium williamsoni* were all present in Twin Creek. Bull trout densities were highest in the lower reaches of Twin Creek, associated with the known spawning area for bull trout in Twin Creek. Bull trout (> 100 mm) abundance remains low in all sections monitored. Rainbow trout (> 75 mm) are the dominant, or co-dominant species captured in the monitoring sections. Continued monitoring is needed to determine actual trends in species abundance, composition, and distribution following the stream restoration work.

Authors:

Christopher C. Downs
Senior Fishery Research Biologist
Idaho Department of Fish and Game

Robert Jakubowski
Natural Resource Technician
Avista Corporation

INTRODUCTION

Twin Creek is a spring-fed tributary to the lower Clark Fork River in Bonner County, Idaho, and is used for spawning by bull trout *Salve/inns confluentus,* westslope cutthroat trout *Oncorhvnchus clarki letii'isi,* brown trout *Sabno trutta* and rainbow trout O. *nlykiss* as well as kokanee O. *nerka* migrating from the Clark Fork River and Lake Pend Oreille (LPO) (Figure 1). During the mid-1950's, shortly after Cabinet Gorge Darn blocked upstream migrations of bull trout in 1952, biologists documented between 50 and 80 bull trout redds each fall in the lower 1.6 km of Twin Creek. Recent estimates of bull trout spawner to redd ratios for LPO tributaries suggest an average of 2.9 bull trout spawn for every redd constructed (Downs and Jakubowski, 2003), or that approximately 140 to 230 adults were entering Twin Creek annually to spawn. In the early 1950's, much of lower Twin Creek was channelized for agricultural purposes, resulting in a significant reduction in actual stream length, and a loss of habitat diversity. Before the stream restoration project was completed in 2001, the stream channel was relatively straight, wide, and shallow, with depths rarely exceeding 15 cm during the summer/fall low flow period. Livestock grazing occurred throughout most of the summer, and streamside vegetation was limited to grasses and a few alders along approximately 30 percent of the channel length. Since 1992, the average number of bull trout redds counted in this reach was six, representing a tenfold reduction in bull trout spawning activity from the 1950's, putting this population at risk of extinction. A project was initiated in 1999 to move much of Twin Creek back into its original channel, restore the natural meander pattern, and reconstruct the habitat diversity. The primary goal of the restoration project was to restore numbers of spawning bull trout using Twin Creek to levels observed prior to channelization of the stream.

The Twin Creek restoration project was a complete channel reconstruction that involved constructing approximately 1,737 m of new stream channel, diverting water out of the old channel, and filling in much of the old channel with the spoils from construction of the new channel. Construction of the new channel occurred during the summers of 2000 and 2001, and water was turned into the new channel in June 2001. The project resulted in an overall gain in total stream length of 291 m, increased habitat diversity, and restoration of natural stream processes. Because much of the old stream channel was filled in upon completion of the project, the monitoring program does not involve collecting information from the same sections pre and post-treatment over time. We did collect pre-treatment baseline information on fish abundance, size structure, and distribution that will be useful in evaluating the effectiveness of the project. Electrofishing is being used to monitor the fish population response to the restoration project.

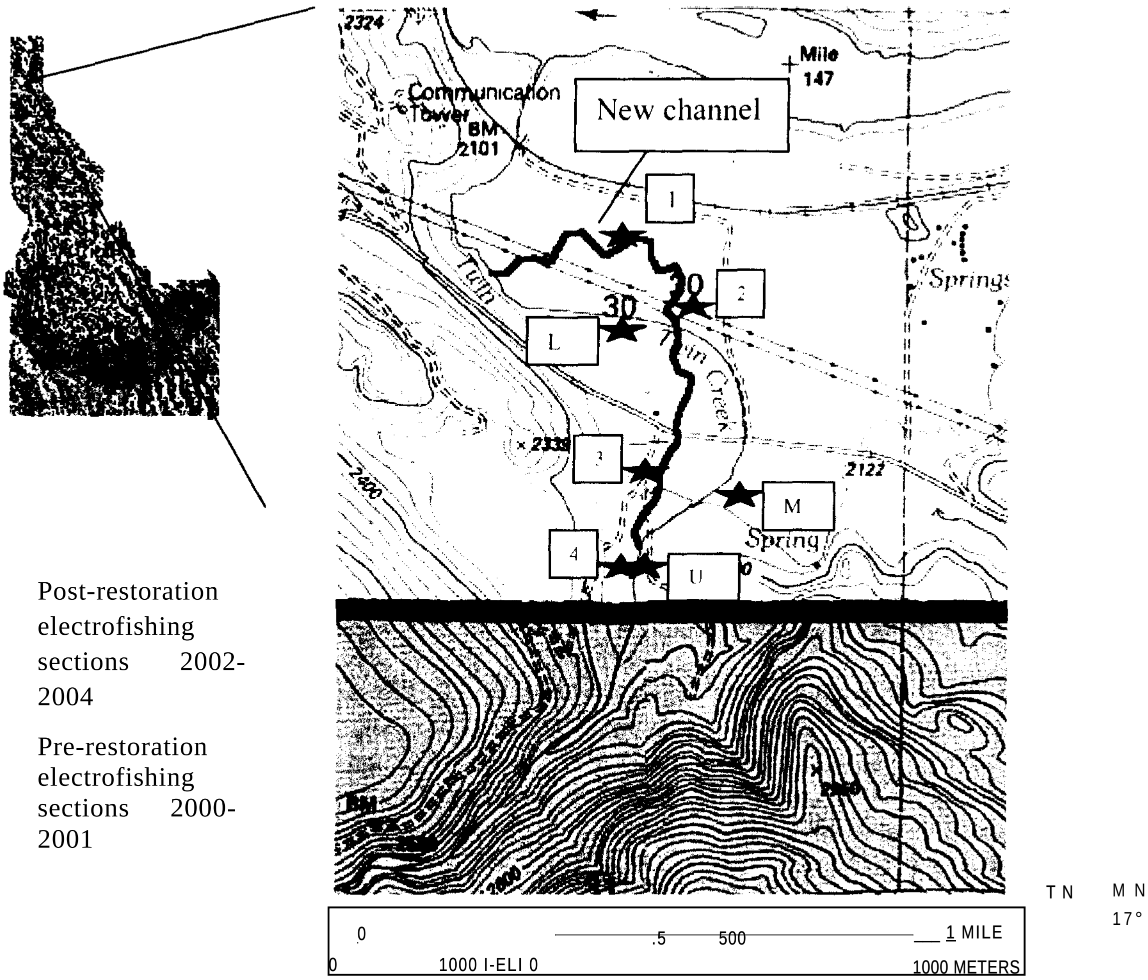


Figure I. Vicinity map and sample site locations for Twin Creek, a tributary to the Clark Fork River, Idaho (L, = lower, M = middle, U = upper pre-restoration sampling sites).

METHODS

We used the removal (depletion) method (Zippin 1958) to estimate abundance and size structure of fish populations in four reaches of Twin Creek following restoration. The software program Capture (White et al. 1982) was used to derive population estimates from the depletion data when three or more passes were conducted, while Microfish (Van Deventer and Platts 1986) was used to derive estimates from the depletion data when a two-pass estimator was needed. Population and density estimates were conducted for fish greater than or equal to 75 mm only (total length; 'FL), due to sampling efficiency considerations. When all the individuals of a particular species were captured on the first pass and a depletion estimate was not possible, we report the total catch on the first pass as the population estimate. We also estimated catch-perunit-effort (CPEJL) as fish captured per minute of electrofishing on the first pass only. We standardized the results of the population estimates by converting the number estimated per linear 100m, to the number captured per $100m^2$. This information will be used in combination with trapping and redd count information on Twin Creek to assess the biological effectiveness of the stream restoration project.

Depletion removal estimates involved measuring a 100 m reach of stream and blocking both ends with a seine to prevent fish movement in or out of the section. GPS coordinates were recorded (NAD 27) and flagging/stakes were used to mark the sections to ensure repeatability. Reaches were numbered sequentially, moving from the downstream-most section (Section one) to the upstream-most section (Section four). Wetted-widths were recorded every 20 m along the transect to estimate the total area of the section. Crews of two or three individuals slowly progressed upstream within the section carefully shocking the stream. A Smith-Root model 12-B battery powered backpack shocker, using pulsed DC current, was used to stun fish, which were netted and placed in a bucket carried with the crew while shocking. Typical settings for the electrofishing unit were G-3 at 300 to 400 volts. Small holes (approximately 3 mm) were drilled in the top half of the side of the bucket to allow a crew member to provide fresh water to the fish without risking escape. Repeated passes were made through the section until the catch on a pass was reduced to 20% or less of the catch on the first pass. Fish that were visually classified as hybrids of bull X brook trout were not included within the bull trout estimates, and those classified as hybrids of westslope cutthroat X rainbow trout were not included within the westslope cutthroat estimate. We also re-ran the population estimates from the 2002 and 2003 field seasons to provide estimates of bull and westslope cutthroat trout, not including hybrids in those estimates, to be used in future comparisons.

We sampled Twin Creek on July 12 and 13, 2004. Fish were anesthetized, measured (total length; mm), weighed (g), and had a sample of scales removed for ageing. All bull trout > 75 mm were tagged with Passive Integrated Transponder (PIT) tags. Fish were allowed to recover their equilibrium and were released back into the stream below the section. All brook trout *Salrelinccs jontinalis* and bull X brook trout hybrids encountered during sampling were removed to reduce the potential risk of hybridization with bull trout, as well as competition with both bull and westslope cutthroat trout.

RESULTS

We captured six salmonid species in Twin Creek in 2004 (Table 1). In Section 1, we were not able to generate an estimate for juvenile hull trout because of the non-declining catch pattern. However, we did capture three juvenile bull trout in this section (> 75 mm). A single 76 mm hull trout hybrid was also captured (based on visual classification), but is not included in the density estimate. No brown or westslope cutthroat trout were captured in Section 1 (Table 2).

C

Table I. Species captured in Twin Creek, a tributary to the Clark Fork River, Idaho, in 2004.

Species	Abbreviation
Brook trout *Salvelinus ~ontinalis*	BRK
Brown trout *Salmo trutta*	BRN
Bull trout *Sal%'elinus confhrentus*	BLT
Mountain whitefish *Prosopiunt tvilliamsoni*	MWF
Rainbow trout *Oncorhmnchus invkiss*	RBT
Westslope cutthroat trout O. *clarki letitisi*	WCT

Table 2. Population estimates for salmonid species (>75 mm; TL) captured in Section 1 in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

Species	Estimate (95% Cl)	N/100m^2	CPUE (fish/minute)
BLT	N/A'	N/A	0.0
BRK	2 (2-2)	0.49	0.07
RBT	6 (6-6)	1.46	0.18

'No estimate. Three bull trout > 75 mm were captured.

Average size of salmonids > 75 mm in Section 1 ranged from 76 mm for a single bull trout hybrid to 206 mm for brook trout (Table 3). Based on comparisons of ages estimated from otoliths largely from brook trout, it appears all of the bull trout captured were likely age-0 (Figure 2). Length-frequency histograms for brook and rainbow trout indicate the presence of multiple age-classes (Figures 3 and 4). A single unknown *Oncorhvnchus sp.*, 30 mm total length, was also captured.

r

Table 3. Mean lengths (TL; mm), mean weights (g), and standard deviation (SD), for individuals 75 mm, and length range for all individuals captured in Section 1 in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

Species	Mean length (SD)	Length range	Mean weight (SD)	Sample size
BLT	80.3 (1.5)	65-82	5.3 (0.6)	3
BLTxBRK	76.0 (N/A)	N/A	5.0 (N/A)	1
BRK	206.0 (9.9)	46-213	99.5 (12.0)	2
RBT	_	_	22.8 (10.6)	6

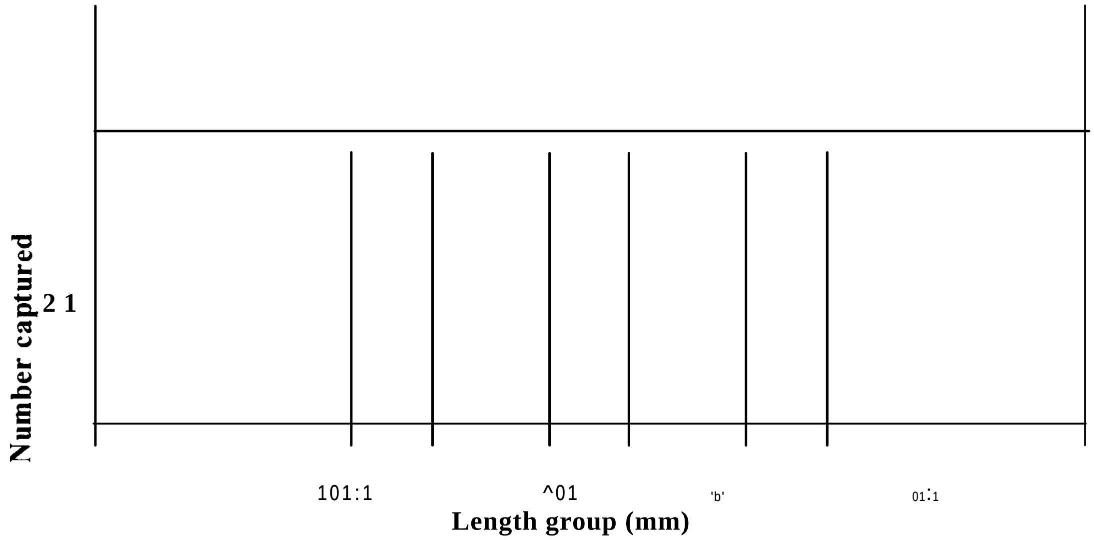


Figure 2. Length frequency histogram for all bull trout (n=6) captured in Section 1, Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

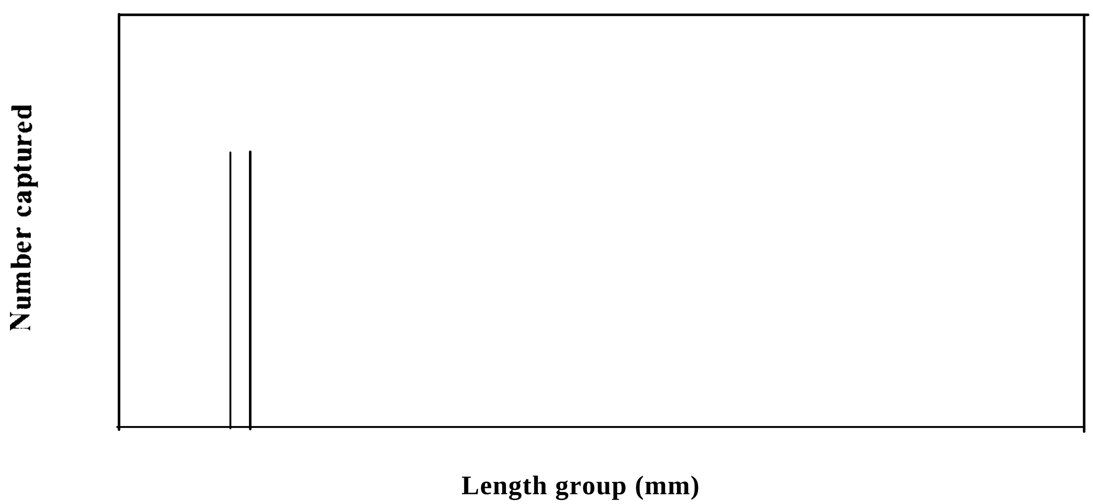


Figure 3. Length frequency histogram for all brook trout (n 6) captured in Section I, Twin Creek, a tributary to the ('lark Fork River, Idaho, in July 2004.

C: C

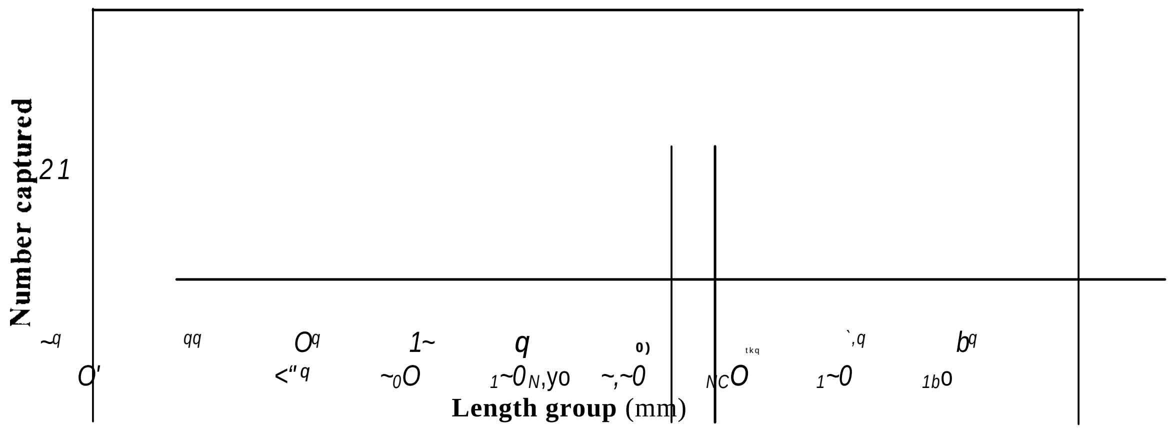


Figure 4. Length frequency histogram for all rainbow trout (n=6) captured in Section 1, Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

In Section 2, brook trout had the highest density (3.13/100m^2), while bull trout had the lowest (1.56/100m^2). A single mountain whitefish and bull trout hybrid, 85 and 102 mm, respectively, were also captured. No westslope cutthroat trout were captured in section 2 (Table 4).

Average size of salmonids > 75 mm ranged from 80.3 mm for brook trout to 133.1 mm for rainbow trout in Section 2 (Table 5). The catch of bull and brook trout appears to be dominated by age-0 individuals (Figures 5 and 6). Rainbow trout catch was dominated by age-1 and older individuals, while both age-0 and age- I and older brown trout were captured in Section 2 (Figures 7 and 8).

Table 4. Population estimates for salmonid species (>75 mm; TL) captured in Section 2 in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

Species	**Estimate (95% CI)**	**N/100m-**	**CPUE (fish/minute)**
BLT	5 (5-5)	1.56	0.08
BRK	10 (10-10)	_	0.21
BRN	6 (6-6)	1.88	0.1 1
RBT	8 (8-8)	2.50	0.16

Table 5. Mean lengths (TL; mm), mean weights (g), and standard deviation (SD), for individuals > 75 mm, and length range for all individuals captured in Section 2 in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

Species	**Mean length (SD)**	**Length range**	**Mean weight (SD)**	**Sample size**
BLT	95.6 (37.7)	70-163	12.8 (16.4)	5
BLTxBRK	102.0 (N/A)	N/A	11.0 (N/A)	1
BRK	80.3 (3.9)	51-88	5.5 (1.0)	10
BRN	130.3 (16.8)	103-145	23.8 (8.7)	6
MWF	85.0 (N/A)	N/A	7.0 (N/A)	1
RBT	133.1 (8.6)		26.9 (6.0)	8

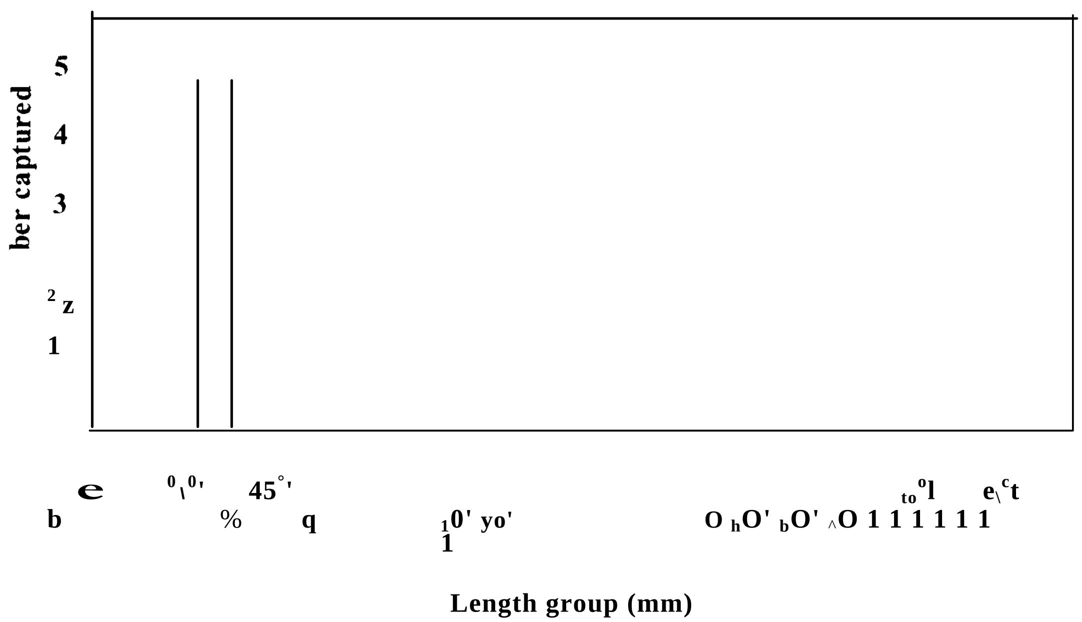


Figure 5. Length frequency histogram for all bull trout (n—7) captured in Section 2, Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

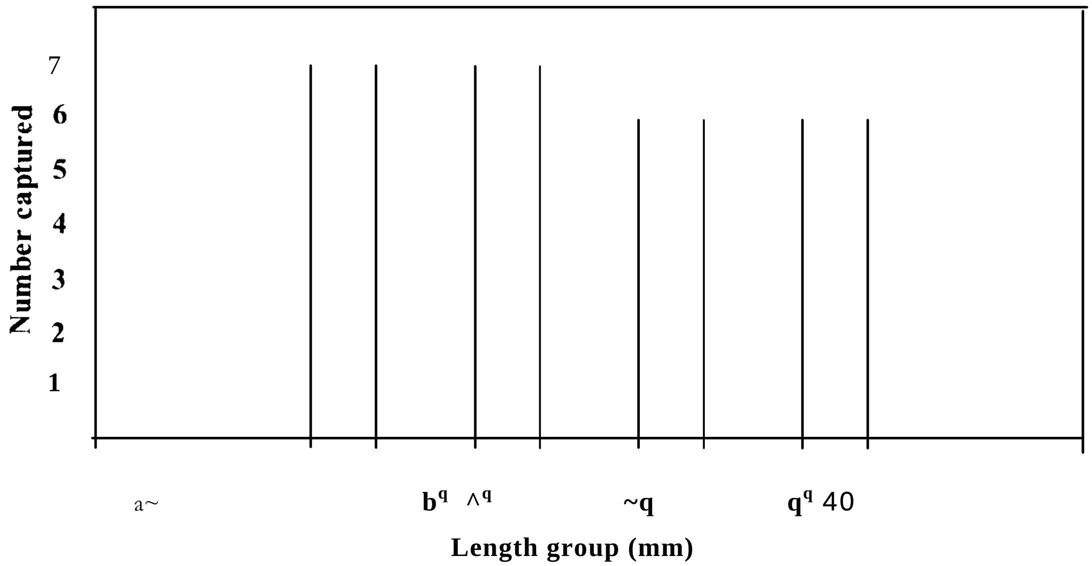


Figure 6. Length frequency histogram for all brook trout (n=26) captured in Section 2, Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

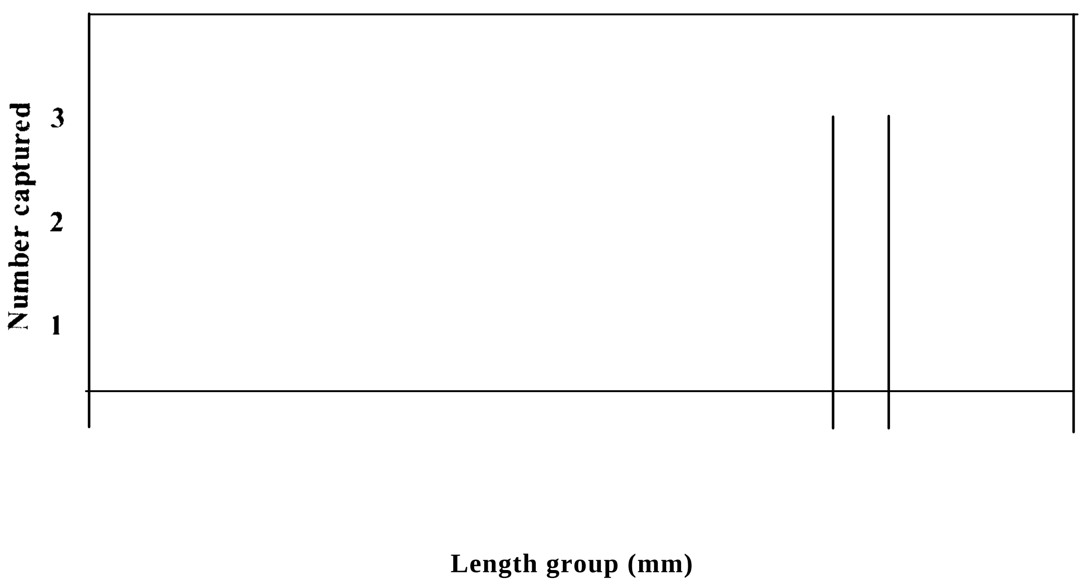


Figure 7. Length frequency histogram for all brown trout (n 6) captured in Section 2, twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

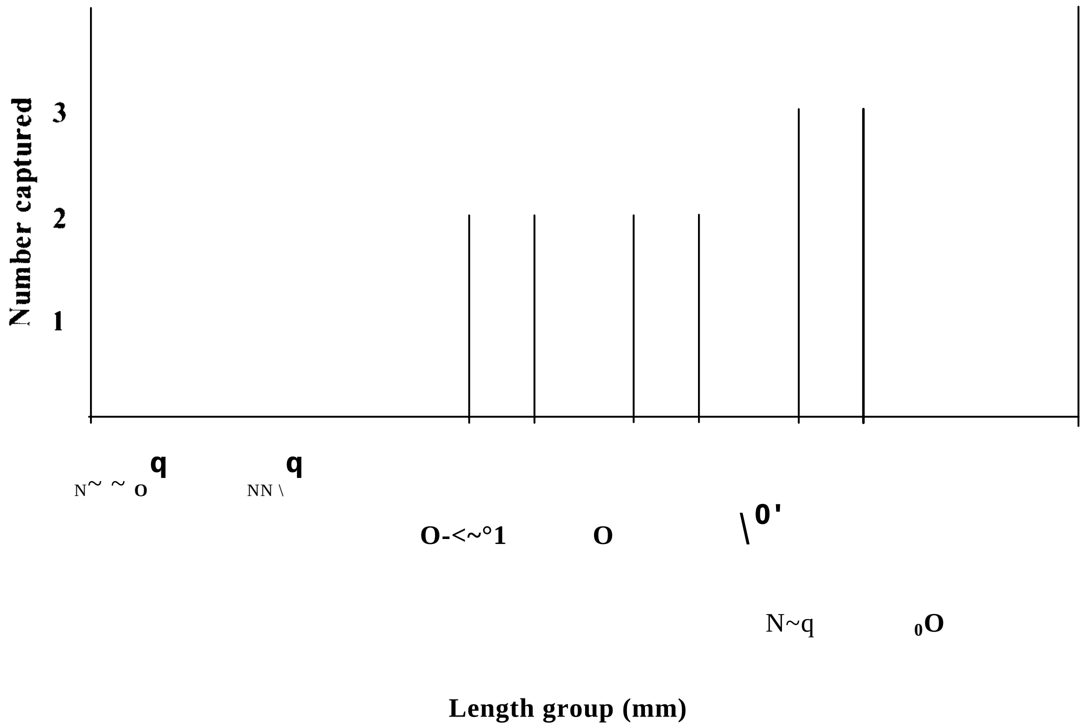


Figure 8. Length frequency histogram for all rainbow trout (n=8) captured in Section 2, Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

In Section 3, rainbow trout had the highest density (1.91/100m^2), while brook and brown trout both shared the lowest (0.27/100m^2). Bull trout density in Section 3 was 1.09/100m^2 (Table 6).

Average size of salmonids >75 mm in Section 3 ranged from 78 mm for a single brook trout to 134 mm for westslope cutthroat trout. No hybrids or mountain whitefish were captured in Section 3 in 2004 (Table 7). The length-frequency histograms from Section 3 indicate multiple age-classes of bull trout present, while brook trout were dominated by age-0 individuals (Figures 9 and 10). Captured rainbow trout comprised multiple age classes, but age-0 fish did not appear to be present in the catch (Figure 11). Westslope cutthroat and brown trout in Section 3 appear to consisted of age-I and older fish, with two westslope cutthroat (113 and 155 mm) and one brown trout (I30 mm) captured.

Table 6. Population estimates for salmonid species (>75 mm; TL) captured in Section 3 in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

Species	**Estimate (95%** CI)	**N/100m^2**	**CPUE (fish/minute)**
BLT	4 (4-4)	1.09	0.07
BRK	I (1-1)	0.27	0.04
BRN	1 (1-1)	0.27	0.04
RBT	7 (7-7)	1.91	0.18
WCT	2 (2-2)	0.55	0.07

Table 7. Mean lengths (TL; mm), mean weights (g), and standard deviation (SD), for individuals > 75 mm, and length range for all individuals captured in Section 3 in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

Species	**Mean length (SD)**	**Length range**	**Mean weight (SD)**	**Sample size**
BLT	111.5 (43.0)	71-167	18.0 (18.2)	4
BRK	78.0 (N/A)	48-78	5.0 (N/A)	1
BRN	130.0 (N/A)	N/A	23.0 (N/A)	1
RBT	131.7 (26.1)	100-182	26.9 (18.7)	7
WCT	134.0 (29.7)	113-155	23.5 (13.4)	2

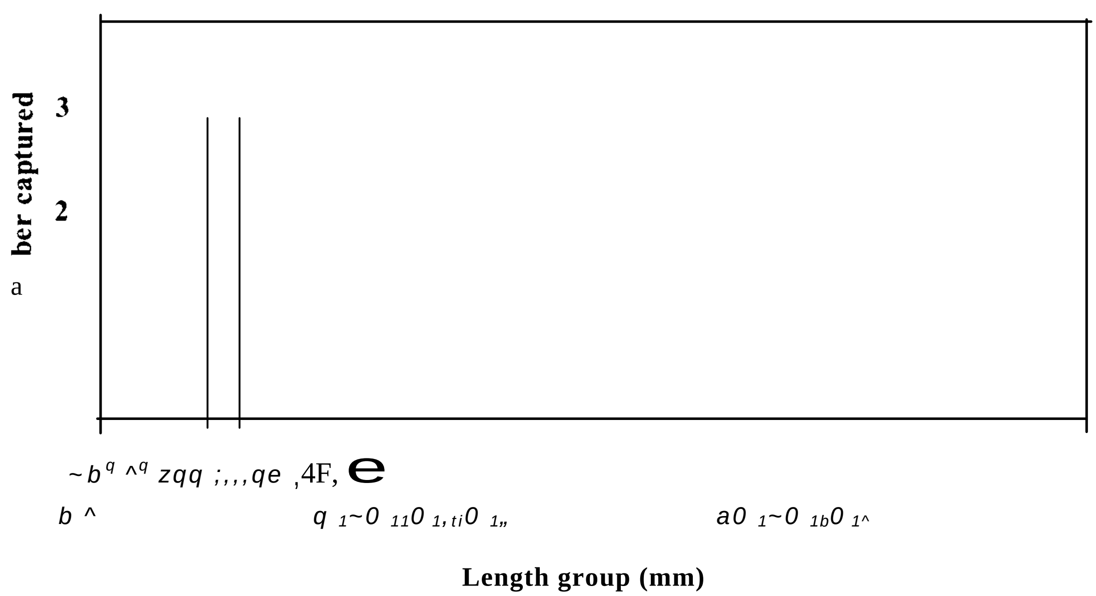


Figure 9. Length frequency histogram for all bull trout (n=5) captured in Section 3, Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

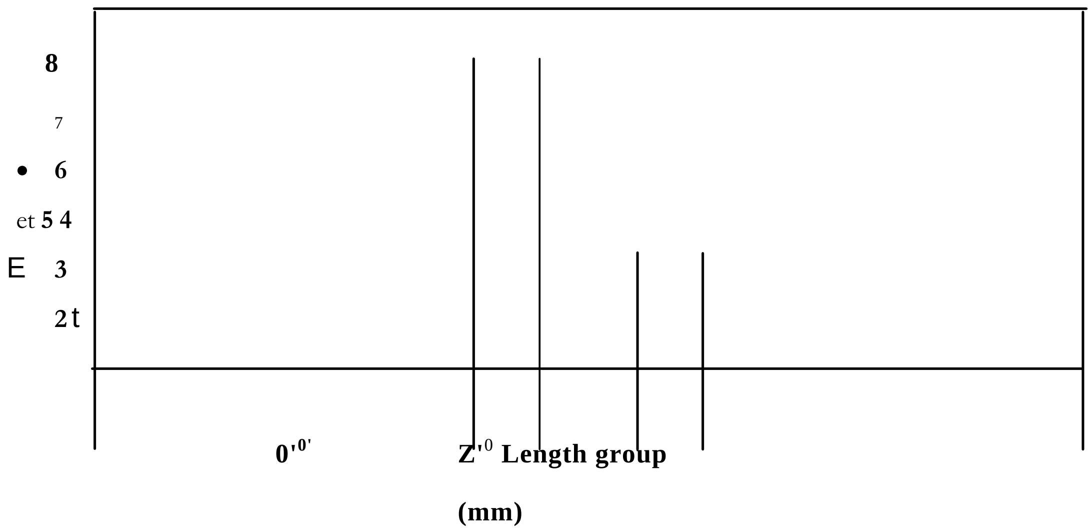


Figure 10. Length frequency histogram for all brook trout (n=14) captured in Section 3, Twin Creek, a tributary to the ('lark Fork River, Idaho, in July 2004.

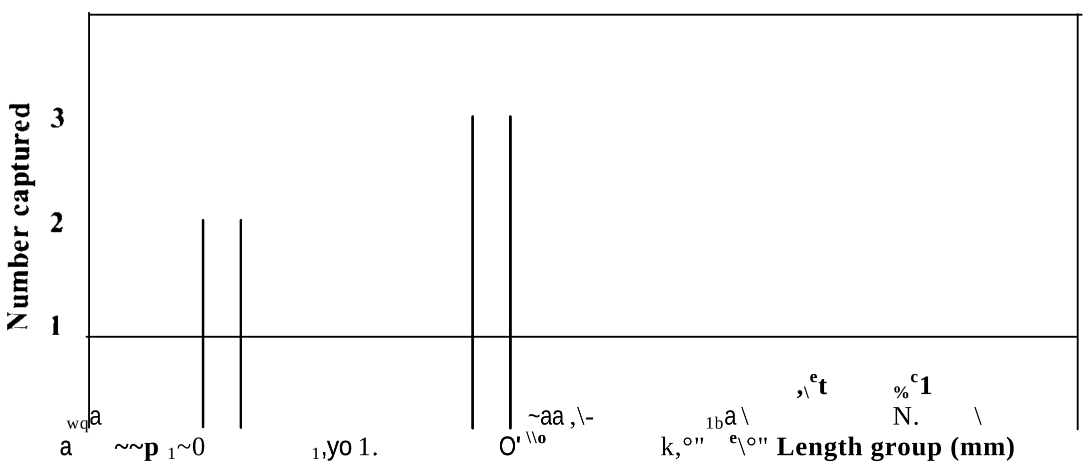


Figure 11. Length frequency histogram for all rainbow trout (n 7) captured in Section 3, Twin ('reek, a tributary to the Clark Fork River. Idaho, in July 2004.

C

C)

In Section 4, rainbow trout and a single brook trout (58 mm) were the only species captured. A single westslope cutthroat X rainbow trout hybrid (based on visual classification) was also captured. Rainbow trout density was estimated at 8.48/100m^2 (Table 8).

Average size of rainbow trout >75 mm in section 4 was 109.4 mm. A single 164 mm westslope cutthroat X rainbow trout hybrid was also captured (Table 9). The length-frequency histogram from Section 4 for rainbow trout captured indicates the presence of multiple age-classes (Figure 12).

Table 8. Population estimates for salmonid species (>75 mm; TL) captured in Section 4 in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

Species	Estimate (95% Cl)	N/100m^2	CPUE (fish/minute)
RBT	26 (26-34)	8.48	0.57

Table 9. Mean lengths (TL; mm), mean weights (g), and standard deviation (SD), for individuals > 75 mm, and length range for all individuals captured in Section 4 in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2004.

S M e a n Species	length (SD)	Length range	Mean weight (SD)	Sample size
RBT	109.4 (22.6)	68-174	15.0 (10.9)	26
WCTxRBT	164.0 (N/A)	N/A	46.0 (N/A)	1

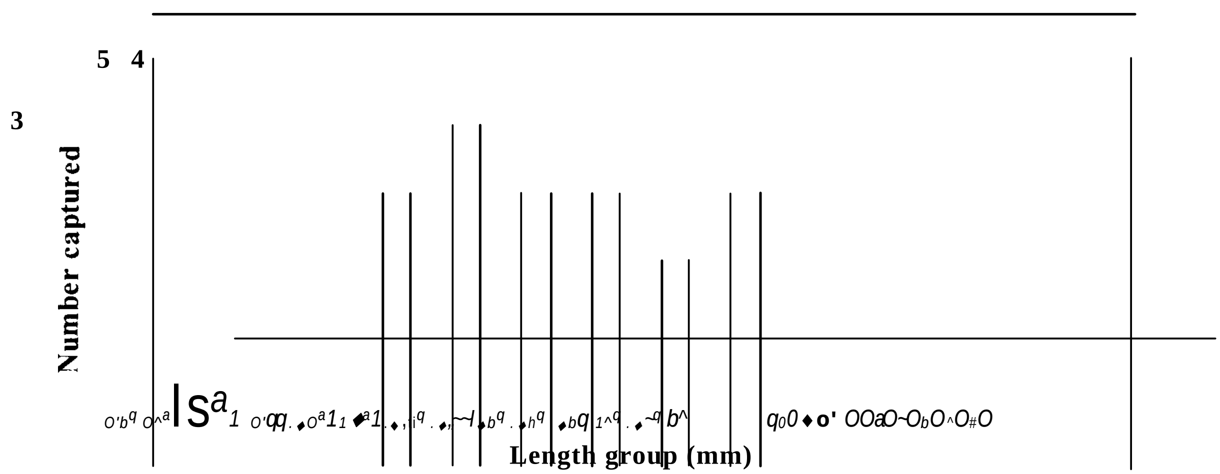


Figure 12. Length frequency histogram for all rainbow trout (n 27) captured in Section 4, Twin ('reek, a tributary to the Clark Fork River, Idaho, in July 2004.

DISCUSSION

Pratt (1985) observed the same salmonid species assemblage in Twin Creek in 1983 and 1984 as we did in our sampling from 2002 through 2004. Existing data (Downs and Jakubowski 2003, Downs and Jakubowski 2005) suggests that the juvenile bull trout population in Twin Creek is comprised primarily of age-0 individuals. This is in contrast to previous electrofishing results in other LPO tributaries, such as Trestle and Gold creeks, which showed the presence of multiple age-classes of juvenile bull trout in tributaries to LPO (Fredericks et al. 2000; Downs and Jakubowski, this report). Based on the data in this study and our trapping results, it appears that very few juvenile bull trout remain in Twin Creek beyond age-0. Based on previous otolith microchemical work of Horan and Moran (2001), age-0 outmigrants from Trestle Creek do not appear to make a substantial contribution to adult spawning escapement. If size at outmigration confers a survival advantage in the lake environment, as some of our work on Trestle Creek (Downs and Jakubowksi 2003), and the work of others (Horan and Moran 2001) suggests, the Twin Creek bull trout population should benefit from the creation of more complex tributary habitat in Twin Creek. This habitat should allow juvenile bull trout to spend one to three years rearing in Twin Creek before migrating to LPO, as has been observed in other LPO tributaries (Downs and Jakubowski 2003, 2005), and is more typical for the species (Fraley and Shepard 1989, Pratt 1992).

The presence of exotic species such as brook and brown trout, competing for food and space with juvenile bull trout, may adversely affect the bull trout response to the stream restoration. During the annual population estimates post-restoration (after 2001), all brook trout were removed from the sections. In total we removed 40 brook trout and 6 bull X brook trout hybrids from the four estimate sections in 2002. In 2003, we removed a total of 60 brook trout and 5 bull X brook trout hybrids from the four estimate sections. In 2004, 47 brook trout and 2 hybrids were removed from the four estimate sections. Brook trout abundance in the sections did not appear to be impacted consistently by the previous years removal effort, with the exception of section four, which showed a marked decline in brook trout abundance from 2000 to 2004. Recruitment of age-0 brook trout into the sections on an annual basis remains relatively strong. It is likely that brook trout in habitat adjacent to the depletion sections rapidly re-colonized the sections. In a sample of 33 individual juvenile bull trout from Twin Creek, Neraas and Spruell (2001) identified 10 bull X brook trout hybrids, one of which was a second generation hybrid. The continued presence of bull X brook trout hybrids indicates hybridization is an ongoing problem. C

Percent species composition pre and post restoration in Twin Creek shows a great deal of variability. This is complicated by the lack of repeatable sampling sections because the project was a complete channel reconstruction. However, if we compare the pre and post restoration sampling results from similar locations along the longitudinal gradient of Twin Creek, we can get some idea of the amount of change that has occurred. The total catch of juvenile bull trout (all sizes) was highest in the lowest reaches of Twin Creek. This correlates with the known location of adult bull trout spawning in Twin ('reek, which occurs between the mouth of Twin ('reek and River Road. Sampling date may influence the number of fish of a given species > 75 mm in each sampling section. Later sampling dates afford more time for age-0 individuals to grow into the -2-75 mm size group and bias any comparisons with other years when sampling may have been conducted earlier. This is particularly relevant for brook, brown, and hull trout (fall spawners) which seem to grow into the > 75 mm size group over the course of the summer field sampling season in Twin ('reek. It is apparent when viewing the length frequency histograms for brook and bull trout, that the age-0 group is growing into the > 75 size group during summer sampling. This is also evident in earlier sampling (Downs and Jakubowski 2005). To reduce bias in our across year comparisons of species composition associated with age-0 individuals growing into the > 75 mm size group, we compared the total catch of fish > 100 mm for these species (fall spawners). We continued to use the > 75 mm size group for westslope cutthroat and rainbow trout (spring spawners) because it doesn't appear as though they grow into the > 75 mm size group by the July sampling period. The comparison between 2001, 2002, and 2004 late June through July sampling using these size groups should afford a comparison of primarily age-1 and older individuals.

Across the three years compared (2001, 2002, and 2004), we have not seen a consistent shift in species composition of age-1 and older individuals (Figures 13 through 15). Comparing the relative abundance of age-1 and older salmonids, rather than all those > 75 mm, by species, provides a mechanism to minimize the impact of seasonal variation in timing of sampling or fry emergence on trend comparisons. Rainbow trout are the co-dominant or dominant species in all sections across all years. Catch of age-0 bull trout remains highest in the lowest sampling sections, as it was in earlier sampling years (Downs and Jakubowski 2005). Total catch of age-1 and older bull trout remains low in all sections (2 or less) over the three years compared, with no obvious trends apparent.

rr

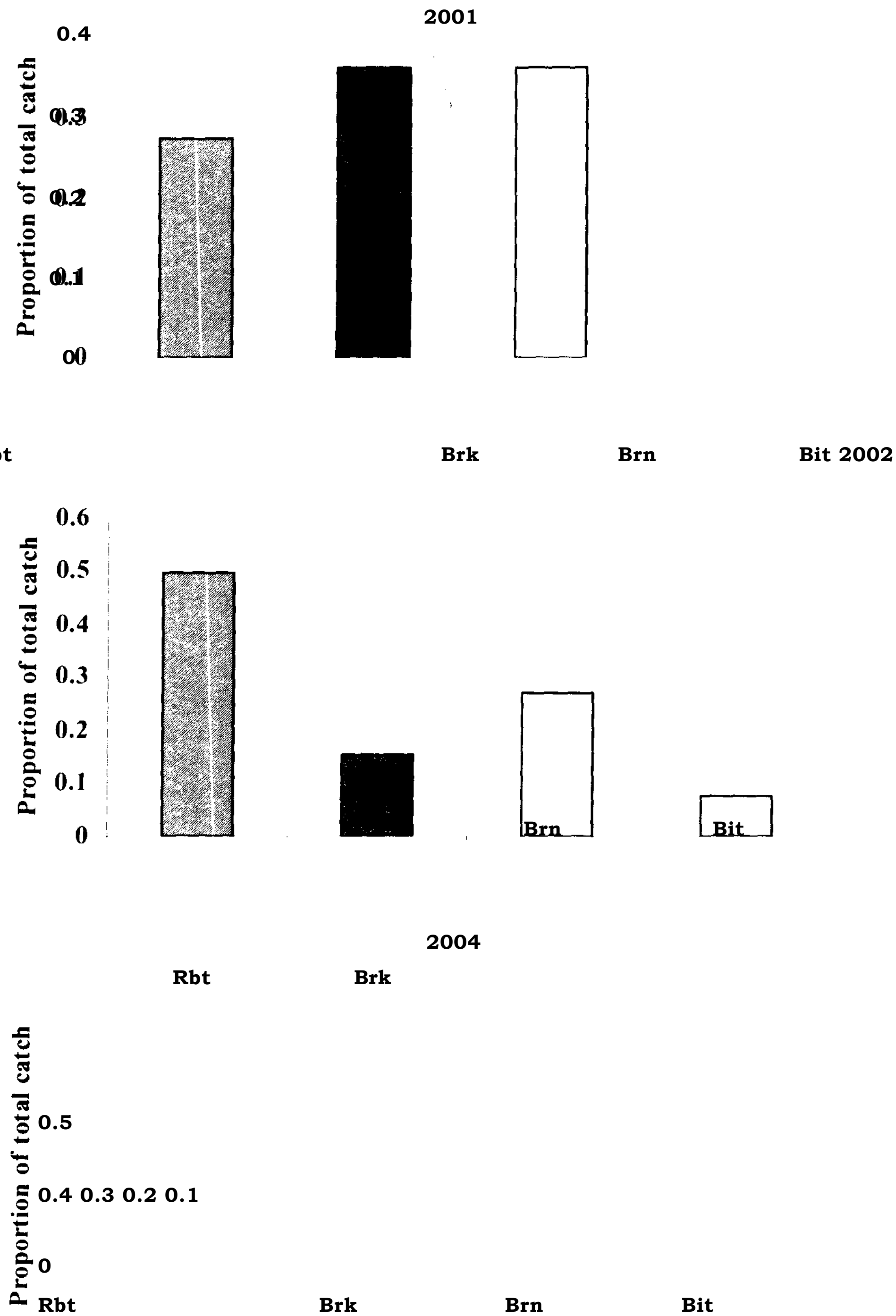


Figure 13. Salmonid species composition for age-1 and older fish in lower Twin Creek, a tributary to the Clark Fork River, Idaho, pre (2001) and post (2002 and 2004) stream restoration efforts. Sample locations differed from the pre to the post sampling periods, but were similar in location along the longitudinal gradient of the stream channel.

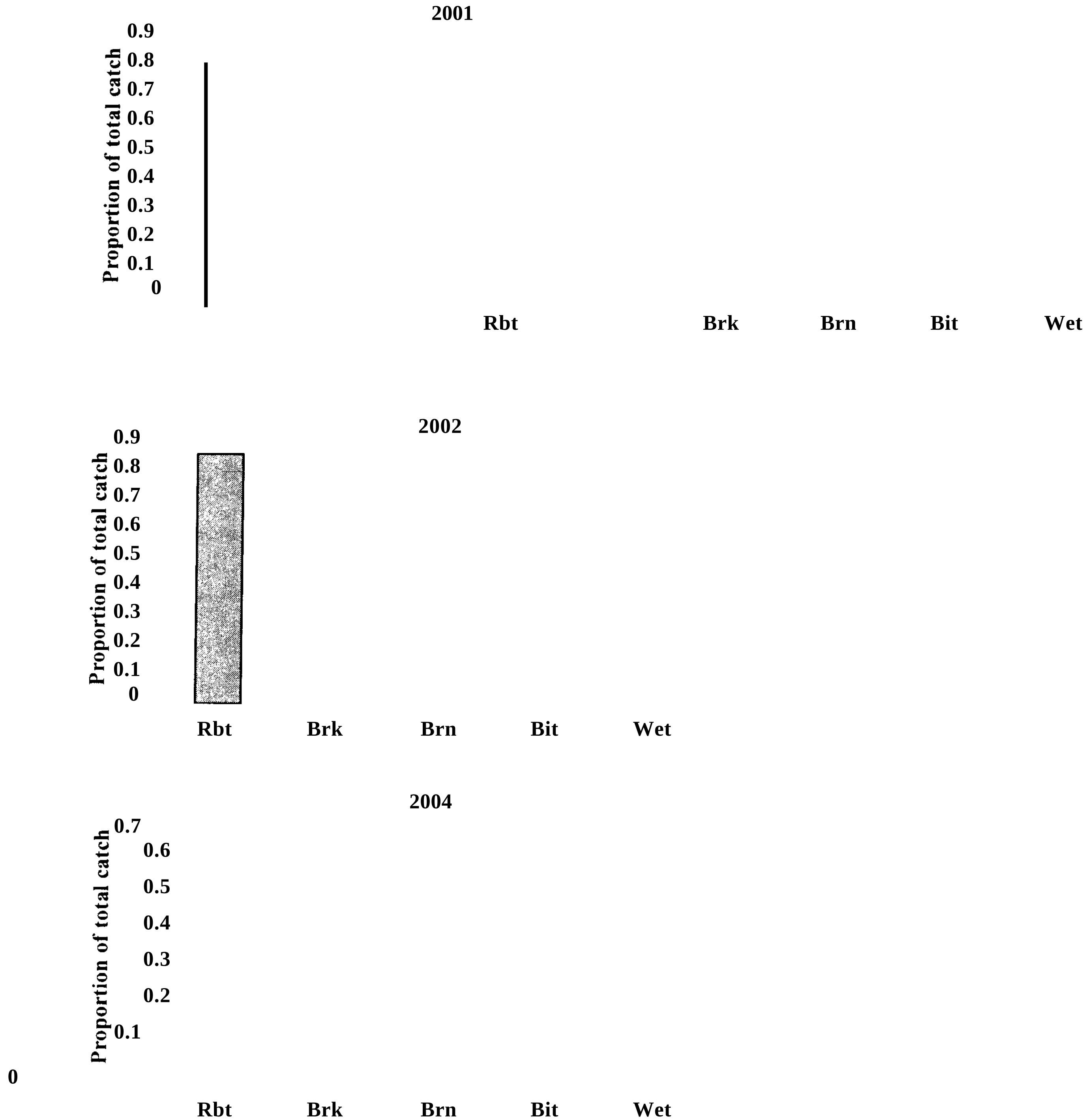


Figure 14. Salmonid species composition for age-1 and older fish in middle [win ('reek, a tributary to the ('lark Fork River, Idaho, pre (2001) and post (2002 and 2004) stream restoration efforts. Sample locations differed from the pre to the post sampling periods, but were similar in location along the longitudinal gradient of the stream channel.

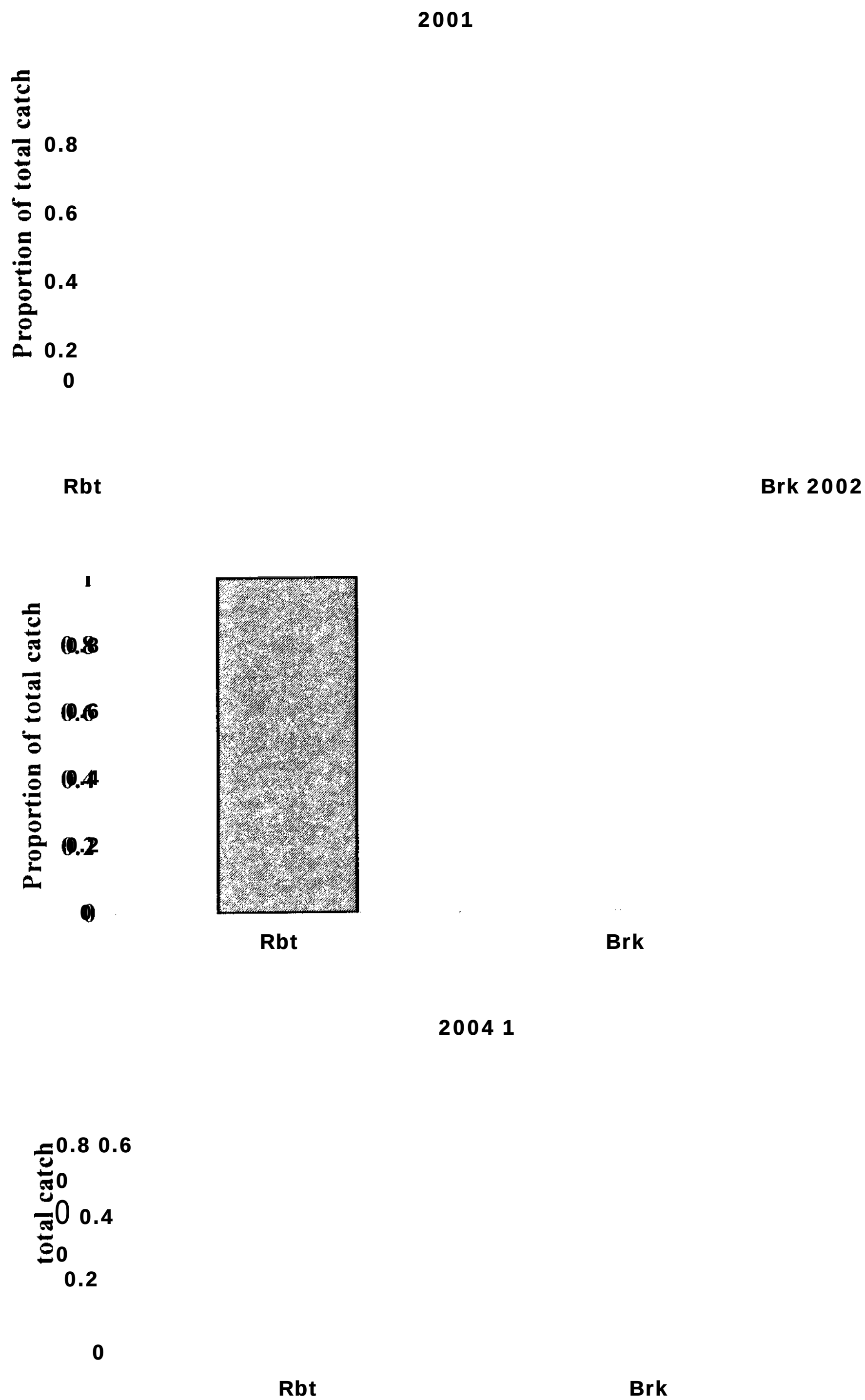


Figure 15. Salmonid species composition for age-1 and older fish in upper twin Creek. a tributary to the ('lark Fork River, Idaho, pre (2001) and post (2002 and 2004) stream restoration efforts in the same 100 m untreated reach.

(.

In the middle reach of Twin Creek in 2000 no bull trout were captured, while in 2001, a single 161 mm bull trout was captured. No age-0 bull trout were captured in this reach in either year. In 2002, the year following the completion of the restoration project, a single 187 mm bull X brook trout hybrid was captured in the comparison Section 3, post restoration. In 2003, a total of 12 juvenile bull trout were captured in the comparison Section 3. One of these fish was 219 mm in length, while the others were age-0 bull trout. In 2004, a total of five bull trout were captured in the comparison Section 3. Based on a comparison with the length-frequency histogram for brook trout from the same section, all five appear to be age-1 or older individuals, with the two largest being 124 and 167 mm in length. Although 14 juvenile brook trout were also captured in this section, no bull trout hybrids were captured in 2004. A series of log-drop structures, coupled with low summer/fall flows and stream flow intermittency in the old channel just downstream of the middle electrofishing section (sampled in 2000 and 2001) may have been impeding upstream movement of juvenile or adult bull trout. However, the new channel also experiences intermittency during late summer/fall periods and it appears that either juvenile bull trout are moving upstream into this area at other times of the year when flows permit, or some adult bull trout are moving upstream into this reach to spawn. The scenario of movement of juvenile bull trout upstream into this reach from the known spawning area located farther downstream (Pratt 1985) is more plausible, as channel intermittency on the restored channel likely limits upstream movement of adult bull trout during the periods of the year when adult bull trout are found in Twin Creek (Downs et al. 2003; Downs and Jakubowski 2003). Further monitoring is needed to determine if a trend exists in increased numbers of juvenile bull trout observed in the middle reaches Twin Creek.

Section 4 (Upper sampling reach) has been consistently sampled from 2000 through 2004 and was not impacted by stream restoration. We observed consistently low numbers of bull trout in this section across all years. Numbers of brook trout appeared to decline over time in this section, but this may be due to annual removal of brook trout associated with our sampling efforts. Rainbow and westslope cutthroat trout had the highest densities, but their numbers did fluctuate relatively widely over the study period. Although not used for direct comparison due to a later sampling date, relatively high densities (12.05 fish $\geq$ 75 mm /100m^2) of westslope cutthroat trout were observed in Section 4 in 2003. These fish were not present in the section in 2001, 2002, or 2004. Relatively strong abundance of westslope cutthroat trout was also seen in Section 3 in 2003. Densities of westslope cutthroat trout remained low in Sections 1 and 2 in 2003, suggesting that the observed increase in westslope cutthroat trout abundance in 2003 may be the result of increased reproductive effort or success in a larger area of Twin Creek, beyond that of the restoration area. Continued monitoring will be needed to determine the fish population response to the restoration work.

ACKNOWLEDGEMENTS

The authors wish to thank John Suhfras and Steve Lowe of Avista Corporation for their contributions to field data collection. We would also like to thank Mark Gamblin and Ned Horner of the Idaho Department of Fish and Game, Joe DosSantos of Avista Corp., Laura Katzman of Montana Fish, Wildlife, and Parks, and Larry Lockard of the U.S. Fish and Wildlife Service for their reviews of this report.

LITERATURE CITED

Downs, C. and R. Jakubowski. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2002 Progress Report. Project 1, Johnson and Granite creeks bull trout trapping: Project 2, Bull trout redd counts and escapement estimates; Project 3, Clark Fork River fishery assessment; Project 5, Trestle and Twin creeks outmigration and Lake Pend Oreille bull trout survival study. Avista Corporation. Spokane, Washington

Downs, C., and R. Jakubowski. 2005. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2003 Progress Report. Project 2, 2003 Lake Pend Oreille bull trout redd counts; Project 3, 2003 Clark Fork River fishery assessment progress report; Project 5, 2003 Trestle and Twin creeks bull trout outmigration and Lake Pend Oreille survival study progress report; Project 6, 2003 Johnson and Granite creeks bull trout trapping; Project 7, 2003 Twin Creek restoration monitoring progress report. Report to Avista Corporation from the Idaho Department of Fish and Game. Boise, Idaho.

Downs, C., R. Jakubowski, and S. Moran. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 1999-2001 Progress Report. Project I, Johnson and Rattle creeks bull trout trapping; Project 2, Bull trout redd counts and escapement estimates 1999-2001; Project 3, Clark Fork River fishery assessment 1999-2001; Project 4, Lake Pend Oreille tributary instream flow evaluation, Idaho Tributary Habitat Acquisition and Recreational Fishery Enhancement Program, Appendix A. Report of the Idaho Department of Fish and Game and Avista Corporation to Avista Corporation, Spokane, Wa.

Fraley, J.J. and B.B. Shepard. 1989. Life-history, ecology, and population status of migratory bull trout Salvelinus confluentus in the Flathead Lake and river system, Montana. Northwest Science 63(4): 133- 143.

Fredericks, J., J. Davis, N. Horner, and C. Corsi. 2000. Regional fisheries management investigation, Panhandle Region (Subprojects I-A, II-A, III-A, IV-A), Report IDFG 00-20, Boise.

Horan, D. and E. Moran. 2001. Microchemical analysis of bull trout otoliths from Lake Pend Oreille Basin. Final Report. U.S. Forest Service, Rocky Mountain Research Station, Boise, Idaho.

Neraas, L.P. and P. Spruell. 2001. Fragmentation of riverine systems: the genetic effects of dams on hull trout (Salvelinus confluentus) in the Clark Fork River system. Molecular Ecology 10:1153-1164.

Pratt, K. 1985. Pend Oreille trout and char life history study. Report to the Idaho Department of Fish and Game and the Lake Pend Oreille Idaho Club.

Pratt, K. 1992. A review of bull trout life history. Pages 5-9 in Howell, P. J. and D. V. Buchanan, editors. Proceedings of the (.Gearhart Mountain hull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis.

Van Deventer, J.S. and W.S. Platts. 1986. Documentation for MICROFISH 2.2: A software package for processing electrofishing data obtained by the removal method. Intermountain Research Station, Boise, Idaho.

White, G.0 ., D.R. Anderson, K.P. Burnham, and D.L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, LA-87-87-NERP, Los Alamos, New Mexico.

Zippin, C. 1958. The removal method of population estimation. Journal of Wildlife Management. 22(1):82-90.

ci
0 0

0 CJ

0

Project 8: 2004 Tributary Fish Population Monitoring Progress Report

ABSTRACT

The Avista mitigation program has been acquiring stream habitat, restoring stream habitat, and conducting habitat assessments in tributaries to Lake Pend Oreille since the Clark Fork Settlement Agreement was signed in 1999. It is necessary to conduct fish population monitoring in these tributaries to establish baseline information on fish populations from which we can gauge the success/failure of our efforts, and better understand population dynamics of fish species of interest. In 2004 we conducted depletion-removal population estimates on three tributaries to Lake Pend Oreille (Gold, Granite and Trestle), and two tributaries to Lightning Creek (Rattle and East Fork Lightning), which enters the Clark Fork River at the town of Clark Fork, Idaho. Estimates were conducted in a total of 13 sections among the five streams (three in Granite, Trestle and E. Fk. Lightning; two in Gold and Rattle). Bull trout *Salvelinus con/luentus* were present at widely varying densities in all sections sampled. Trestle Creek supported the highest densities of juveniles (>75 mm) observed (15.2/100m^2). In general, the highest densities were estimated in the sections located highest in each tributary. Westslope cutthroat trout *Oncorhtnclurs clarki letit'isi* were found in all sections sampled, with the exception of the lowest section in the E. Fk. Lightning Creek. Densities of juvenile westslope cutthroat trout (>75 mm) were highest in Trestle Creek (8.6/100m^2). Juvenile mountain whitefish *Prosopiunr trilliamsoni* were only present in the lowest section in Trestle Creek. Brook trout S. *fimtinalis* do not appear to be widely distributed or abundant in any of the study streams evaluated.

Authors:

Christopher C. Downs
Senior Fishery Research Biologist
Idaho Department of Fish and Game

Robert Jakubowski
Natural Resource Technician
Avista Corporation

INTRODUCTION

As part of a relicensing agreement for Cabinet Gorge and Noxon Rapids dams, Avista Corporation provides annual funding to acquire and/or enhance habitat in tributaries to Lake Pend Oreille (LPO) and the Clark Fork River in Idaho. The initial focus of these efforts is on enhancing native fish populations including bull trout *Sah'elinus confluentus* and westslope cutthroat trout *Oneorh}nchus clarki lewisi*, as well as mountain whitefish *Prosopiu,n tirilliamsoni*. Significant investment has been made in habitat acquisitions in the Gold, Granite, and Trestle creek drainages since implementation began in 1999. In 2002, a large-scale watershed assessment was undertaken in the Lightning Creek drainage to identify potential restoration opportunities in the drainages. In 2003, we undertook a feasibility assessment and developed a restoration design for approximately 945 m of Granite Creek. The objective of the Granite Creek restoration project is to provide fish passage and improved habitat conditions for bull trout.

Each of these actions will require some monitoring to determine project effectiveness. For habitat acquisition projects, we will be establishing baseline population estimates that can be compared with future estimates to see if populations decline, remain stable, or increase in response to the conservation measures. Habitat enhancement projects will be monitored to determine if project objectives have been met by comparing pre and post-restoration population estimates of target fish in the same sections of stream over time. This would include monitoring within the restoration project area itself, as well as population monitoring outside of the restoration area. By evaluating project effectiveness, we gain understanding of fish population response to our activities, and enhance the likelihood of success in the future.

STUDY SITES

East Fork Lightning Creek

East Fork Lightning Creek is a fourth-order tributary to Lightning Creek. It enters Lightning Creek from the east, approximately 14 km upstream of the mouth of Lightning Creek (Figure 1). East Fork Lightning Creek drains approximately 53 km' of the Cabinet Mountains (Philip Williams and Associates 2004). Three major tributaries to East Fork Lightning Creek are Char, Savage, and Thunder creeks, and a significant proportion of the headwaters of the drainage lie in Montana. Annual precipitation is reported as 1,575 mm (USFS, unpublished data) and the drainage is composed primarily of meta-sediments, as well as glacial till along the lower reaches of the stream channel (Philip Williams and Associates 2004). Maximum water temperature reached 16.5 "C near the mouth on August 1 I, 2001, but remained below I3"C during summer months farther upstream, near the mouth of' ('har Creek, during the same year (USFS, unpublished data).

Excess hedload, loss of large woody debris, and altered flow and water delivery patterns are believed to he the major limiting factors to hull trout populations in East Fork Lightning

Creek (PBTAT 1998). All of the bull trout spawning, and most of the rearing habitat in the drainage lies within the winter rain-on-snow zone, extending up to an elevation of 1,372 m (Philip Williams and Associates 2004), potentially exacerbating the effects of unstable stream channels on bull trout spawning and rearing success. Bull trout redd counts have averaged 51 from 1983 through 2004. Based on redd counts, spawning escapement in East Fork Lightning Creek appears to have declined relatively dramatically since counts began in 1983, but recent counts suggest an improving trend (Downs and Jakubowski 2005). The Lightning Creek Watershed Assessment (Philip Williams and Associates 2004) identified several areas in the East Fork Lightning Creek drainage for future restoration.

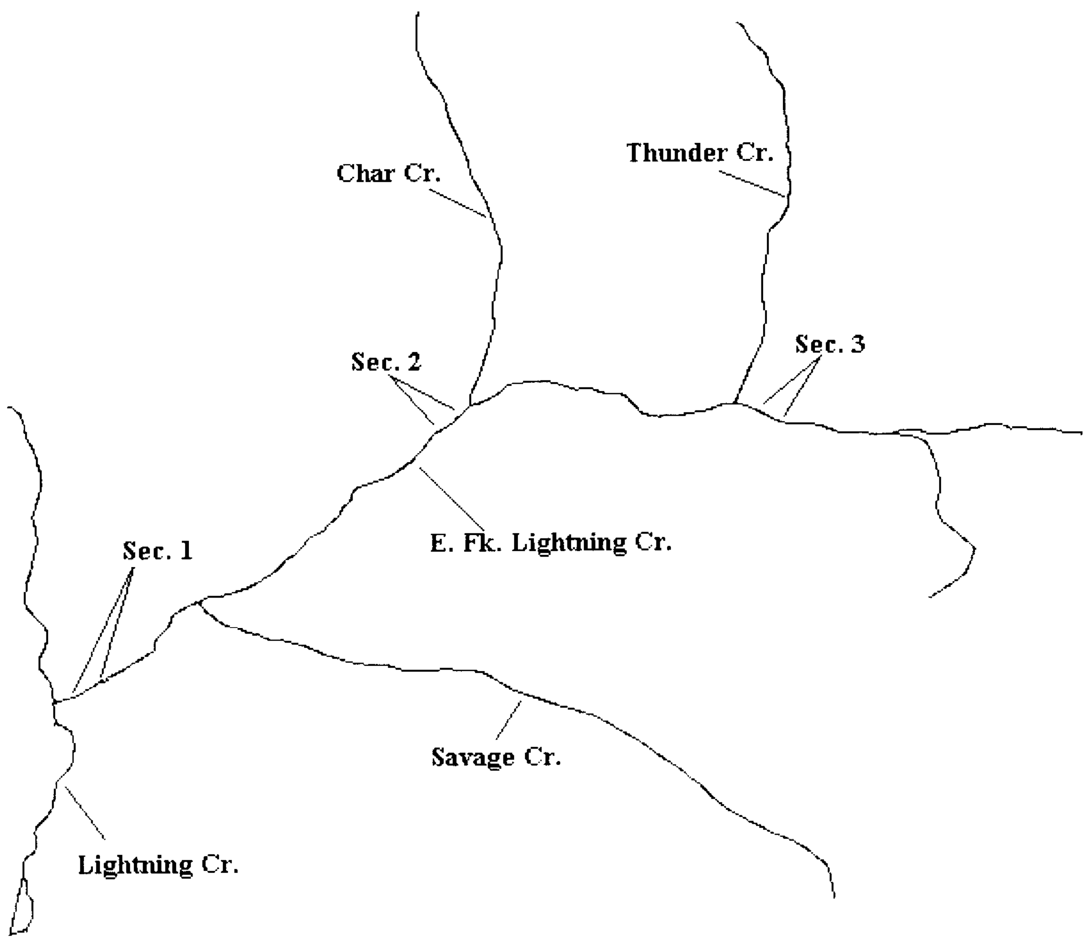


Figure I. Electrofishing sections on East Fork Lightning Creek, a tributary to lightning Creek, near ('lark Fork, Idaho, sampled in 2004.

Gold Creek

Gold Creek is a southeast shore tributary to Lake Pend Oreille and drains approximately 56 km^2 of the northern end of the Bitterroot Mountains (PBTAT 1998) (Figure 2). Elevations range from approximately 629 in at the mouth to 1,861 m at Packsaddle Mountain (PBTAT 1998). Large mine sites caused massive disturbance to the upper watershed and have contributed large amounts of sediment to the stream channels. Excess bedload is considered the largest limiting factor for bull trout habitat in the drainage (PBTAT 1998). Water temperatures in Gold Creek remain very cold year-around. Water temperatures at the mouth of Gold Creek never exceeded 12 °C in 2001 (USFS, unpublished data). Gold Creek supports one of the strongest runs of bull trout in the Lake Pend Oreille system. Bull trout redd counts have averaged 120 from 1983 through 2004. Analysis of redd counts indicates an increasing trend in the number of adult bull trout returning to spawn in Gold Creek (Downs and Jakubowski 2005). Bull trout are not known to spawn upstream of the confluence with West Gold Creek. Four parcels of land were acquired for conservation purposes under the Clark Fork Settlement Agreement totaling approximately 19.8 ha, and habitat acquisition for conservation purposes remains a priority in this watershed.

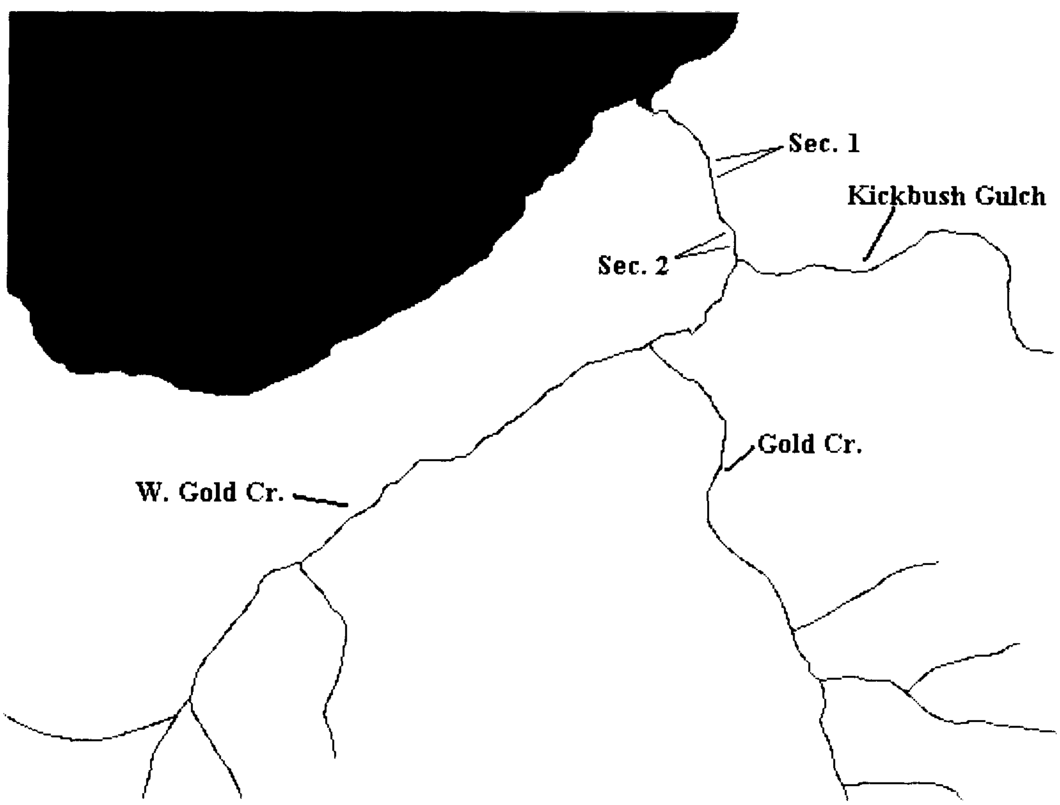


Figure 2. Electrolishing sections on Gold Creek, a tributary to Lake Pend Oreille, Idaho, sampled in 2004.

Granite Creek

Granite Creek is an east shoreline tributary to Lake Pend Oreille and drains approximately 68 km`' of the northern end of the Bitterroot Mountains (PBTAT 1998) (Figure 3). Bankfull discharge for Granite Creek is approximately 6.2 ems (River Design Group 2004). Maximum water temperature reached 14.8 °C at the USFS Road 271 1 bridge crossing, lower in the watershed, on August 7, 2001. Farther upstream at the USFS Road 278 crossing, water temperatures were cooler, with a high of 13.3 °C on the same date (USFS, unpublished data).

The LPO Key Watershed Bull Trout Problem Assessment (PBTAT 1998) recognized Granite Creek as high priority for bull trout restoration/conservation actions. Bull trout redd counts have averaged 43 annually from 1983 through 2004. During flood events in the winter of 1995-96, the reach of Granite Creek between Kilroy Bay Bridge and the mouth of Sullivan Springs, immediately downstream of Section 1, underwent significant changes, and now has a diffuse and largely sub-surface flow pattern during low flow conditions. Fish passage is impaired during summer/fall months in this location on Granite Creek. Continued channel instability in this reach threatens to degrade fish habitat further in Granite Creek. A restoration project is planned for Granite Creek to begin in 2005. The plan calls for constructing/restoring approximately 946 m of stream channel in the impaired reach.

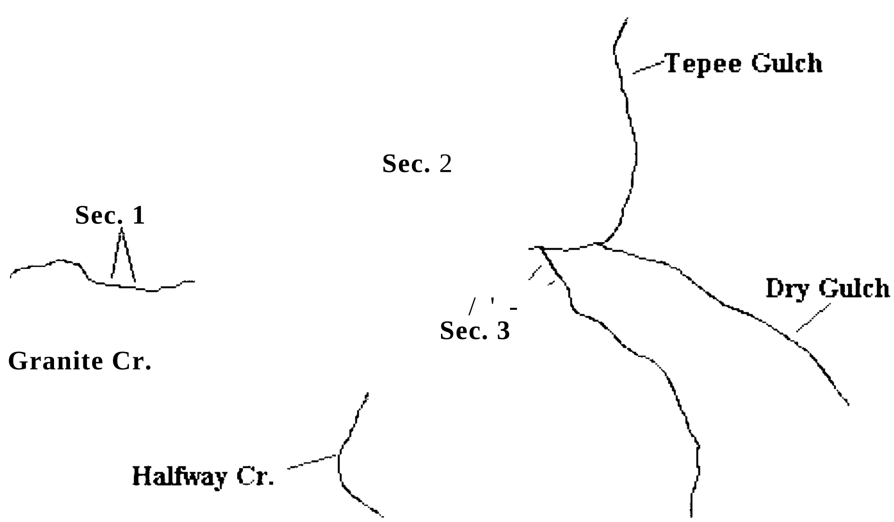


Figure 3. Llectroflshing sections on Granite ('reek, a tributary to Lake Pend Oreille, Idaho, sampled in 2004.

Rattle Creek

Rattle Creek is a third-order tributary to Lightning Creek, entering approximately 27 km upstream of the mouth of Lightning Creek (Philip Williams and Associates 2004) (Figure 4). Rattle Creek drains approximately 27 km^2 of the Cabinet Mountains. Average annual precipitation has been reported as 2,010 mm (USFS, unpublished data). Upslope areas are composed primarily of meta-sediments, with glacial till along the stream channel bottom (Philip Williams and Associates 2004). Maximum water temperature reached 13.5 °C near the mouth on August 14, 2001 (USFS, unpublished data).

Excess bedload, loss of large woody debris, and altered flow and water delivery patterns are believed to be the major limiting factors to bull trout populations in Rattle Creek (PBTAT 1998). All of the bull trout spawning and rearing habitat in Rattle Creek lies within the winter rain-on-snow zone, extending up to an elevation of 1,372 m (Philip Williams and Associates 2004), potentially exacerbating the effects of unstable stream channels on bull trout spawning and rearing success. Bull trout redd counts have averaged 22 from 1983 through 2004. Based on redd counts it appears that adult bull trout escapement in Rattle Creek has been trending downward from 1983 to present, however shorter term trends (1994 to present) suggest a statistically significant positive trend in spawning escapement. The Lightning Creek Watershed Assessment (Philip Williams and Associates 2004) identified multiple sites for potential restoration projects in the Rattle Creek drainage.

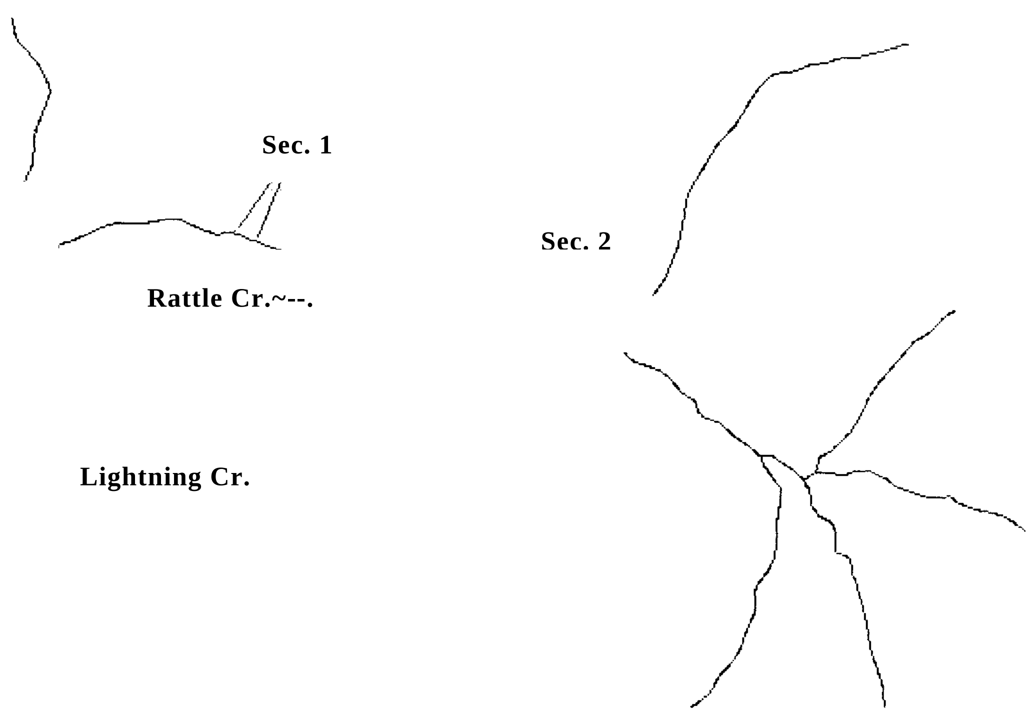


Figure 4. Electrotishing sections on Rattle ('reek, a tributary to Lightning ('reek, near ('lark Fork, Idaho, sampled in 2004.

Trestle Creek

Trestle Creek is a third-order northeast shore tributary to Lake Pend Oreille (Figure 5). Trestle Creek drains approximately 60 km` of the Cabinet Mountains (PBTAT 1998). Trestle Creek contains some of the highest quality bull trout habitat in the Lake Pend Oreille system. Trestle C'reek's steep slopes, pinnate drainage pattern, high drainage density, and elevations within the rain-on snow zone results in a rapid hydrologic response from snowmelt or large precipitation events (PBTAT 1998).

Trestle Creek supports the strongest run of bull trout in the Lake Pend Oreille system, accounting for on average 40% of the total redds counted annually. Bull trout redd counts have averaged 251 from 1983 through 2004. It is believed that threats to bull trout habitat have been significantly reduced by the U.S. Forest Service watershed restoration project completed in 1995 (PBTAT 1998). The most significant threat remaining to bull trout habitat in the watershed cones from residential development in the lower 5.6 km of the channel. Five parcels of land totaling approximately 45.7 ha were acquired for conservation purposes under the Clark Fork Settlement Agreement. Habitat acquisition for conservation purposes remains a priority in this watershed.

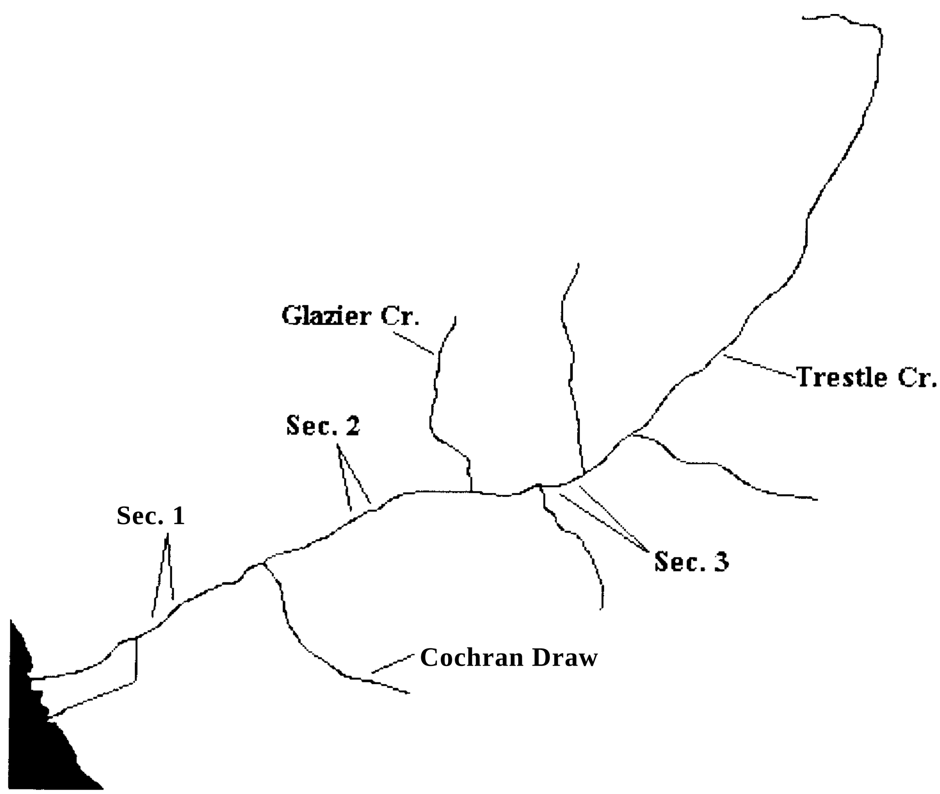


Figure 5. Flectrotishing sections on Trestle ('reek, a tributary to Lake Pend Oreille, Idaho, sampled in 2004.

METHODS

We used the removal (depletion) method (Zippin 1958) to estimate abundance and size structure of fish populations in the five streams surveyed. The software program Capture (White et al. 1982) was used to derive estimates from the depletion data when three or more passes were conducted, while Microfish (Vandeventer and Platts 1986) was used to derive estimates from the depletion data when a two-pass estimator was needed. Population and density estimates were conducted for fish > 75 mm only (total length; TL), due to sampling efficiency considerations. When all the individuals of a particular species were captured on the first pass and a depletion estimate was not possible, we report the total catch on the first pass as the population estimate. We also estimated catch-per-unit-effort (CPUE) as fish captured per minute of electrofishing on the first pass only. We standardized the results of the population estimates by converting the number estimated per linear 100 m, to the number captured per $100m^2$

.

Depletion-removal estimates involved measuring a 100 m reach of stream and blocking both ends with a seine to prevent fish movement in or out of the section. GPS coordinates were recorded and flagging/stakes were used to mark the sections to ensure repeatability. Reaches were numbered sequentially, moving from the downstream-most section (Section one) to the upstream-most section (Section two or three) (Table 1). Wetted-widths were recorded every 20 m along the transect to estimate the total area of the section. A crew of two individuals slowly progressed upstream within the section carefully shocking the stream. A Smith-Root model 12-B battery powered backpack shocker, using pulsed DC current, was used to stun fish, which were netted and placed in a bucket carried with the crew while shocking. Typical settings for the electrofishing unit were H-3 at 600 to 800 volts. Small holes (approximately 3 mm) were drilled in the top half of the side of the bucket to allow a crew member to provide fresh water to the fish without risking escape. Repeated passes were made through the section until the catch on a pass was reduced to 20% or less of the catch on the first pass.

Fish were anesthetized, measured (total length; mm), weighed (g), had a sample of scales removed for ageing, and most bull trout > 75 mm were tagged with Passive Integrated Transponder (PIT) tags (Table 2). Fish were allowed to recover their equilibrium and were released back into the stream below the section. All brook trout *Salvelinus % ntinulis* encountered during sampling were removed to reduce the potential risk of hybridization with bull trout, as well as competition with both bull and westslope cutthroat trout.

Table I. Section number, GPS location for the downstream end of each section, and sampling dates for the five streams surveyed (two tributaries to the Clark Fork River, Idaho, three tributaries to Lake Pend Oreille, Idaho).

Stream	Section	Bottom of section GPS coordinates (NAD 27)	Sample date
E. Fk. Lightning	1	11 566275 E 5343385 N	8/5/04
	2	11 569150E 5345528 N	8/9/04
	3	11 571415E 5345862 N	8/10/04
Gold	1	11 541361E 5312325 N	7/20/04
	2	11 541483 E 5312002N	7/19/04
Granite	1	11 544320 E 5325845 N	7/21/04
	2	11 546641E 5326376 N	7/26/04
	3	11 548020 E 5325924 N	7/27/04
Rattle	1	11 562178E 5353025 N	7/28/04
	2	11 564799E 5352500 N	8/4/04
Trestle	1	11 549102E 5348139 N	8/ 1 1 /04
	2	11 551730E 5349536 N	8/12/04
	3	11 555936E 5351716N	8/ 1 8/04

Table 2. Species abbreviations for salmonids captured in the five streams surveyed near Clark Fork, Idaho, during 2004.

Species	Abbreviation
Brook trout *Salvelinus /imtinalis*	BRK
Bull trout *Sa/velinuv coif/luc'ntus*	BLT
Rainbow trout *Oncorin*[v]*nchus nrrkiss*	RBT
Westslope cutthroat trout O. *Clark/ leuvsi*	WC"1'
Mountain whitefish *Prosopiunr tirillium.cuni*	MWF

RESULTS

East Fork Lightning Creek

We captured brook, bull, rainbow and westslope cutthroat trout in the East Fork Lightning Creek in 2004. In addition, sculpin *Cottus sp.* and unidentified *Oncorhvnchu.c sp.* (either westslope cutthroat or rainbow trout *O.n ‣ykiss)* were also captured. In Section 1, an estimate for bull and brook trout was not possible due to low catches of fish ≥ 75 mm. However, a single 130 mm bull and 127 mm brook trout were captured, providing a density based on catch of 0.1 I/100m' for each species. No westslope cutthroat trout were captured in Section 1 (Table 3).

Table 3. Population estimates for salmonid species (>75 mm; TL) captured in Section 1, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	Estimate (95% CI)	N/100m²	CPUE (fish/10 minutes)
BLT	N/A"	0.11 `	0.0
BRK	N/A[h]	0.11 `	0.0
RBT	149 (146-159)	16.2	9.26

"Estimate not available. One bull trout 130mm was captured.
Estimate not available. One brook trout 127mm was captured.
Based on total catch.

Average size of salmonids > 75 mm in Section 1 ranged from 118 mm for rainbow trout, to 130 mm for a single bull trout (Table 4). Length-frequency histograms for bull and rainbow trout in Section 1 indicate the presence of multiple age-classes, while unidentified *Oncor/nnchus* ,cp. (mean TL =43 mm; range=35-52 mm; n=7) all appear to be age-0 (Figures 6 through 8).

Table 4. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section I, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
BLT	130 (N/A) (1)	47-130	20 (N/A) (l)
BRK	127 (N/A) (1)	N/A	20 (N/A) (1)
RBT	1 18 (19.6) (144)	82-192	18 (1 1.0) (133)

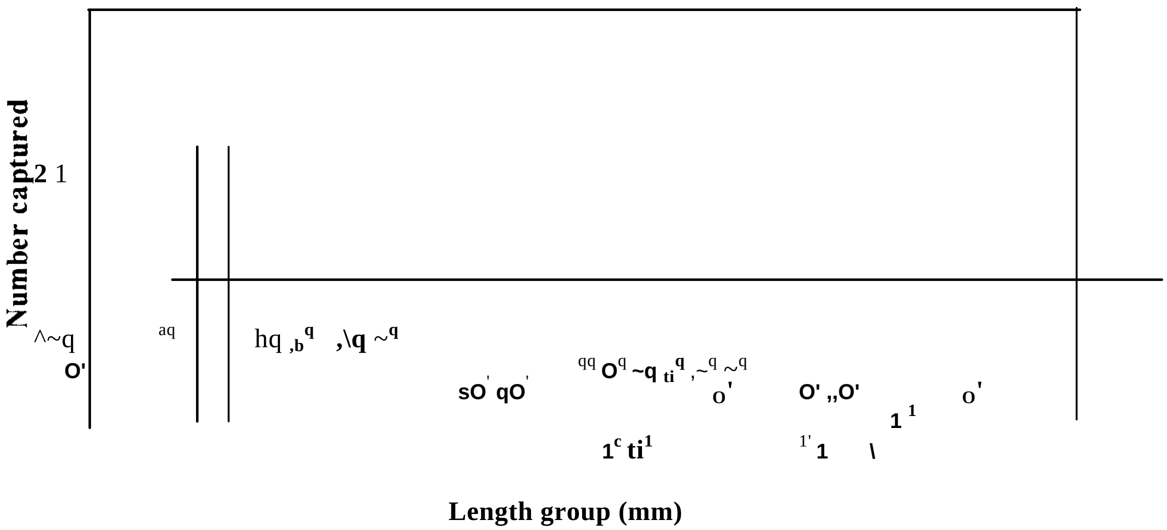


Figure 6. Length frequency histogram for bull trout (n=5) captured during August in Section 1, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2004.

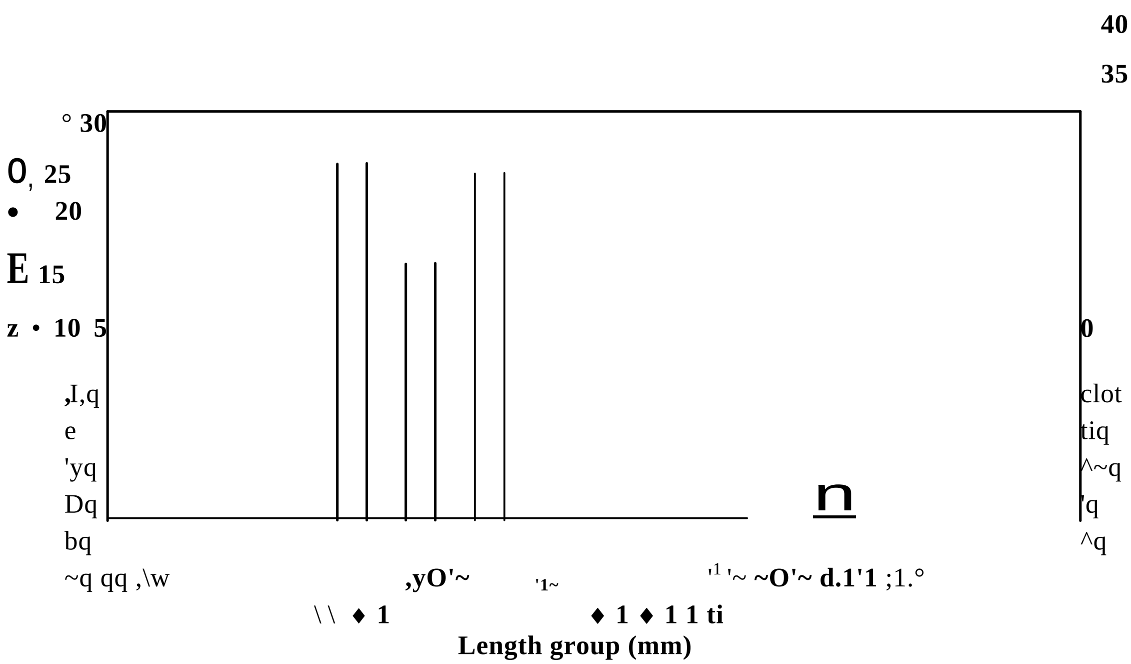


Figure 7. Length frequency histogram for rainbow trout (n 144) captured during August in Section I, East Fork Lightning ('reek, a tributary to Lightning ('reek near Clark Fork, Idaho, in 2004.

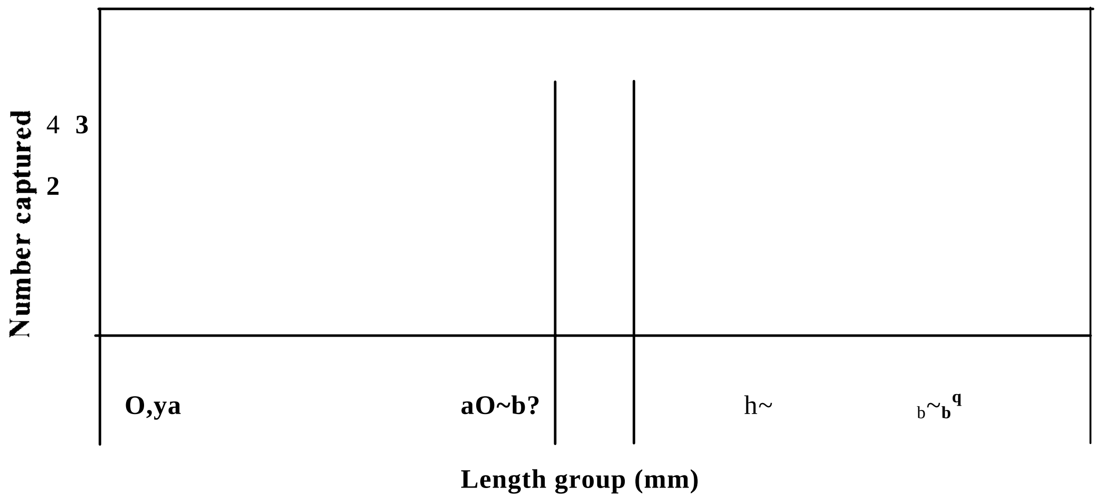


Figure 8. Length frequency histogram for unidentified *Oncorhynchuc sp.* (n=7) captured during August in Section 1, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2004.

In Section 2, rainbow trout had the highest density (6.30/100m^2), while westslope cutthroat trout had the lowest (1.40/100m`$^2$). Bull trout density in Section 2 was 1.57/100m`^{2} (Table 5).

Average size of salmonids > 75 mm in Section 2 ranged from 118 mm for westslope cutthroat trout to 154 mm for bull trout (Table 6). Length-frequency histograms from Section 2 indicate the presence of multiple age-classes (Figures 9 through 11).

Table 5. Population estimates for salmonid species (>75 mm; TL) captured in Section 2, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	Estimate (95% CI)	N/100m^2	CPUE (fish/10 minutes)
BLT	9 (N/A)	1.57	1.84
RBT	36 (34-38)	6.30	6.14
WCT	8 (7-9)	1.40	1.43

Table 6. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 2, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
BLT	154 (32.6) (9)	58-201	36 (20.1)(9)
RBT	125 (30.4)(36)	82-213	22 (16.3)(34)
WCT	1 18 (35.7) (8)	86-183	21 (21.6)(8)

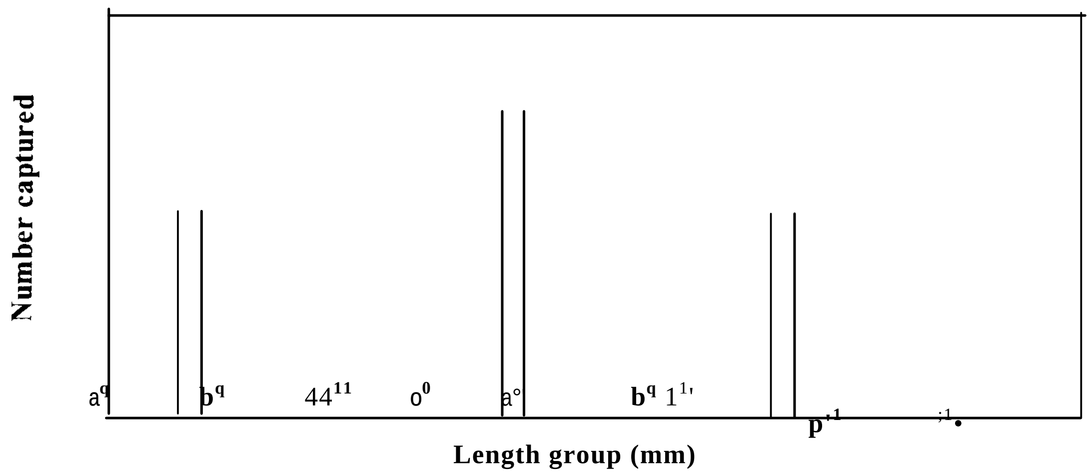


Figure 9. Length frequency histogram for bull trout (n=11) captured during August in Section 2, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2004.

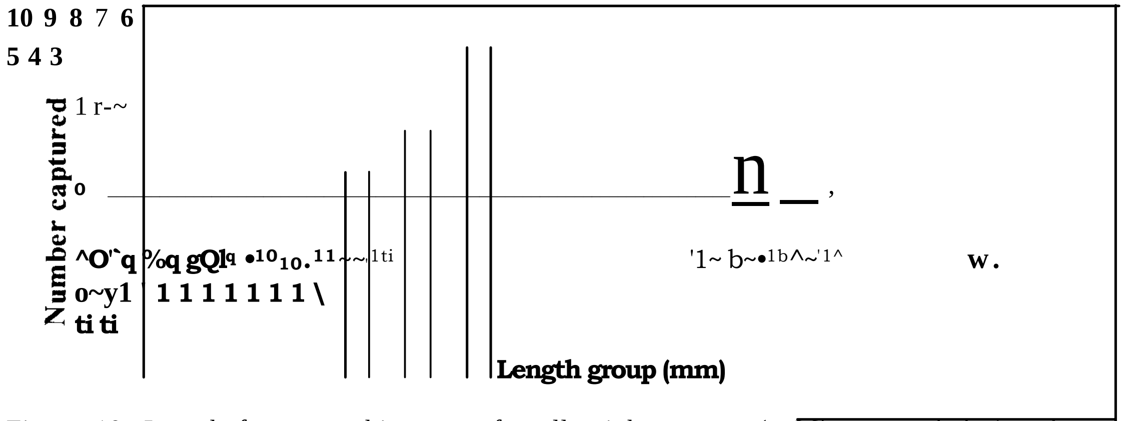


Figure 10. Length frequency histogram for all rainbow trout (n=36) captured during August in Section 2, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2004.

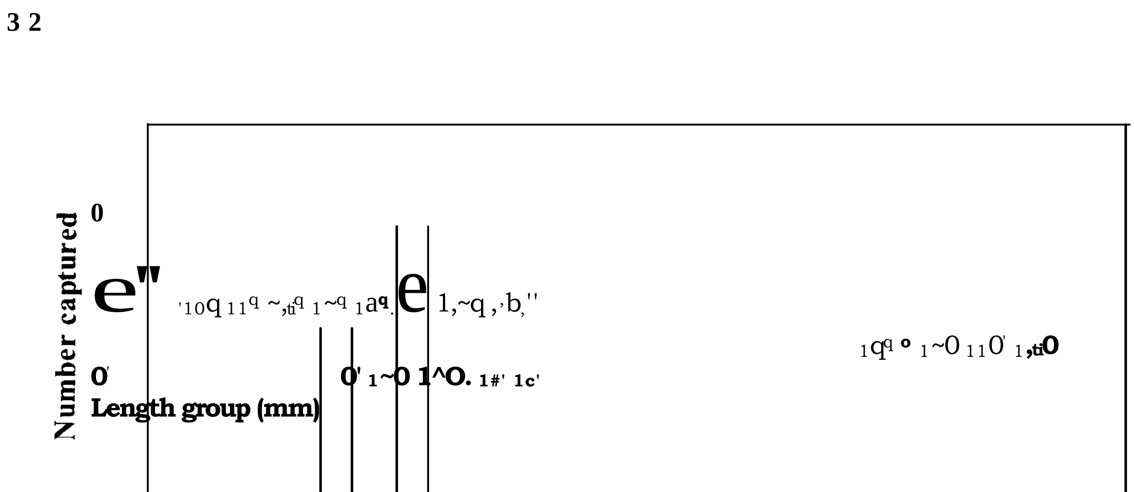


Figure I L Length frequency histogram for all westslope cutthroat trout (n-8) captured during August in Section 2, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2004.

In Section 3, westslope cutthroat trout had the highest density (8.40/100m²), while bull trout had a density of 6.00/100m² (Table 7). No other salmonid species were captured in Section 3.

Average size of salmonids > 75 mm in Section 3 ranged from 104 mm for bull trout to 125 mm for westslope cutthroat trout (Table 8). Length-frequency histograms from Section 3 indicate the presence of multiple age-classes (Figures 12 and 13).

Table 7. Population estimates for salmonid species (>75 mm; TL) captured in Section 3, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	Estimate (95% CI)	N/100m²	CPUE (fish/10 minutes)
BLT	15 (15-15)	6.00	3.27
WCT	21 (21-21)	8.40	5.56

Table 8. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 3, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
BLT	104 (12.2) (15)	54-145	N/A
WCT	125 (55.9) (21)	76-235	N/A

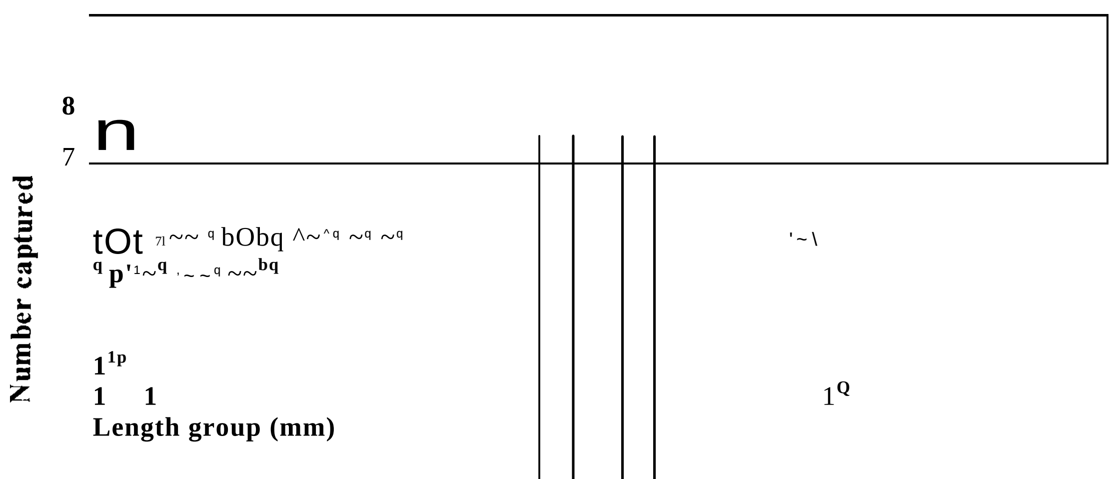


Figure 12. Length frequency histogram (or all hull trout (n 16) captured during August in Section 3, Fast Fork Lightning Creek, a tributary to Lightning ('reek near Clark Fork, Idaho, in 2004.

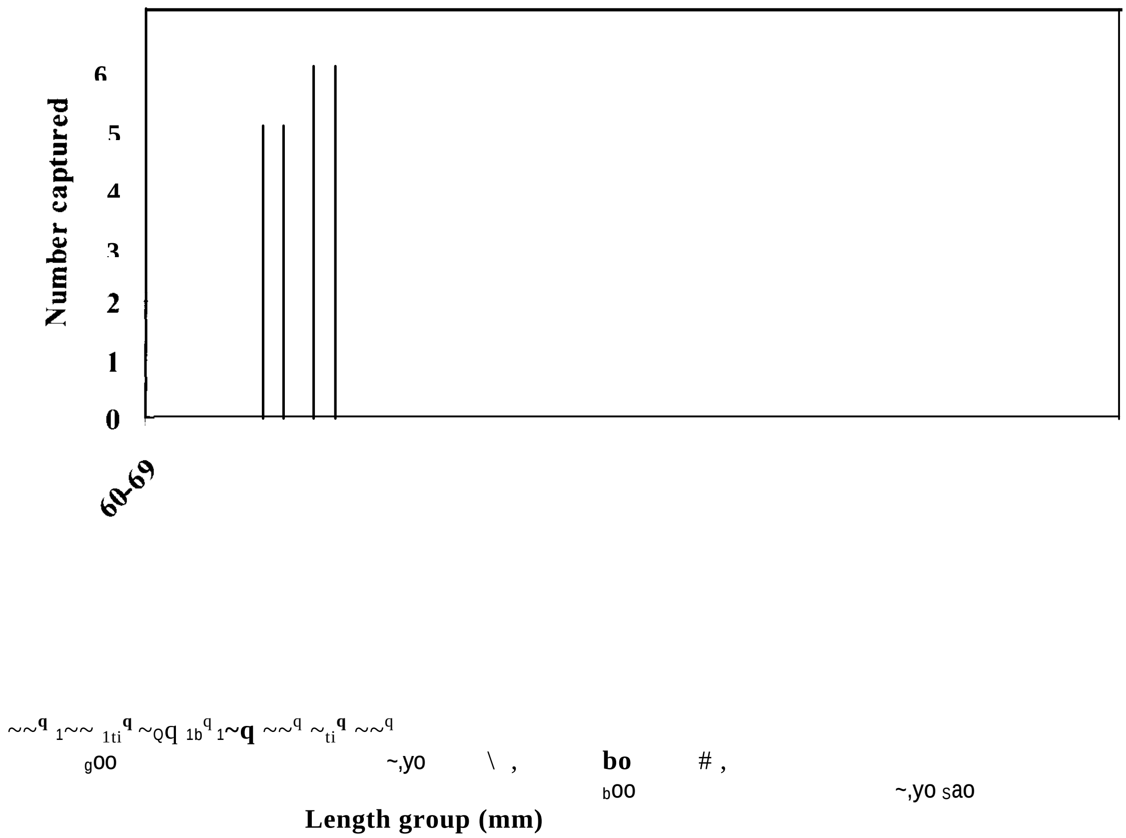


Figure 13. Length frequency histogram for all westslope cutthroat trout (n=21) captured during August in Section 3, East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2004.

Gold Creek

We captured bull and westslope cutthroat trout in Gold Creek in 2004. In Section I. bull trout had the highest density (13.76/100m`^{2}), while the density for westslope cutthroat trout was 0.93/100m^2 (Table 9).

Average size of salmonids > 75 mm in Section 1 ranged from 104 mm for westslope cutthroat trout to 122 mm for bull trout (Table 10). Length-frequency histograms from Section I indicate the presence of multiple age-classes (Figures 14 and I5).

Fable 9. Population estimates for salmonid species (>75 mm; TL) captured in Section 1, Gold Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Estimate (95% CI)**	**N/100m**[i]	**CPUE (fish/10 minutes)**
BLT	89 (83-95)	13.76	10.80
WC"[	6 (N/A)	0.93	0.91

Table 10. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 1, Gold Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	122 (14.1) (86)	48-190	16 (6.4) (86)
WCT	104 (30.7) (6)	77-163	13 (14.5) (6)

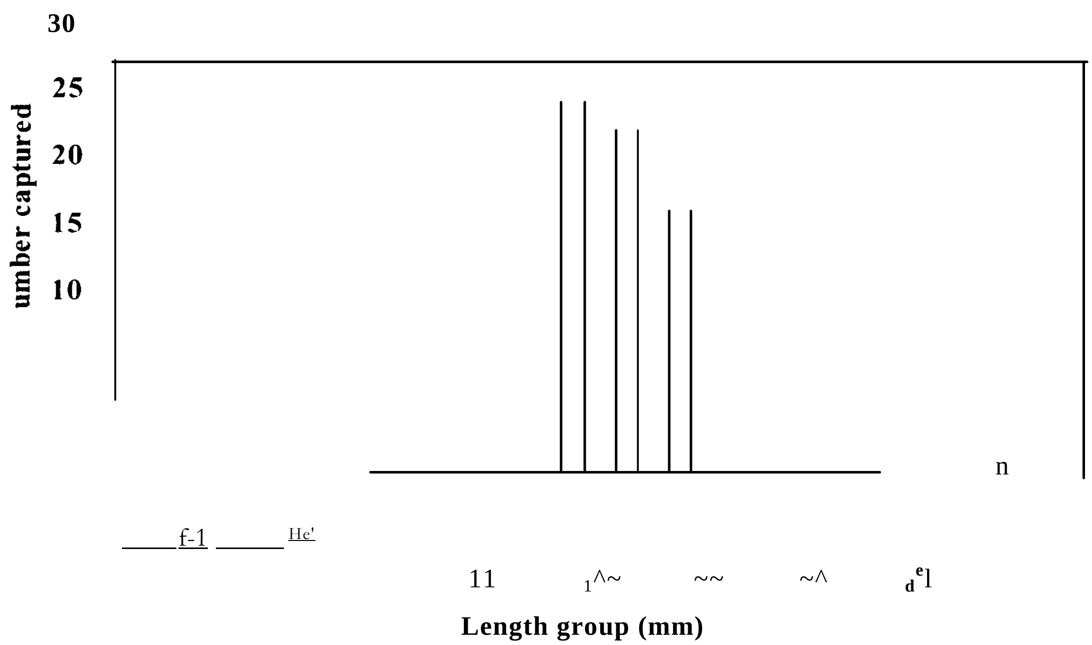


Figure 14. Length frequency histogram for all bull trout (n=97) captured during July in Section 1, Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

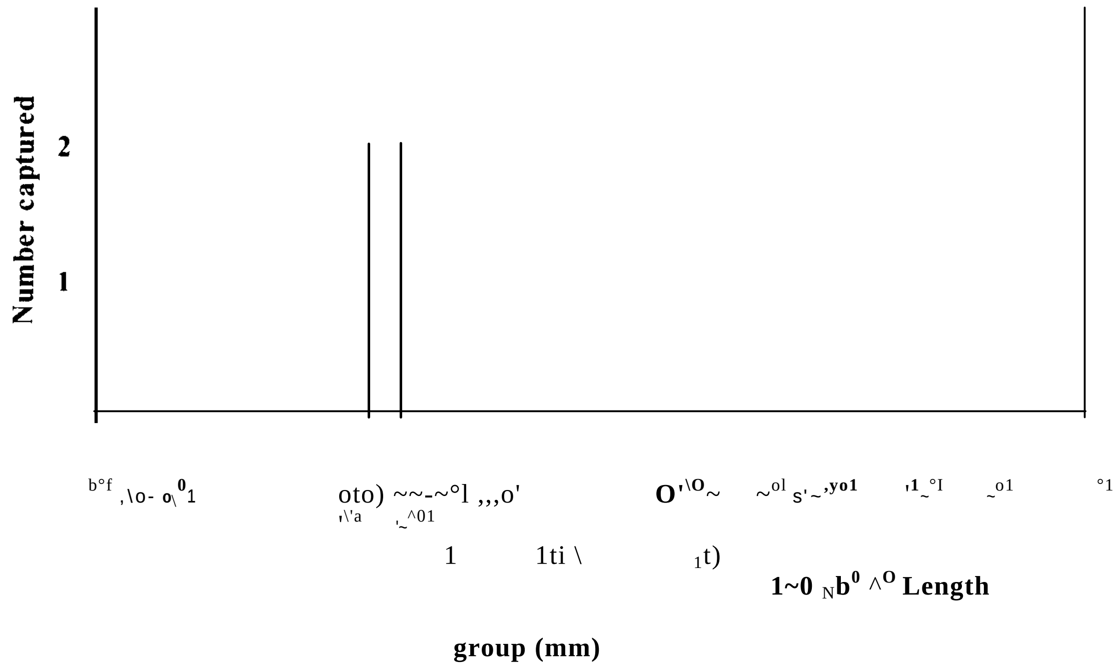


Figure 15. Length frequency histogram for all westslope cutthroat trout (n=6) captured during July in Section I, Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

In Section 2, bull trout had the highest density (1 1.29/100m^2), while the density for westslope cutthroat trout was 0.89/100m^2 (Table I I).

Average size of salmonids > 75 mm in Section 2 ranged from 1 l5 mm for westslope cutthroat trout to 119 mm for bull trout (Table 12). Length-frequency histograms from Section 2 indicate the presence of multiple age-classes (Figures 16 and 17).

Table 1 1. Population estimates for salmonid species (>75 mm; TL) captured in Section 2, Gold Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Estimate (95% Cl)**	**N/100m^2**	**CPUE (fish/10 minutes)**
BLT	76 (76-83)	11.29	8.81
WCT	6 (6-6)	0.89	0.49

Table 12. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 2, Gold ('reek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	1 19 (16.7) (75)	59-197	15 (7.9) (75)
WCT	1 15 (23.7) (6)	71-153	15 (10.2) (6)

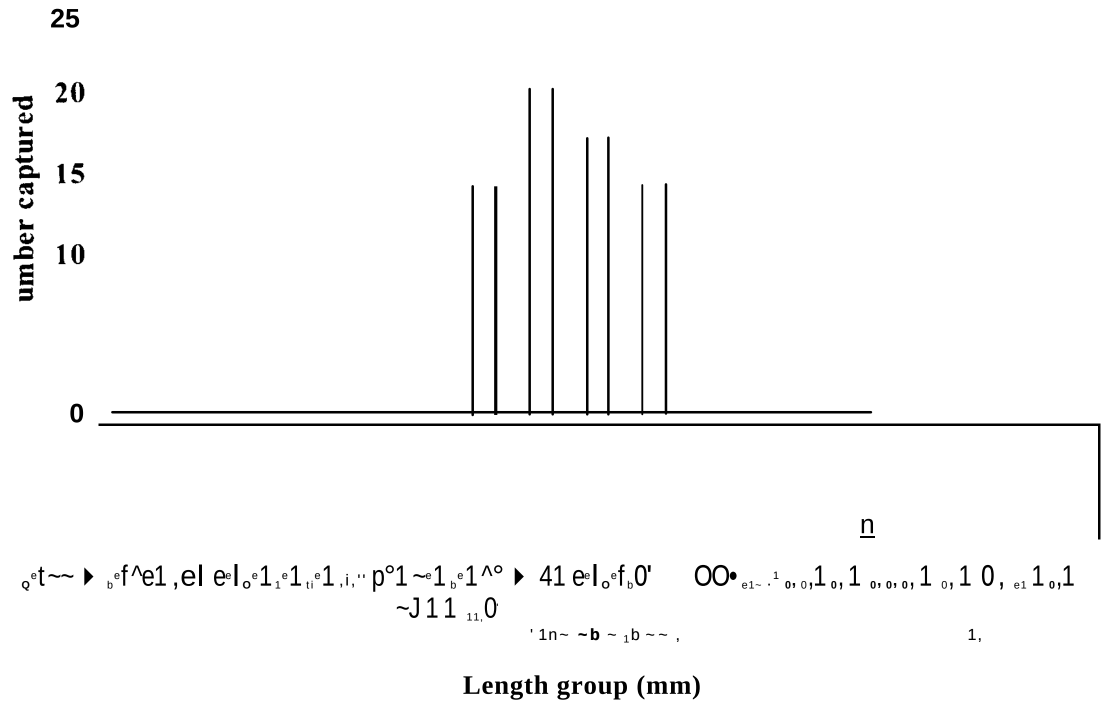


Figure 16. Length frequency histogram for all bull trout (n=76) captured during July in Section 2, Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

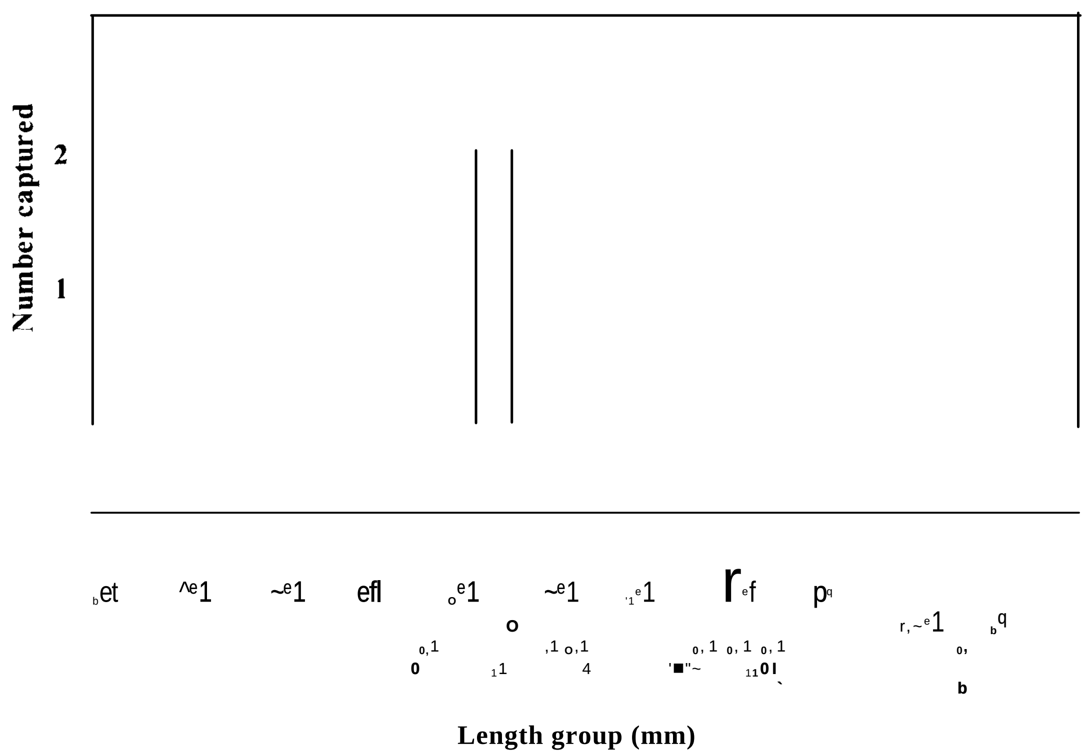


Figure 17. Length frequency histogram for all westslope cutthroat trout (n= 7) captured during July

in Section 2, Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

Granite Creek

We captured bull, rainbow and westslope cutthroat trout in Granite Creek in 2004. In Section 1, westslope cutthroat trout had the highest density (3.27/100m^2), while rainbow trout had the lowest (0.19/100m^2). Bull trout density in Section l was 3.08/100m^2 (Table 13).

Average size of salmonids > 75 mm in Section I ranged from 124 mm for westslope cutthroat trout to 213 mm for a single rainbow trout (Table 14). Length-frequency histograms from Section l indicate multiple age-classes present for both bull and westslope cutthroat trout (Figures 18 and 19).

Table 13. Population estimates for salmonid species (>75 nu'n; TL) captured in Section 1, Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/10 minutes)**
BLT	16 (16-16)	3.08	3.53
RBT	1 (1-1)	0.19	0.32
WCT	17 (17-17)	3.27	4.17

Table 14. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section I, Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	133 (14.8) (16)	52-155	21 (7.1) (16)
RBT	213 (N/A) (I)	N/A	124 (N/A) (1)
WCT	124 (27.1) (17)	95-189	22 (18.2) (17)

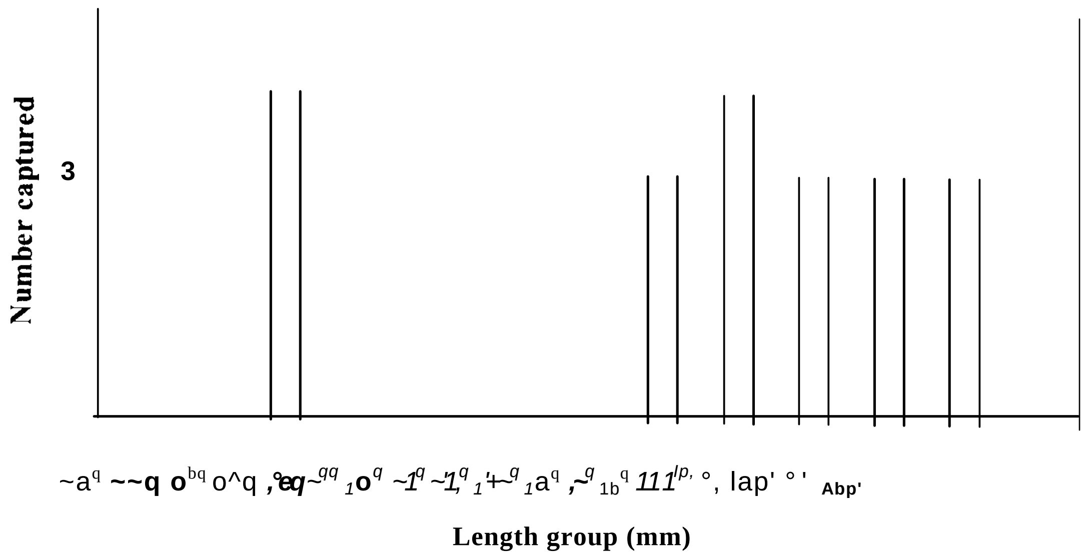


Figure 18. Length frequency histogram for all bull trout (n=23) captured during July in Section 1, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

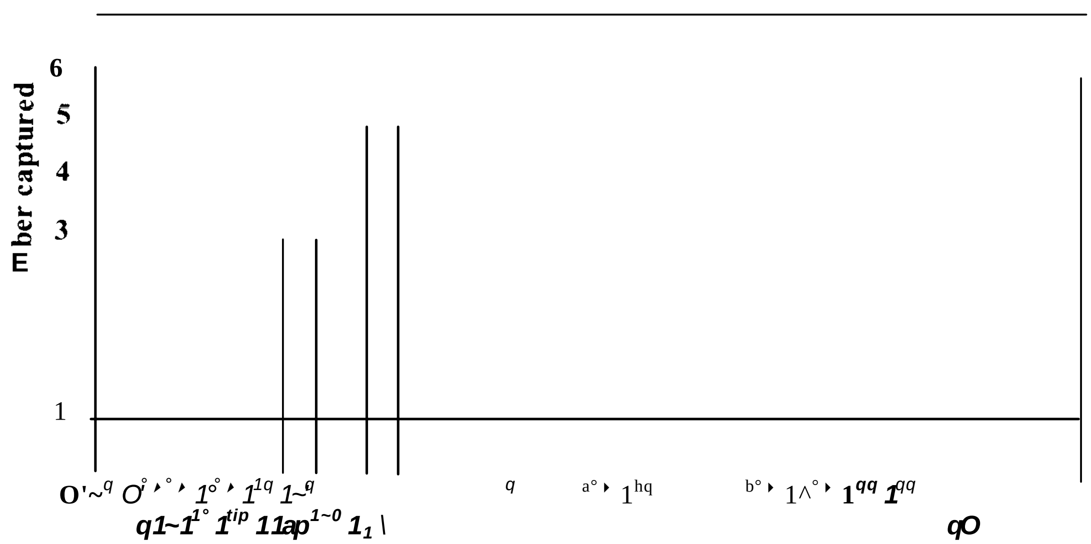


Figure 19. Length frequency histogram for all westslope cutthroat trout (n 17) captured during July in Section I, Granite ('reek, a tributary to Lake Pend Oreille, Idaho, in 2004

In Section 2, bull trout had the highest density (9.69/100m^2), while westslope cutthroat trout had a density of 1.73/100m^2 (Table 15). No rainbow trout were captured.

Average size of salmonids > 75 mm in Section 2 ranged from 116 mm for bull trout to 132 mm for westslope cutthroat trout (Table 16). Length-frequency histograms from Section 2 for both species captured indicate the presence of multiple age-classes (Figures 20 and 21).

Table 15. Population estimates for salmonid species (>75 mm; TL) captured in Section 2, Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Estimate (95%** CI)	**N/100m^2**	**CPUE (fish/10 minutes)**
BLT	67 (64-70)	9.69	9.49
WCT	12 (11-13)	1.73	1.90

Table 16. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 2, Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	1 16 (17.2) (66)	50-210	15 (9.0) (66)
WCT	132 (60.3) (12)	78-253	35 (46.2) (12)

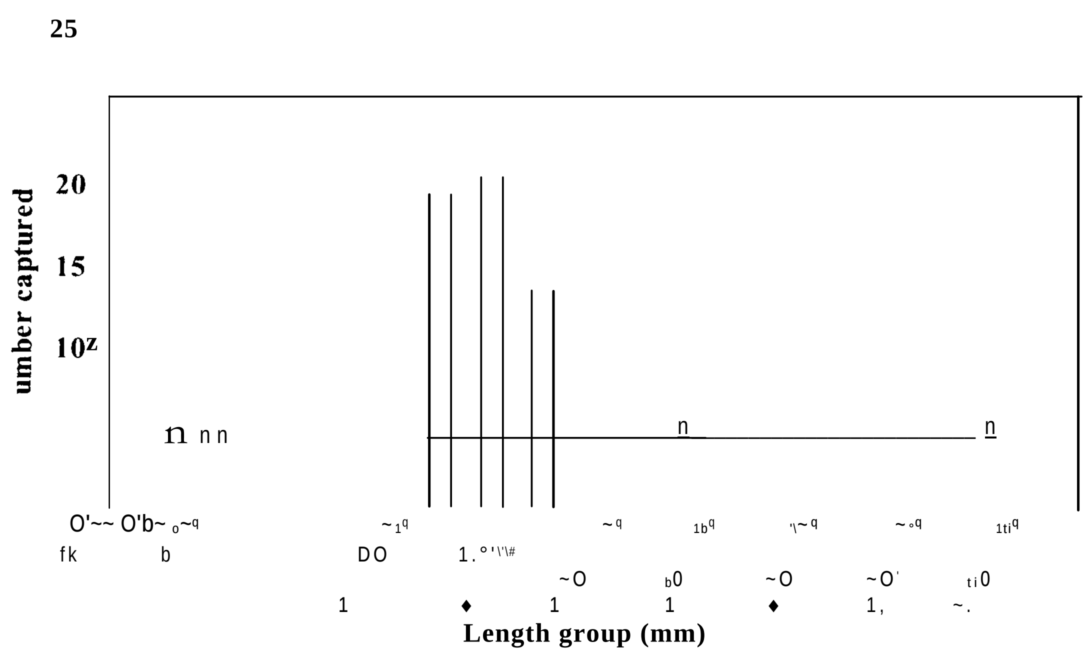


Figure 20. Length frequency histogram for all bull trout (n 70) captured during July in Section 2, Granite Creek, a tributary to Lake Pend Oreille. Idaho, in 2004.

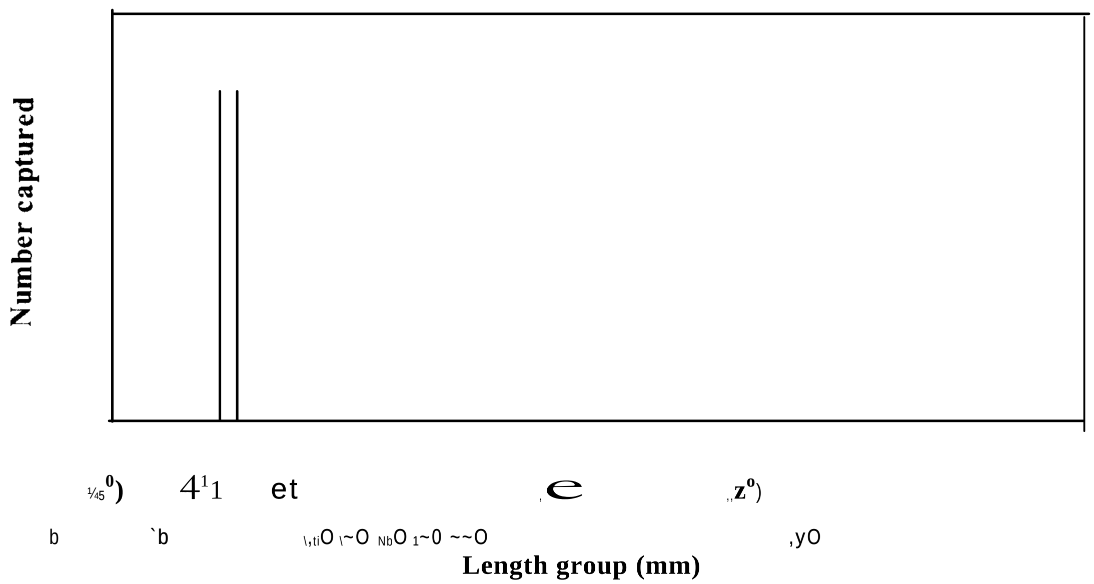


Figure 21. Length frequency histogram for all westslope cutthroat trout (n=12) captured during July in Section 2, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

In Section 3, bull trout had the highest density (13.73/100m^2), while westslope cutthroat trout had a density of 1.33/100m^2 (Table 17).

Average size of salmonids > 75 mm in Section 3 ranged from 107 mm for bull trout to 133 mm for westslope cutthroat trout (Table 18). Length-frequency histograms from Section 3 for both species captured indicate the presence of multiple age-classes (Figures 22 and 23).

Table 17. Population estimates for salmonid species (>75 mm; TL) captured in Section 3, Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/l0 minutes)**
BLT	62 (60-64)	13.73	10.97
WCT	6 (5-7)	1.33	1.00

Table 18. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 3, Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	107 (19.7) (62)	81-216	12 (10.8) (62)
WCT	l33 (59.2) (6)	77-217	34 (36.8)(6)

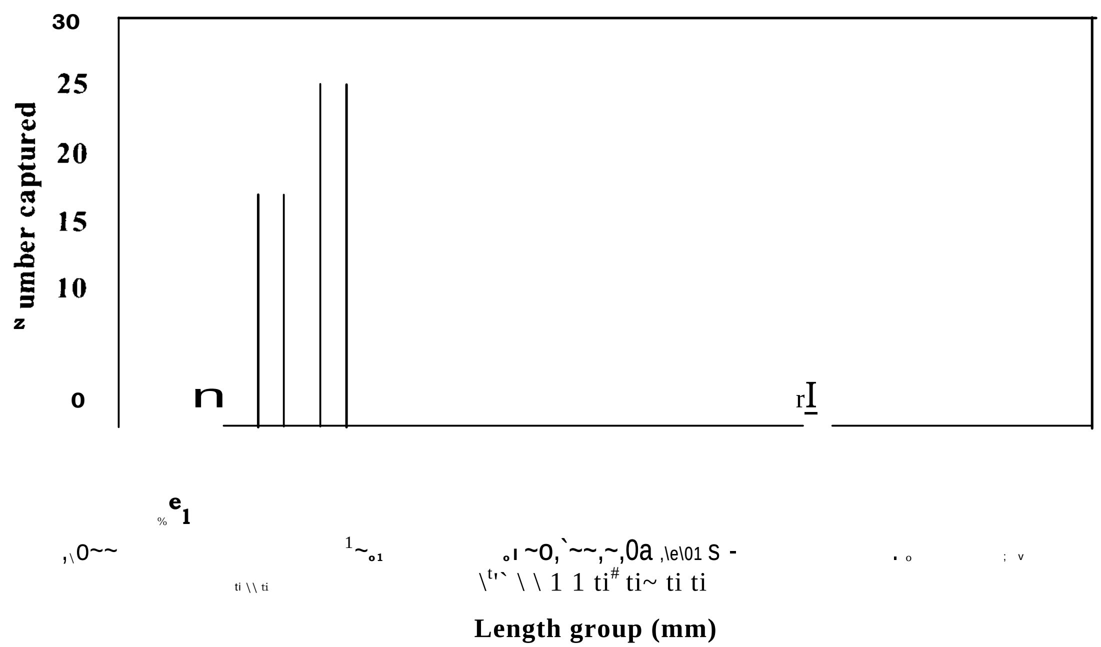


Figure 22. Length frequency histogram for all bull trout (n=62) captured during July in Section 3, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

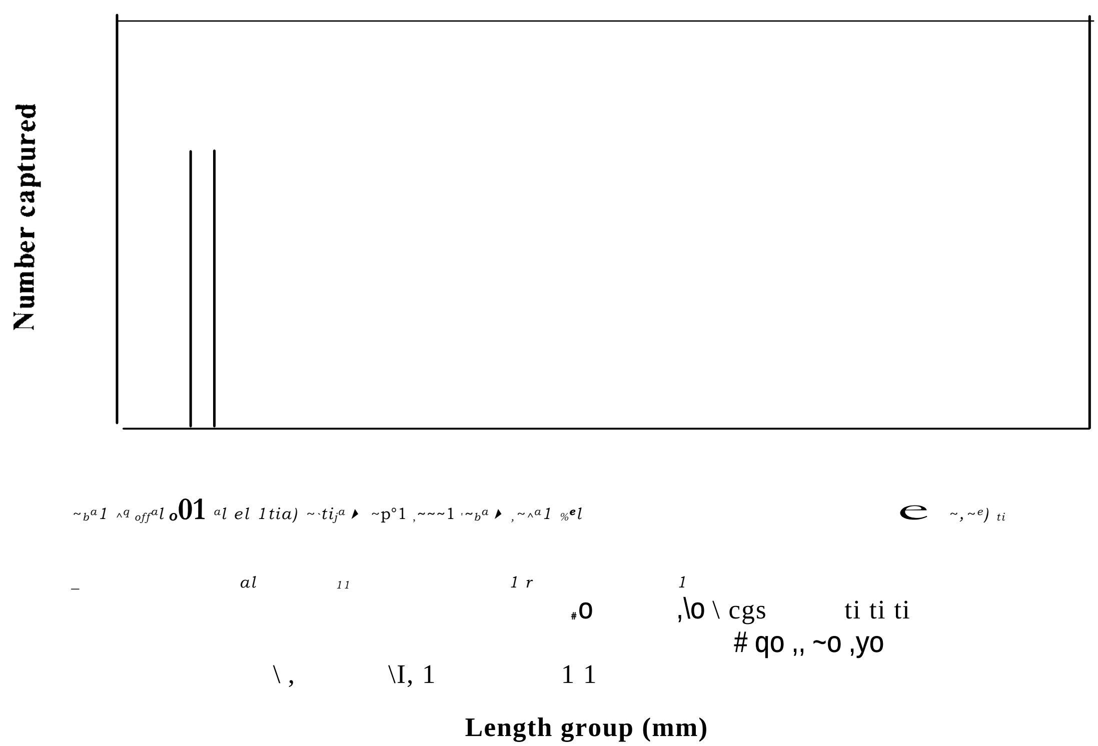


Figure 23. Length frequency histogram for all westslope cutthroat trout (n 6) captured during July in Section 3, Granite ('reek, a tributary to lake Pend Oreille, Idaho, in 2004.

Rattle Creek

We captured bull, rainbow and westslope cutthroat trout in Rattle Creek in 2004. In Section 1, bull trout had the highest density (5.92/100m^2), while westslope cutthroat trout had the lowest (0.16/100m^2). Rainbow trout density was 3.78/100m^2 (Table 19).

Average size of salmonids > 75 mm in Section 1 ranged from 109 mm for bull trout to 178 mm for a single westslope cutthroat trout (Table 20). Length-frequency histograms from Section 1 indicate the presence of multiple age-classes for both bull and rainbow trout (Figures 24 and 25).

Table 19. Population estimates for salmonid species (>75 mm; TL) captured in Section 1, Rattle Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	**Estimate (95% Cl)**	**N/100m^2**	**CPUE (fish/10 minutes)**
BLT	36 (36-43)	5.92	3.51
RBT	23 (23-23)	3.78	3.07
WCT	1 (1-1)	0.16	0.15

Table 20. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 1, Rattle Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	109 (29.8) (35)	75-171	14 (1 l.3) (35)
RBT	111 (25.9) (23)	74-155	17 (1 1.6) (23)
WCT	178 (N/A) (1)	N/A	53 (N/A) (1)

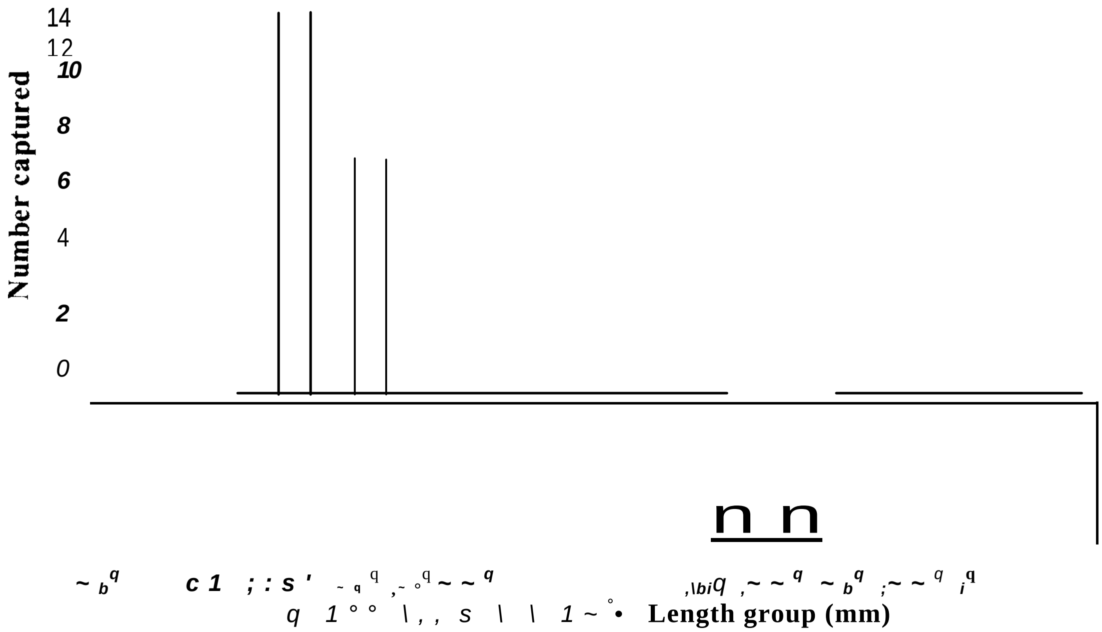


Figure 24. Length frequency histogram for all bull trout (n¯35) captured during July in Section 1, Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2004.

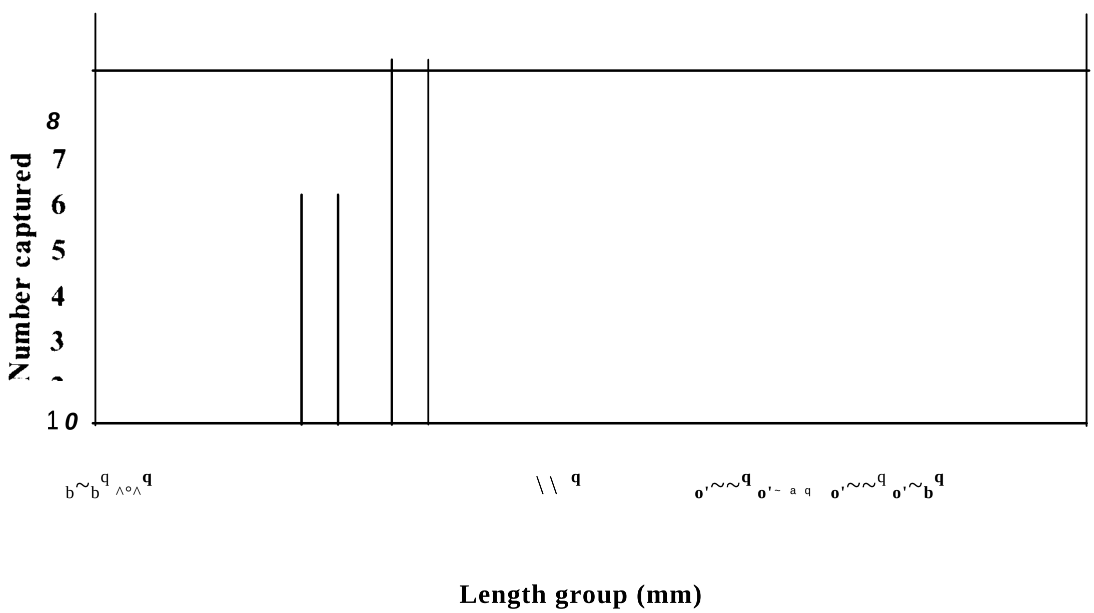


Figure 25. Length frequency histogram for all rainbow trout In 24) captured during July in Section 1, Rattle ('reek, a tributary to Lightning Creek, near ('lark Fork, Idaho, in 2004.

In Section 2, bull trout had the highest density (12.67/100m^2), while rainbow trout had the lowest (0.37/100m`'). Westslope cutthroat trout density was 0.93/100m^2 (Table 21).

Average size of salmonids > 75 mm in Section 2 ranged from 108 mm for bull trout to 153 mm for westslope cutthroat trout (Table 22). Length-frequency histograms from Section 2 for bull and westslope cutthroat trout indicate the presence of multiple age-classes (Figures 26 and 27).

Table 21. Population estimates for salmonid species (>75 mm; TL) captured in Section 2, Rattle Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	**Estimate (95%** CI)	**N/100m^2**	**CPUE (fish/10 minutes)**
BLT	68 (66-70)	12.67	8.47
RBT	2 (N/A)	0.37	0.28
WCT	5 (4-6)	0.93	0.56

Table 22. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 2, Rattle Creek, a tributary to Lightning Creek near Clark Fork, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	108 (20.2)(68)	45-142	12(5.8) (68)
RBT	112 (25.5)(2)	94-130	16(11.3) (2)
WCT	153 (23.9)(5)	125-186	37(20.4) (5)

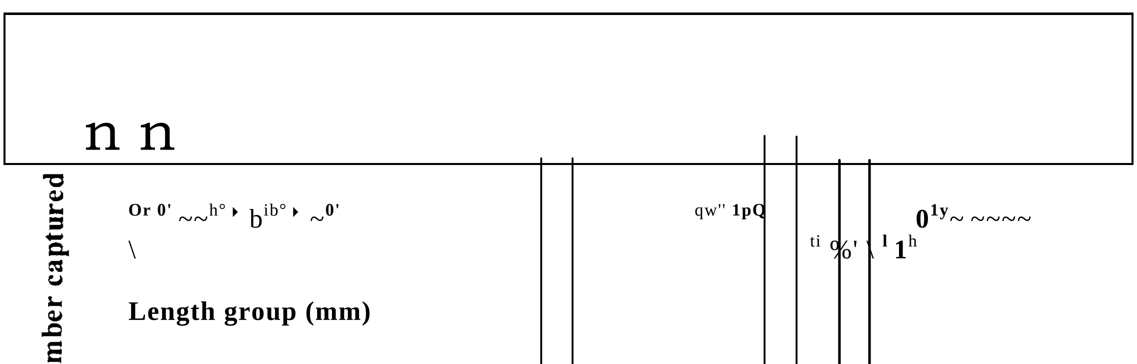


Figure 26. Length frequency histogram for all bull trout (n 70) captured during August in Section 2, Rattle Creek, a tributary to Lightning ('reek, near ('lark Fork, Idaho, in 2004.

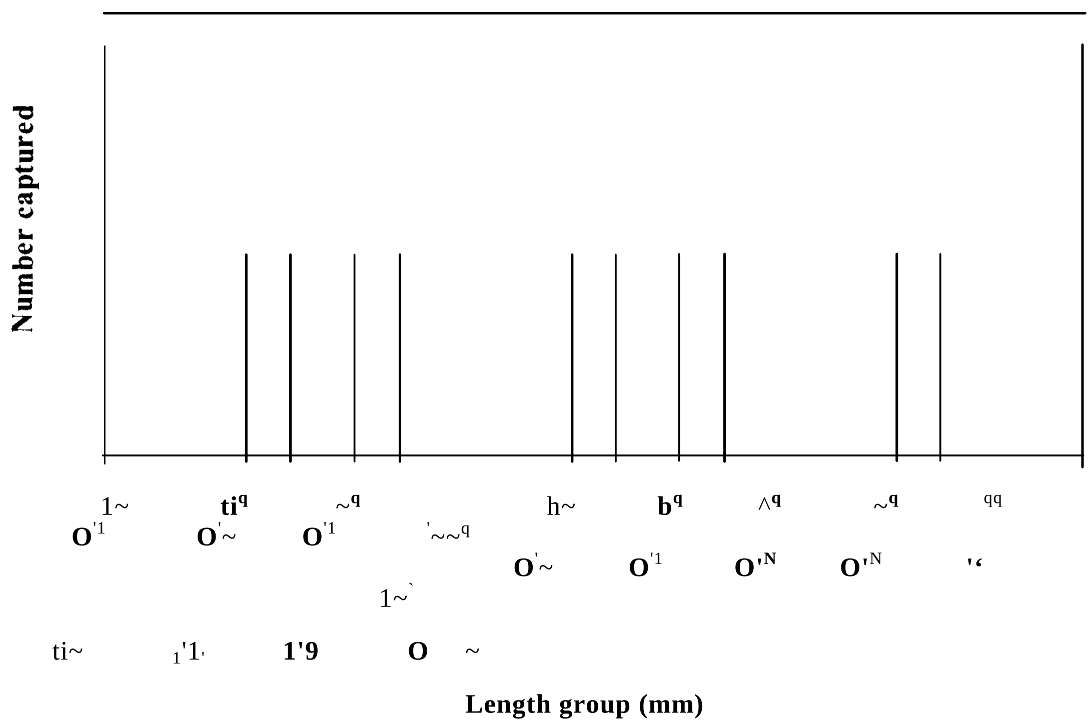


Figure 27. Length frequency histogram for all westslope cutthroat trout (n¯5) captured during August in Section 2, Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2004.

Trestle Creek

We captured mountain whitefish and bull, rainbow and westslope cutthroat trout in Trestle Creek in 2004. In Section 1, westslope cutthroat trout had the highest density (4.47/100111^2), while bull trout had the lowest (0.72/100m^2). The density for both mountain whitefish and rainbow trout was 1.15/100111^2 (Table 23).

Average size of salmonids > 75 mm in Section I ranged from 122 mm for westslope cutthroat trout to 196 mm for mountain whitefish (Table 24). Length-frequency histograms from Section 1 for bull, rainbow and westslope cutthroat trout indicate multiple age-classes present, dominated by age-0 bull trout. The length-frequency histogram for mountain whitefish shows the presence of' most likely a single, older age-class (Figures 28 through 31).

Table 23. Population estimates for salmonid species (>75 mm; TL) captured in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	Estimate (95% Cl)	N/100m^2	CPUE (fish/10 minutes)
BLT	5 (5-5) _	0.72	0.63
MWF	8 (8-8)	1.15	1.06
RBT	8 (8-8)	1.15	1.69
WCT	31 (31-31)	4.47	4.44

Table 24. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	146 (32.4) (5)	44-203	33 (28.0) (5)
MWF	196 (8.0) (8)	186-207	66 (9.4) (8)
RBT	141 (14.1) (8)	121-165	30 (9.5) (8)
WCT	122 (30.8) (31)	89-194	23 (19.9) (31)

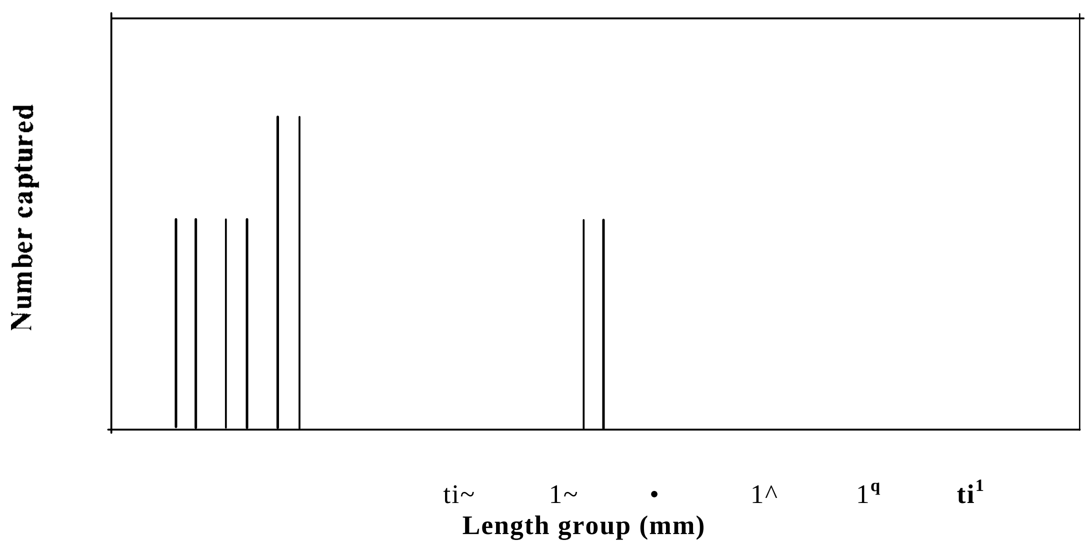


Figure 28. Length frequency histogram for all bull trout (n=13) captured during August in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

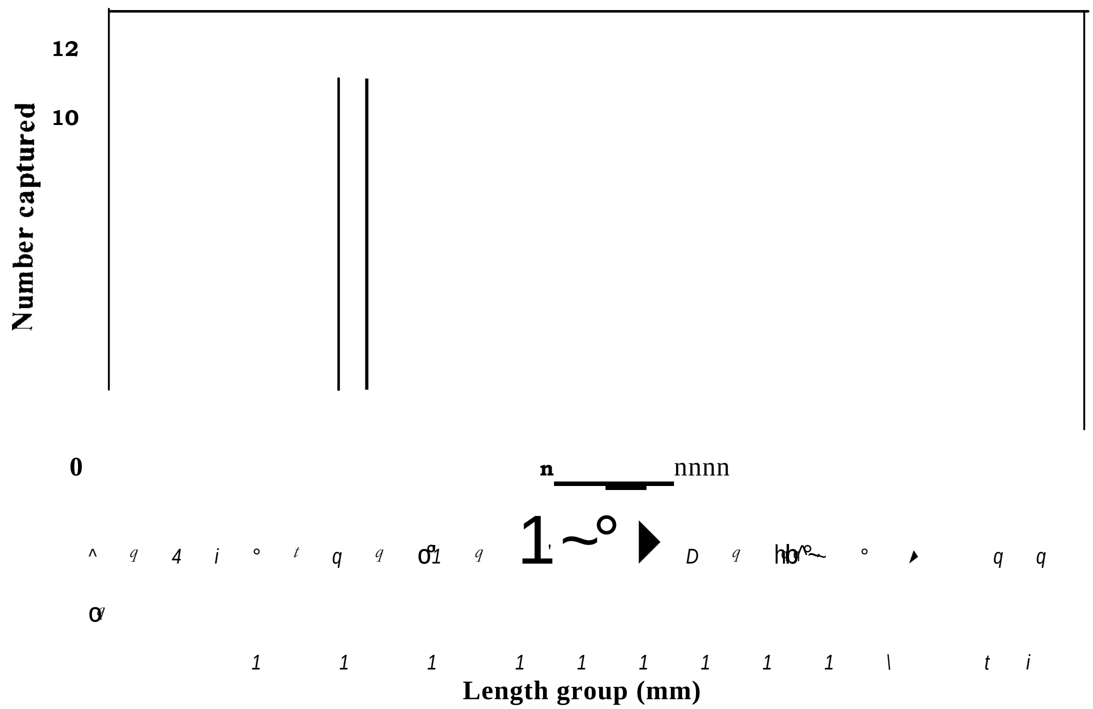


Figure 29. Length frequency histogram for all westslope cutthroat trout (n=31) captured during August in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

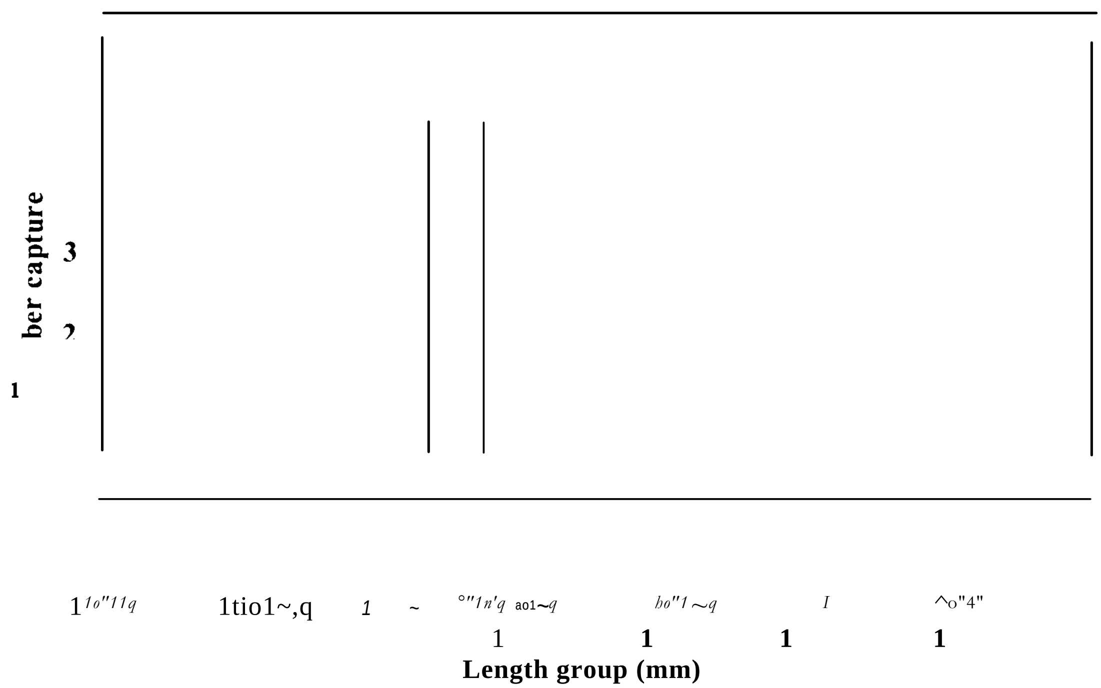


Figure 30. Length frequency histogram for all rainbow trout (n 8) captured during August in Section I, Trestle ('reek, a tributary to Lake Pend Oreille, Idaho, in 2004.

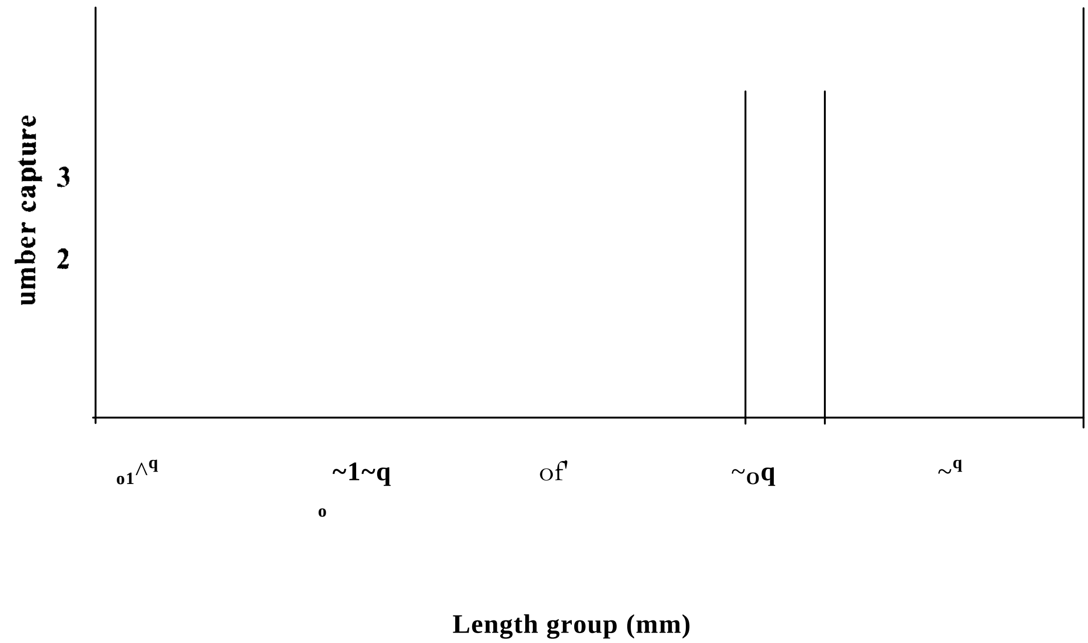


Figure 31. Length frequency histogram for all mountain whitefish (n=8) captured during August in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

In Section 2, westslope cutthroat trout had the highest density (8.55/100m^2), while the density for bull trout was 2.56/100m^2 (Table 25). No other salmonid species were captured in Section 2.

Average size of salmonids > 75 mm in Section 2 ranged from 130 mm for westslope cutthroat trout to 131 mm for bull trout (Table 26). Length-frequency histograms from Section 2 for both species suggest the presence of multiple age-classes (Figures 32 and 33).

lik

Table 25. Population estimates for salmonid species (>75 mm; TL) captured in Section 2, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	Estimate (95% CI)	N/100m^2	CPUE (fish/10 minutes)
E3LT	15 (14-16)	2.56	3.85
WCT	50 (49-51)	8.55	12.65

Table 26. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 2, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
131 .1	131 (28.2)(15)	45-177	15 (13.8)(10)
WC"1	130 (41.5) (50)	72-226	30 (25.3)(32)

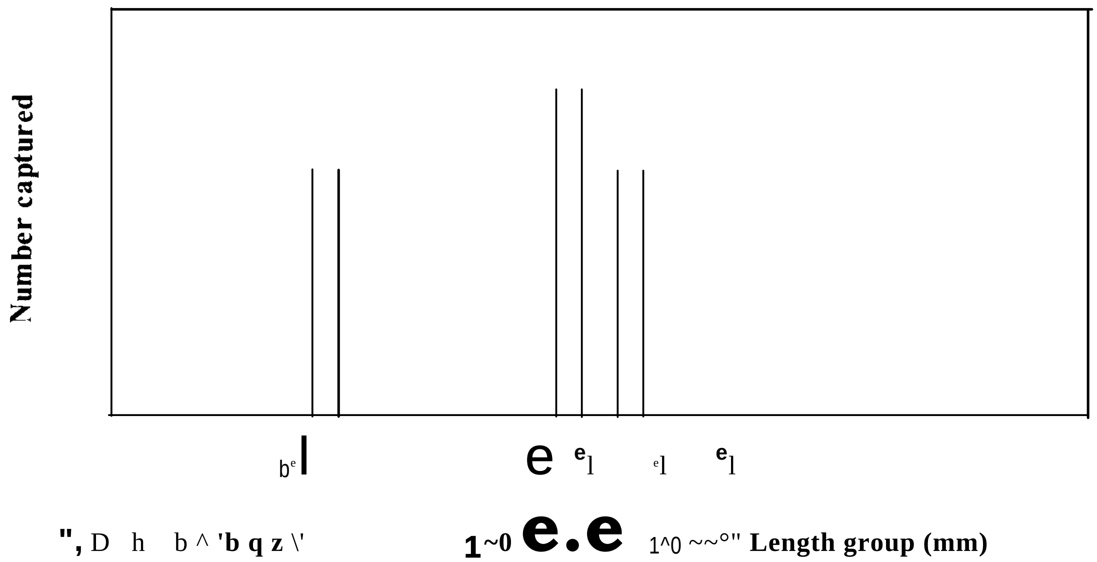
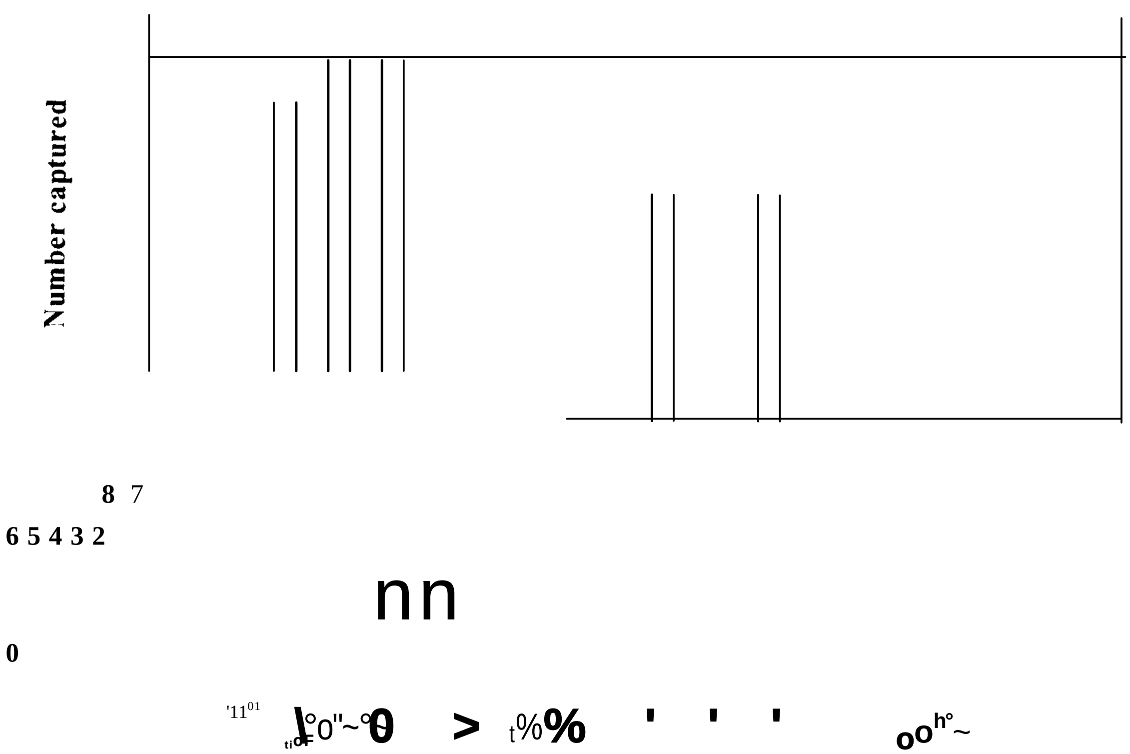


Figure 32. Length frequency histogram for all bull trout (n=22) captured during August in Section 2, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.



Length group (mm)

Figure 33. Length frequency histogram for all westslope cutthroat trout (n 51) captured during August in Section 2, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

In Section 3, bull trout had the highest density (15.18/100m^2), while the density for westslope cutthroat trout was 3.43/100m- (Table 27). No other salmonid species were captured in Section 3.

Average size of salmonids > 75 mm in Section 3 ranged from 111 mm for bull trout to 133 mm for westslope cutthroat trout (Table 28). Length-frequency histograms from Section 3 for both species captured indicate the presence of multiple age-classes (Figures 34 and 35).

Table 27. Population estimates for salmonid species (>75 mm; TL) captured in Section 3, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Estimate (95% Cl)**	**N/100m^2**	**CPUE (fish/10 minutes)**
BLT	62 (62-69)	15.18	10.56
WCT	14 (14-14)	3.43	2.42

Table 28. Mean lengths (TL; mm) and mean weights (g), standard deviation (SD) and sample size (n), for individuals > 75 mm, and length range for all individuals captured in Section 3, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2004.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	1 1 1 (21.8)(62)	52-172	N/A
WCT	133 (52.9) (14)	63-239	N/A

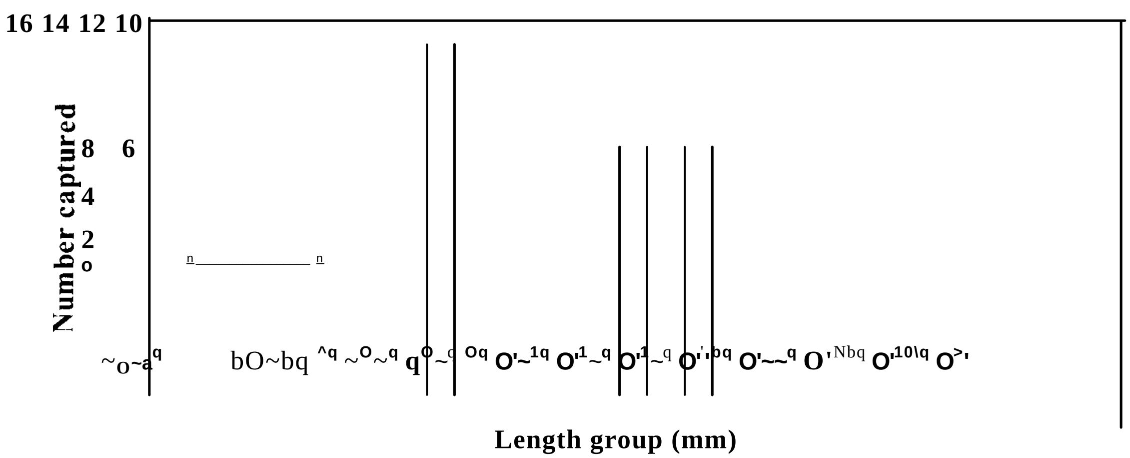


Figure 34. Length frequency histogram for all hull trout (n 66) captured during August in Section 3, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

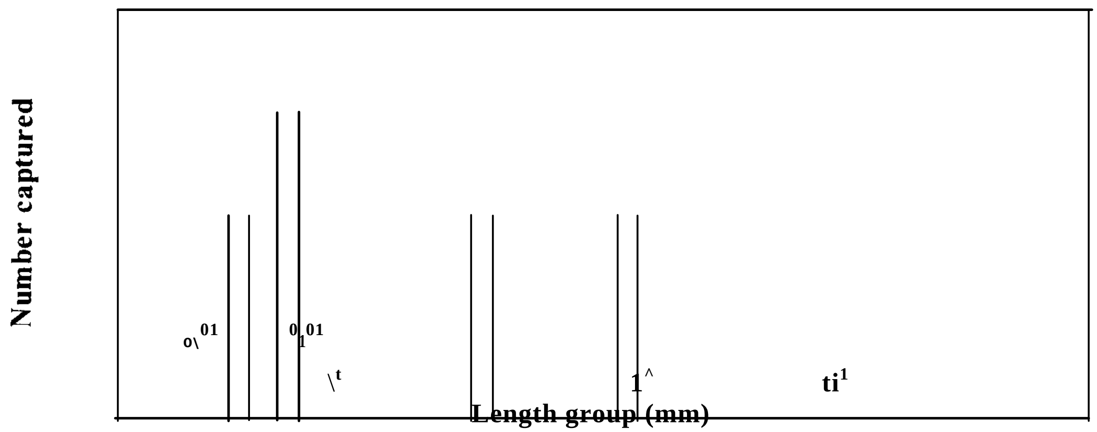


Figure 35. Length frequency histogram for all westslope cutthroat trout (n=15) captured during August in Section 3, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2004.

DISCUSSION

We successfully completed depletion population estimates for juvenile salmonids on l3 sections in 5 streams. These population estimates will serve to augment hull trout monitoring data collected through annual redd counts on these streams. The estimates also provide a mechanism to monitor other native species of interest (westslope cutthroat trout) for which we are unable to do redd counts. They also provide a means to monitor the distribution and relative abundance of non-native fish species in these tributaries.

In general, juvenile hull trout abundance was highest in the upper-most sampling sites of each tributary stream. Both juvenile bull and westslope cutthroat trout were present in all streams sampled. Juvenile mountain whitefish were only captured in the lower reaches of' Trestle Creek. Across all streams sampled, native species (hull and westslope cutthroat trout) were the only species captured in the upper-most sampling sites. The highest juvenile (> 75 mm) bull trout densities observed were found in Trestle creek (15.2/100m), but Granite, Gold, and Rattle creeks all supported juvenile hull trout densities in excess of I2.6/l00m^2. For comparison, Hermann et al. (2003) reported maximum densities for juvenile (> 75 mm) hull trout in the E. Fk. Bull River, upper Prospect Creek, and Rock Creek (all lower Clark Fork River tributaries in Montana) at 4.1/I00m^2, 6.1/100m^2, and 3.8/I00m^2, respectively. Liermann (2003) reported maximum juvenile hull trout densities of 5.7/I00111^2 and 9.7/I00m^2 for Fish Trap Creek and the West Fork Thompson River, respectively, both tributaries to the Thompson River which enters the Clark Fork River near Thompson Falls, Montana. Moran (2004) reported densities of juvenile hull trout

(id

as high as $13.3/100m^2$ in Dry Creek, a tributary to Prospect Creek, a tributary to the lower Clark Fork River in Montana.

Of all the streams sampled, Trestle Creek supported the highest density observed for juvenile (>75 mm) westslope cutthroat trout ($8.6/100m^2$), and the density estimates remained relatively strong over the longitudinal gradient of the stream. Trestle Creek is known to support an adfluvial population of westslope cutthroat trout (Downs and Jakubowski 2003). Aside from capture of adult adfluvial westslope cutthroat trout in Twin Creek, Trestle Creek is the only positively identified contemporary adfluvial westslope cutthroat trout spawning tributary to Lake Pend Oreille. Others may exist, but have not been trapped to determine the presence of migratory fish. Relatively small numbers of outmigrating juvenile westslope cutthroat trout were captured in Granite Creek in 2003 and 2004 (5 and 32, respectively), suggesting an adfluvial component may exist in this tributary as well (Downs and Jakubowski 2003). We did estimate relatively strong densities of westslope cutthroat trout in the upper sampling reach on E. Fk. Lightning Creek (8.4/IOOm), but it is unclear if these are resident or migratory westslope cutthroat trout. The other tributaries had relatively low densities of westslope cutthroat trout (up to 3.3/100m).

Exotic species (primarily rainbow trout) were most abundant, when they were present, in the lower sampling sites. No exotic species were captured in Gold Creek, and only a single rainbow trout was captured in Granite Creek. Rainbow trout densities were relatively high in the lower reaches of E. Fk. Lightning and Rattle creeks, but brook trout were rare in these streams, with only one individual captured in E. Fk. Lightning Creek. The only exotic species captured in Trestle Creek was rainbow trout, but a single brown *Sulmo truttu* and brook trout were captured in a screw trap on Trestle Creek in 2002 (Downs and Jakubowski 2003).

ACKNOWLEDGEMENTS

The authors wish to thank Christina Suhfras of Avista Corporation for her contributions to field data collection. We would also like to thank Mark Gamblin and Ned Horner of the Idaho Department of Fish and Game, Joe DosSantos of Avista Corp., Laura Katzman of Montana Fish, Wildlife, and Parks, and Larry Lockard of the U.S. Fish and Wildlife Service for their reviews of this report.

LITERATURE CITED

Downs, C. and R. Jakubowski. 2003. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2002 Progress Report. Avista Corporation. Spokane, Washington

Downs, C., and R. Jakubowski. 2005. Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring 2003 Progress Report. Report to Avista Corporation from the Idaho Department of Fish and Game. Boise, Idaho.

Liermann, B.W., L.M. Katzman, and T.D. Tholl. 2003. Habitat Restoration Monitoring Comprehensive Report - 2001 and 2002. Report to Avista Noxon Natural Resource Office from Montana Fish, Wildlife, and Parks. Thompson Falls, MT.

Liermann, B.W. 2003. Thompson River Fishery Investigations Comprehensive Report - 2000 through 2002. Report to Avista Noxon Natural Resource Office from Montana Fish, Wildlife, and Parks. Thompson Falls, MT.

Moran, S. 2004. Fish Abundance Studies: Fisheries Survey of the Prospect Creek Drainage, Montana 2003. Avista Corporation. Noxon, Montana.

Panhandle Bull Trout Technical Advisory Team. 1998. Lake Pend Oreille Key Watershed Bull Trout Problem Assessment. Idaho Department of Environmental Quality. Boise.

Philip Williams and Associates. 2004. Lightning Creek Watershed Assessment Report Report to Avista Corporation. Boise, Idaho.

River Design Group. 2004. Granite Creek Watershed Assessment and Restoration Design Report. Report to Avista Corporation. Whitefish, Montana.

Van Deventer, J.S. and W.S. Platts. 1986. Documentation for MICROFISH 2.2: A software package for processing electrofishing data obtained by the removal method. Intermountain Research Station, Boise, Idaho.

White, G.C., D.R. Anderson, K.P. Burnham, and D.L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, LA-87-87-NFRP, Los Alamos, New Mexico.

Zippin, C. 1958. The removal method of population estimation. Journal of Wildlife Management. 22(1):82-90.

C

Christopher C. Downs
Senior Fishery Research Biologist

elAig

Virgil ' ' ' i re, Chief
Bureau of Fisheries

Steve Yundt
Fish Management Supervisor

Submitted by: **Approved by:**

C C

C (