LAKE PEND OREILLE/CLARK FORK RIVER FISHERY RESEARCH AND MONITORING

2005 PROGRESS REPORT

2005 LAKE PEND OREILLE BULL TROUT REDD COUNTS

2005 CLARK FORK RIVER FISHERY ASSESSMENT PROGRESS REPORT

2005 TRESTLE AND TWIN CREEKS BULL TROUT OUTMIGRATION AND LAKE PEND OREILLE SURVIVAL STUDY PROGRESS REPORT

2005 JOHNSON AND GRANITE CREEKS BULL TROUT TRAPPING

2005 TWIN CREEK RESTORATION MONITORING PROGRESS REPORT

2005 TRIBUTARY FISH POPULATION MONITORING PROGRESS REPORT

2005 LOWER CLARK FORK RIVER WESTSLOPE CUTTHROAT TROUT RADIO TELEMETRY AND GENETIC STUDY PROGRESS REPORT

Idaho Tributary Habitat Acquisition and Enhancement Program

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Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring

Progress Report 2005

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Idaho Tributary Habitat Acquisition and Enhancement Program,
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TABLE OF CONTENTS

Page

2005 Lake Pend Oreille Bull Trout Redd Counts

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS – Continued

TABLE OF CONTENTS – Continued

LIST OF TABLES

TABLE OF CONTENTS – Continued

TABLE OF CONTENTS – Continued

Page

LIST OF FIGURES

TABLE OF CONTENTS – Continued

Page

2005 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 – <u>continued</u>

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS – continued

Page

TABLE OF CONTENTS – continued

Page

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS – Continued

Page

LIST OF TABLES

TABLE OF CONTENTS – <u>Continued</u>

LIST OF FIGURES

TABLE OF CONTENTS – **Continued**

Page

TABLE OF CONTENTS – Continued

Page

Page

LIST OF TABLES

LIST OF FIGURES

2005 Lake Pend Oreille Bull Trout Redd Counts Progress Report

ABSTRACT

Bull trout *Salvelinus confluentus* redd counts were conducted in 17 tributaries to Lake Pend Oreille and the Clark Fork River, as well as the Clark Fork River spawning channel in 2005. The Middle and the North Fork East River, as well as Uleda Creek, all tributaries to the lower Priest River, were also surveyed. The total number of redds counted in these areas in 2005 was 940. 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 2005 redd count for these six streams combined (580) was considerably higher than the long-term average of 508 redds. A higher count of 174 redds in Trestle Creek in 2005, compared to 102 in 2004, as well as considerable increases in both Grouse and Gold Creeks, was the cause of the overall higher redd count totals. We identified two statistically significant correlations in the 2005 redd count data. Statistically significant correlations between year and redd count for Granite Creek (tau-b = 0.39; p = 0.03) and Gold Creek (tau-b = 0.36; p = 0.02), indicate long-term increases in these populations. While some populations such as Granite 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 and Savage creeks, where redd counts as high as 36 and 52, respectively, were documented in the early 1980's, but have averaged less than five since 1992.

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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 watershed 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 al. 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 (J. DuPont, IDFG, personal communication). Monitoring of bull trout redds began in these two streams in 2001. The North Fork of the East River, another tributary in the Priest River drainage, was added in 2004.

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, 2005. 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 conducted redd counts on 17 tributaries to LPO, as well as the Clark Fork River, between October 6 and October 20, 2005 (Figure 1; Table 1). 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 staff counted redds in the Middle and North Fork East River system, which are tributaries to the lower Priest River. Recent telemetry studies have shown bull trout using this river system are from LPO. 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 (J. DuPont, IDFG, personal communication).

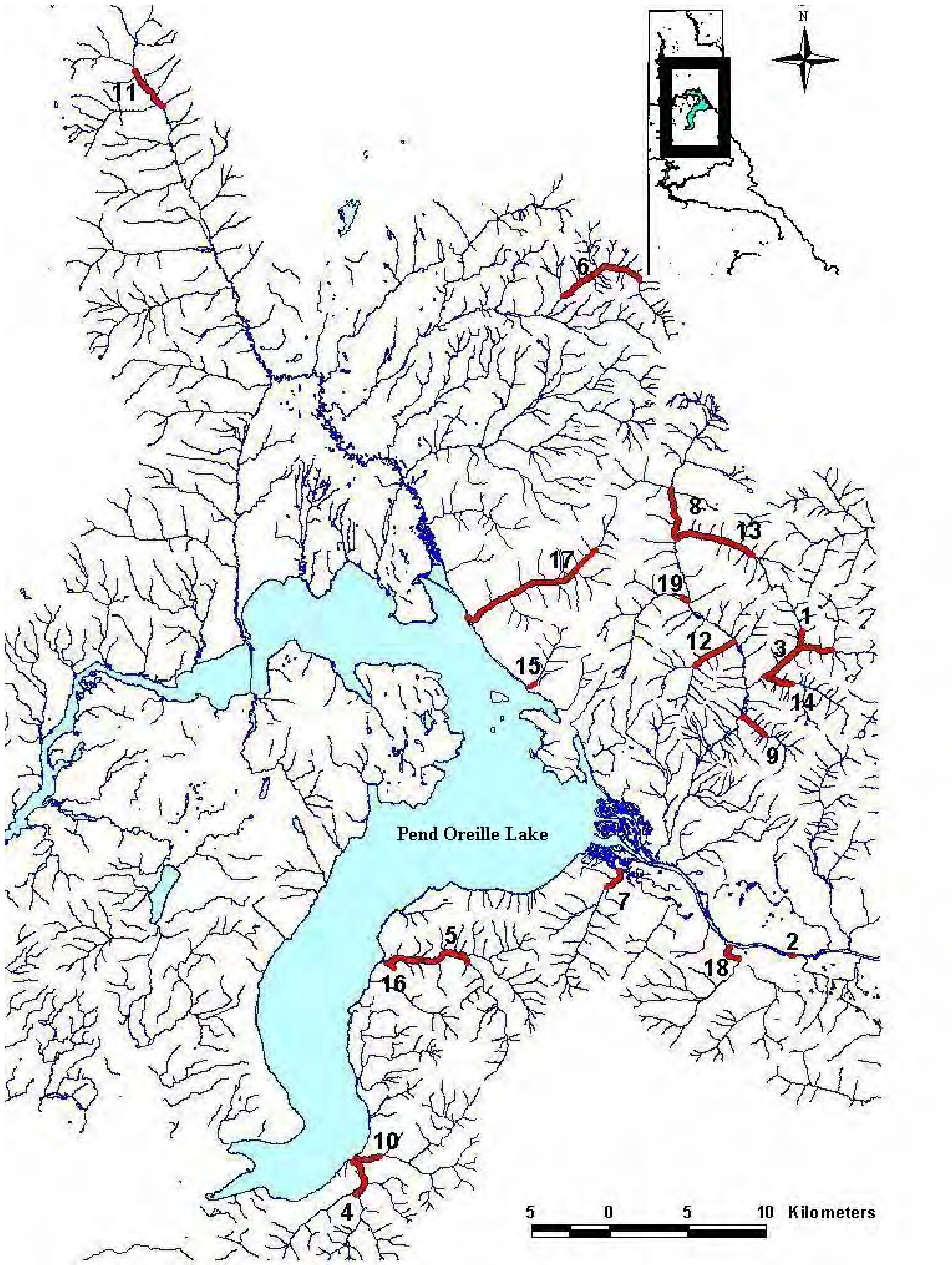

Figure 1. Bull trout redd count sections (with shading) in tributaries of Pend Oreille Lake, Idaho. Numbers denote stream name in Table 1.

Table 1. 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, 1992-2005
Clark Fork River	2	Spawning channel (N/A)	1992-2005
E. Fk. Lightning Cr[a]	3	Savage to Thunder Creek (5.0)	1983-2005
Gold Cr[a]	4	Mouth to 0.2 km upstream of W. Gold confluence (2.4)	1983-2005
Granite Cr	5	Mouth to road 278 crossing (6.4)	1983-1987, 1992-2005
Grouse Cr[a]	6	Flume Creek to end of road 280 (2.4 km beyond gate) (6.5)	1983-2005
Johnson Cr[a]	7	Mouth to falls (1.5)	1983-2005
Lightning Cr	8	Rattle to Quartz (3.2)	1983-1987, 1992-2005
Morris Cr	9	Mouth to trail 132 crossing (N/A)	1999-2005
N. Gold Cr[a]	10	Mouth to falls (1.2)	1983-2005
Pack R	11	Road 231 bridge near McCormick Cr to Falls located 0.4 km downstream of W. Branch (2.8)	1983-1987, 1992-2005
Porcupine Cr	12	Mouth to S.Fk. (3.2)	1983-1987, 1992-2005
Rattle Cr	13	Mouth to falls by upper bridge (5.7)	1983-1987, 1992-2005
Savage Cr	14	Mouth to trail 61 crossing (2.0)	1983-1985, 1987, 1992-2005
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, 1992-2005
Trestle Cr[a]	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 bank un-named tributary (0.5 km)	1983-2005
Twin Cr	18	Mouth to River Road (1.5)	1983-1987, 1992-2005
Wellington Cr	19	Mouth to falls (0.5)	1983-1987, 1992-2005

[a] 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 1 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 $\alpha = 0.05$ 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 2000 through 2005 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 1996. We used 1996 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 17 tributaries to LPO, as well as the Clark Fork River spawning channel in 2005. Bull trout redds were also counted in the Middle and North Fk. East River and Uleda Creek, in the Priest River drainage. Redd counts ranged from a low of zero redds in the North Fork East River and Clark Fork River spawning channel, to a high of 200 redds in Gold Creek (Appendix A).

The long-term correlation analysis revealed two statistically significant correlations between year and redd count. Correlations for Granite Creek (tau-b = 0.39; $p = 0.03$) and Gold Creek (tau-b = 0.36; $p = 0.02$) indicated long-term increases in both populations (Table 2). Three out of seven populations monitored in the Lightning Creek drainage also displayed positive correlations, but none were statistically significant. This is an improvement over last year, when only one of seven streams had a positive correlation value.

Table 2. Correlations between year and redd count (trends) for bull trout populations monitored from 1983 through 2005 in tributaries to Lake Pend Oreille, Idaho.

Stream	Number of years	Tau-b correlation	P-value
Char Cr.	18	0.05	0.79
E. Fk. Lightning Cr.	20	-0.07	0.65
Gold Cr.	23	0.36	0.02[a]
Granite Cr.	18	0.39	0.03[a]
Grouse Cr.	21	-0.05	0.74
Johnson Cr.	22	0.09	0.57
Lightning Cr.	18	-0.04	0.82
N. Gold Cr.	23	-0.14	0.34
Pack R.	18	-0.08	0.65
Porcupine Cr.	18	-0.24	0.16
Rattle Cr.	17	0.13	0.46
Savage Cr.	17	0.03	0.86
Sullivan Springs	18	0.18	0.30
Trestle Cr.	22	0.15	0.37
Twin Cr.	18	-0.05	0.76
Wellington Cr.	18	-0.26	0.14

[a] 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 of 5 out of 16 bull trout populations monitored are stable or increasing, while 11 have undergone long-term declines (Table 3).

Examining only the data from 1996 to present to obtain a view of the short-term trends in populations, we find that 14 of the 16 populations evaluated exhibited positive correlation values (Table 4). Of these, six were statistically significant. This suggests that adult escapement is generally increasing in recent years.

Overall, 11 of 16 populations monitored since at least 1992, had redd counts in 2005 equal to or higher than the long-term average annual redd count. An additional three streams were within 25% of the 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 11 years of redd count data.

Stream	**Year**	**Kendall's tau-b**	**P-value**	**Trend conclusion**
Char Cr.	2000	0.16	0.46	
	2001	0.05	0.82	
	2002	-0.02	0.92	
	2003	-0.08	0.68	
	2004	-0.02	0.93	
	2005	0.05	0.79	Decline
EF Lightning	2000	-0.22	0.26	
	2001	-0.22	0.24	
	2002	-0.16	0.37	
	2003	-0.16	0.34	
	2004	0.09	0.60	
	2005	-0.07	0.65	Decline
Gold Cr.	2000	0.22	0.20	
	2001	0.26	0.12	
	2002	0.33	0.04	
	2003	0.34	0.03	
	2004	0.31	0.04	
	2005	0.36	0.02	Stable/Increase
Granite Cr.	2000	0.14	0.50	
	2001	0.03	0.87	
	2002	0.13	0.52	
	2003	0.24	0.20	
	2004	0.33	0.07	
	2005	0.39	0.03	Stable/Increase
Grouse Cr.	2000	-0.13	0.49	
	2001	-0.18	0.32	
	2002	-0.17	0.34	
	2003	-0.14	0.42	
	2004	-0.15	0.36	
	2005	0.05	0.74	Decline
Johnson	2000	-0.13	0.45	
	2001	-0.02	0.91	
	2002	0.04	0.83	
	2003	-0.07	0.67	
	2004	-0.01	0.98	
	2005	0.09	0.57	Decline
Lightning Cr.	2000	-0.37	0.08	
	2001	-0.31	0.12	
	2002	-0.25	0.20	
	2003	-0.2	0.28	
	2004	-0.14	0.43	
	2005	-0.04	0.82	Decline

Table 3. Continued.

Stream	Year	Kendall's tau-b	P-value	Trend conclusion
N. Gold Cr.	2000	-0.23	0.18	
	2001	-0.29	0.08	
	2002	-0.28	0.08	
	2003	-0.3	0.06	
	2004	-0.18	0.25	
	2005	-0.14	0.34	Decline
Pack R.	2000	-0.56	0.01	
	2001	-0.43	0.03	
	2002	-0.36	0.06	
	2003	-0.29	0.11	
	2004	-0.20	0.26	
	2005	-0.08	0.65	Decline
Porcupine Cr.	2000	-0.55	0.01	
	2001	-0.59	0.00	
	2002	-0.62	0.00	
	2003	-0.5	0.01	
	2004	-0.36	0.05	
	2005	-0.24	0.16	Decline
Rattle Cr.	2000	-0.38	0.08	
	2001	-0.17	0.43	
	2002	-0.07	0.74	
	2003	0.04	0.84	
	2004	0.09	0.62	
	2005	0.13	0.46	Stable/Increase
Savage Cr.	2000	-0.43	0.05	
	2001	-0.35	0.09	
	2002	-0.2	0.33	
	2003	-0.11	0.57	
	2004	-0.01	0.96	
	2005	0.03	0.86	Decline
Sullivan Sp.	2000	0.35	0.10	
	2001	0.21	0.29	
	2002	0.21	0.27	
	2003	0.18	0.34	
	2004	0.16	0.36	
	2005	0.18	0.30	Stable/Increase
Trestle Cr.	2000	0.13	0.48	
	2001	0.22	0.20	
	2002	0.31	0.07	
	2003	0.38	0.02	
	2004	0.23	0.14	
	2005	0.15	0.37	Stable/Increase

Table 3. Continued.

Stream	Year	Kendall's tau-b	P-value	Trend conclusion
Twin Cr.	2000	0.08	0.71	
	2001	-0.03	0.87	
	2002	-0.01	0.96	
	2003	-0.08	0.68	
	2004	-0.08	0.68	
	2005	-0.05	0.76	Decline
Wellington Cr.	2000	-0.34	0.11	
	2001	-0.31	0.12	
	2002	-0.29	0.13	
	2003	-0.24	0.20	
	2004	-0.24	0.19	
	2005	-0.26	0.14	Decline

Table 4. Correlations between year and redd count (trends) for bull trout populations monitored from 1996 to 2005 in tributaries to Lake Pend Oreille, Idaho.

Stream	Tau-b correlation	P-value
Char Cr.	0.05	0.86
E. Fk. Lightning Cr.	0.20	0.42
Gold Cr.	0.56	0.03[a]
Granite Cr.	0.33	0.18
Grouse Cr.	0.11	0.65
Johnson Cr.	0.36	0.15
Lightning Cr.	0.63	0.01[a]
N. Gold Cr.	0.21	0.41
Pack R.	0.69	0.01[a]
Porcupine Cr.	0.67	0.01[a]
Rattle Cr.	0.54	0.03[a]
Savage Cr.	0.74	0.00[a]
Sullivan Springs	-0.23	0.36
Trestle Cr.	0.11	0.66
Twin Cr.	-0.34	0.17
Wellington Cr.	0.12	0.64

[a] Denotes statistical significance

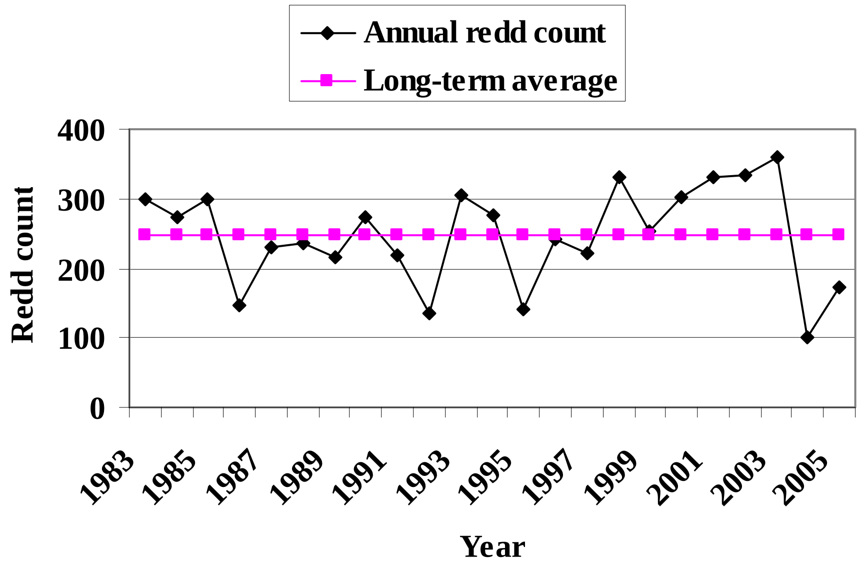

Figure 2. Annual Trestle Creek bull trout redd counts and average redd count, 1983 through 2005, Lake Pend Oreille, Idaho.

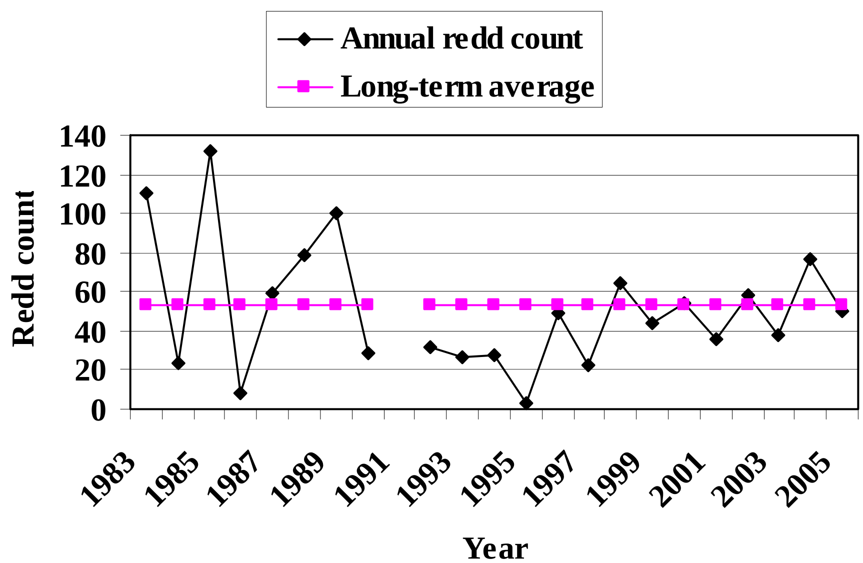

Figure 3. Annual East Fork Lightning Creek bull trout redd counts and average redd count, 1983 through 2005, Lake Pend Oreille, Idaho.

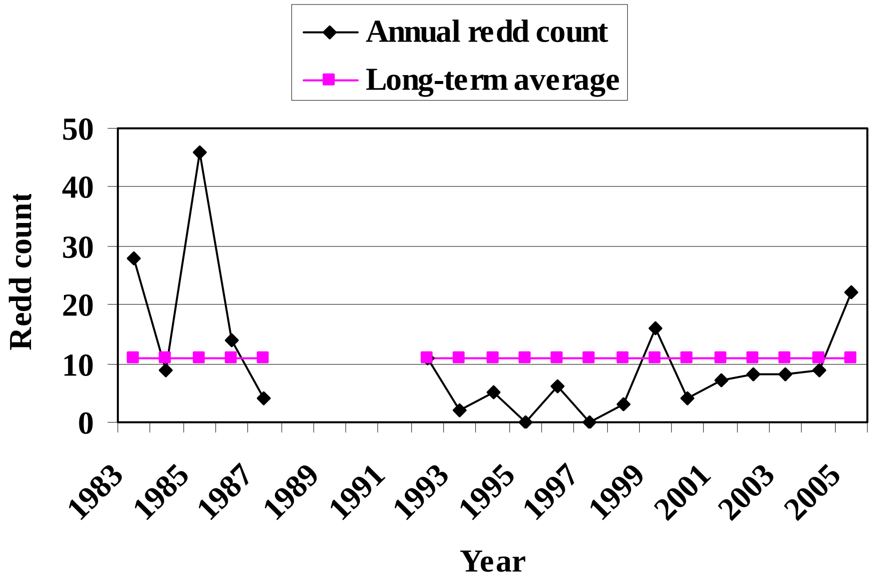

Figure 4. Annual Lightning Creek, a tributary to the Clark Fork River, Idaho, bull trout redd counts and average redd count, 1983 through 2005.

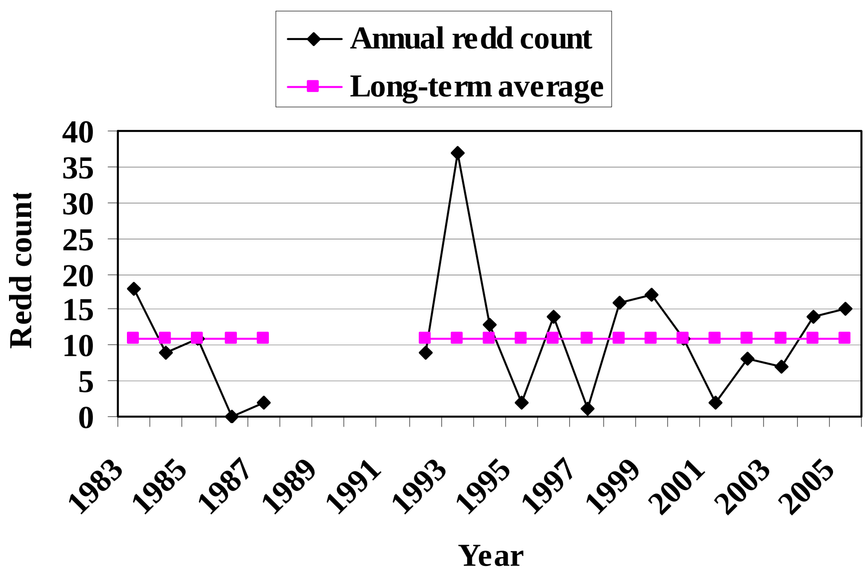

Figure 5. Annual Char Creek, a tributary to Lightning Creek, bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2005, Lake Pend Oreille, Idaho.

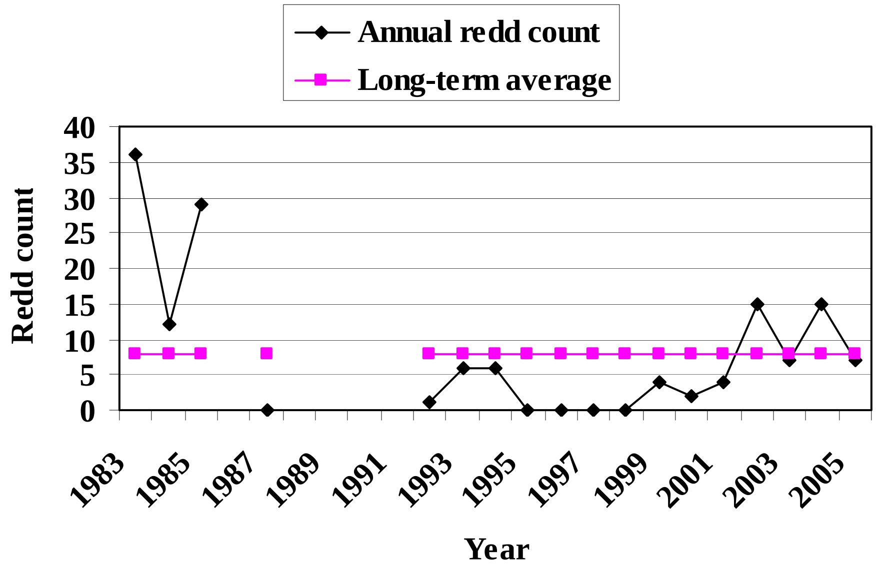

Figure 6. Annual Savage Creek, a tributary to Lightning Creek, bull trout redd counts and average redd count, 1983 through 1985, 1987, and 1992 through 2005, Lake Pend Oreille, Idaho.

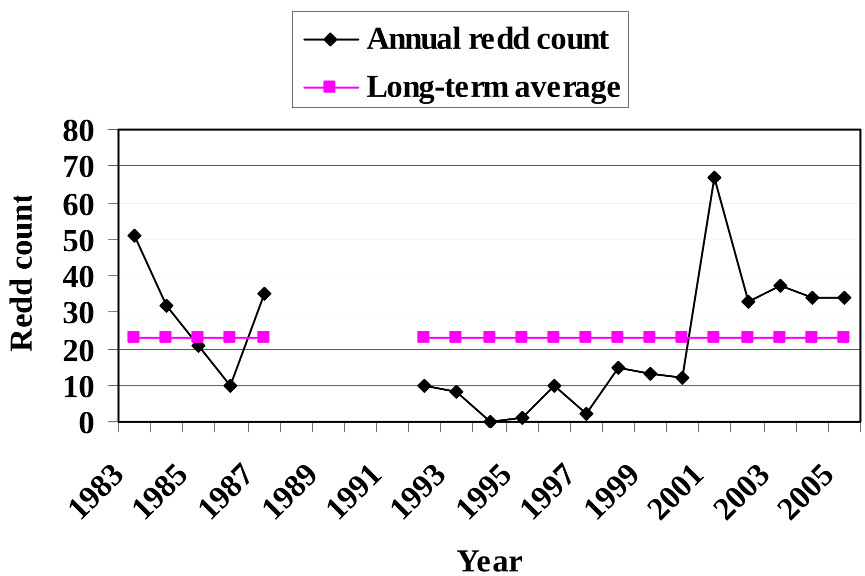

Figure 7. Annual Rattle Creek, a tributary to Lightning Creek, bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2005, Lake Pend Oreille, Idaho.

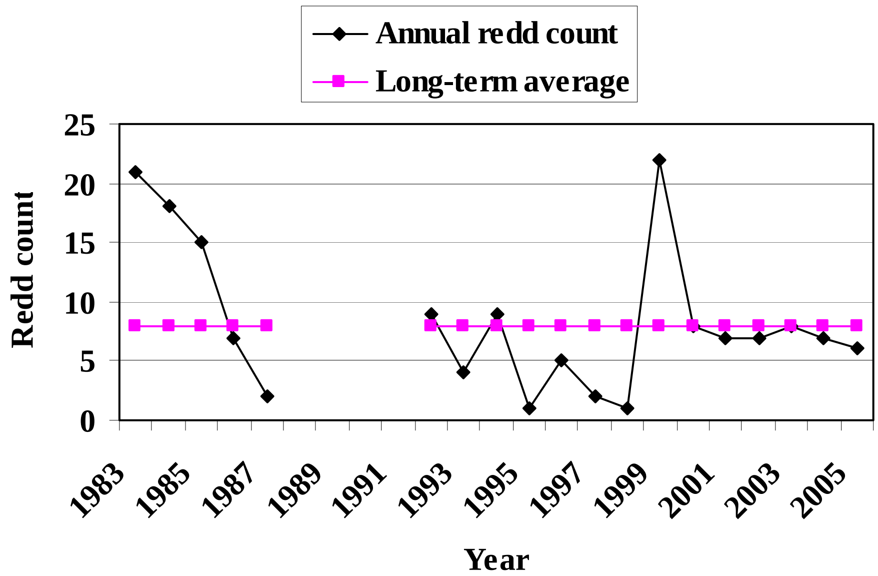

Figure 8. Annual Wellington Creek, a tributary to Lightning Creek, bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2005, Lake Pend Oreille, Idaho.

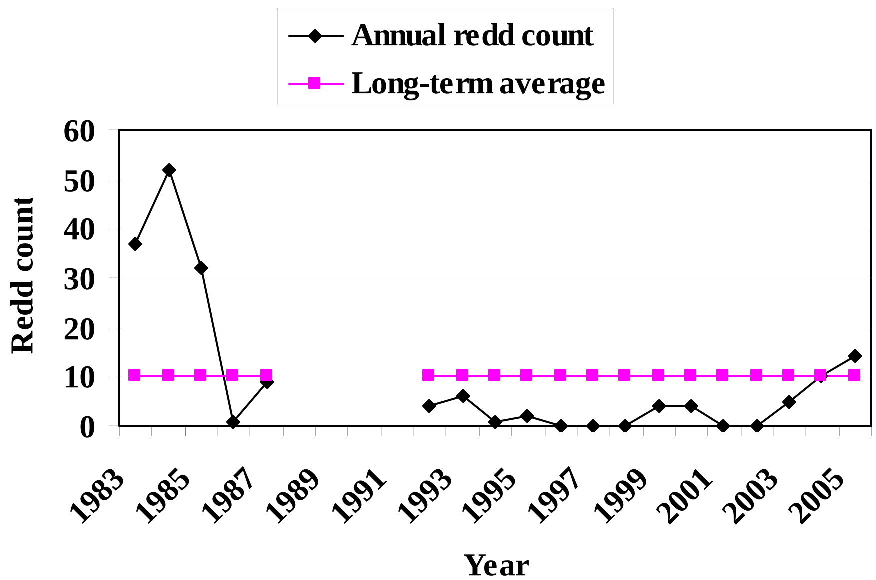

Figure 9. Annual Porcupine Creek, a tributary to Lightning Creek, bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2005, Lake Pend Oreille, Idaho.

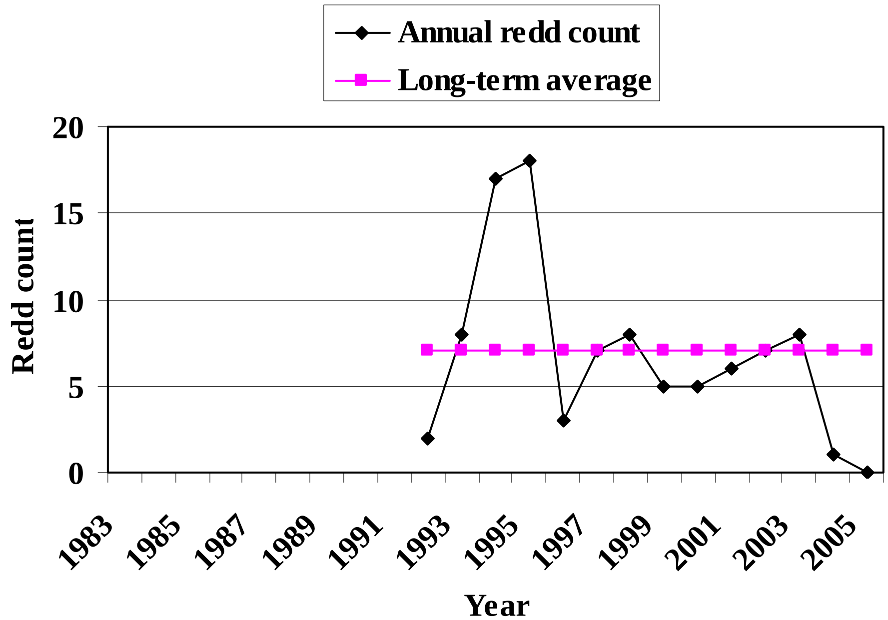

Figure 10. Annual Clark Fork River (Cabinet Gorge Fish Hatchery spawning channel) bull trout redd counts and average redd count, 1992 through 2005, Lake Pend Oreille, Idaho.

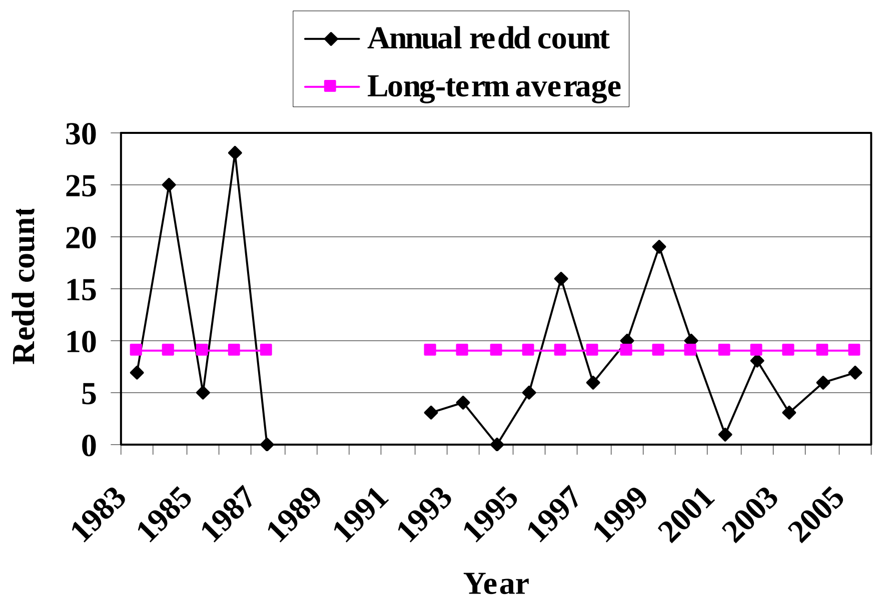

Figure 11. Annual Twin Creek, a tributary to the Clark Fork River, Idaho, bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2005.

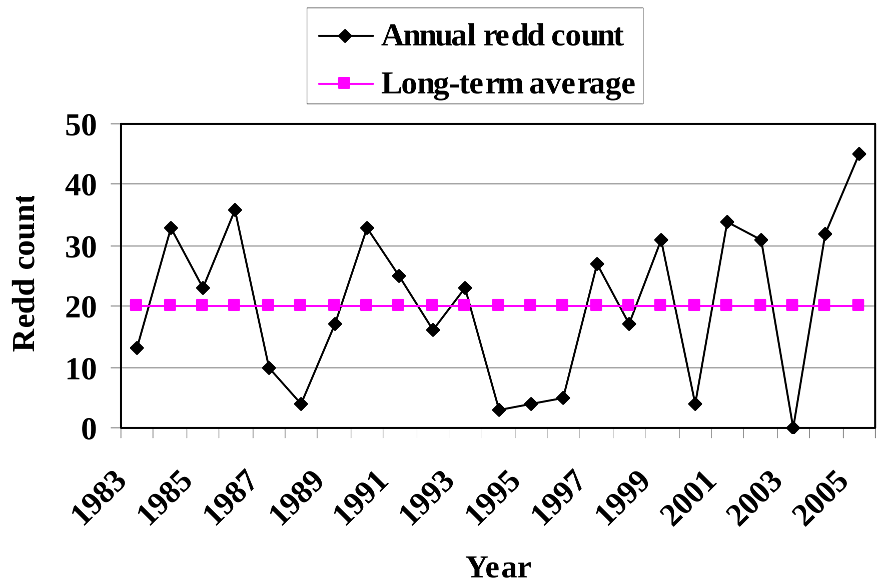

Figure 12. Annual Johnson Creek, a tributary to the Clark Fork River, Idaho, bull trout redd counts and average redd count, 1983 through 2005.

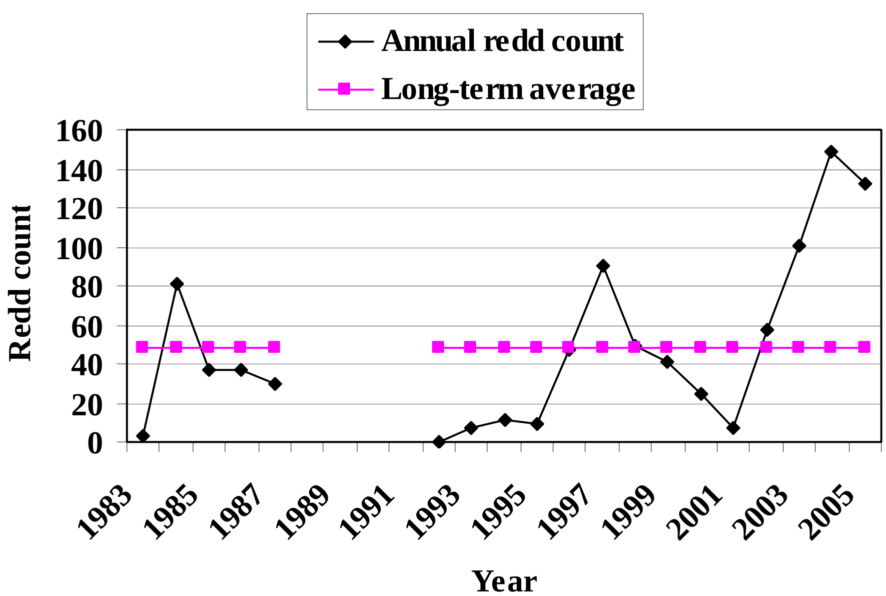

Figure 13. Annual Granite Creek bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2005, Lake Pend Oreille, Idaho.

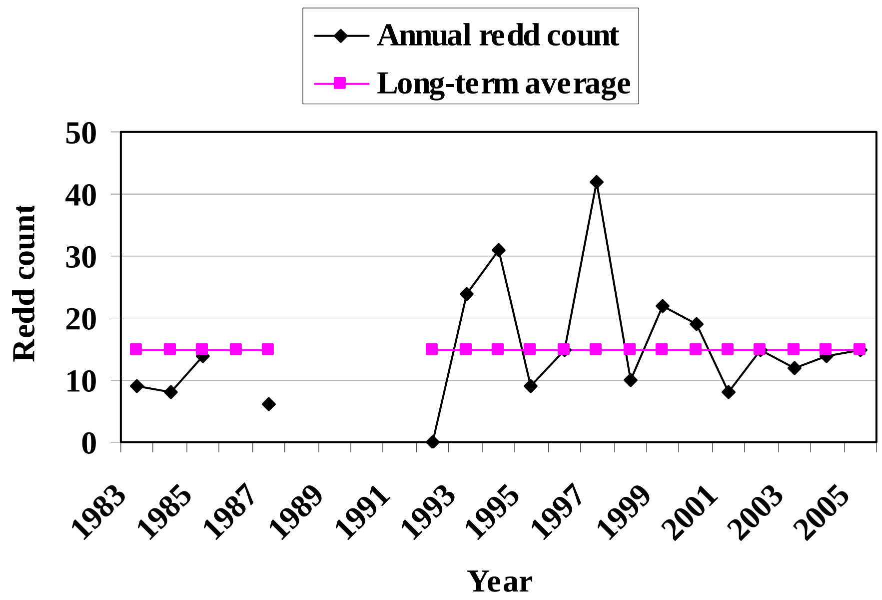

Figure 14. Annual Sullivan Springs Creek bull trout redd counts and average redd count, 1983 through 1985, 1987, and 1992 through 2005, Lake Pend Oreille, Idaho.

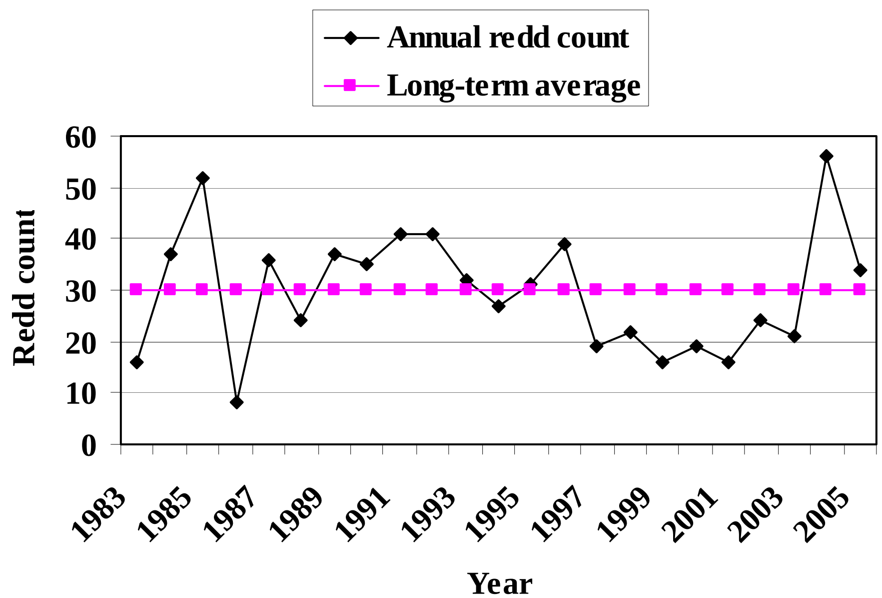

Figure 15. Annual N. Gold Creek bull trout redd counts and average redd count, 1983 through 2005, Lake Pend Oreille, Idaho.

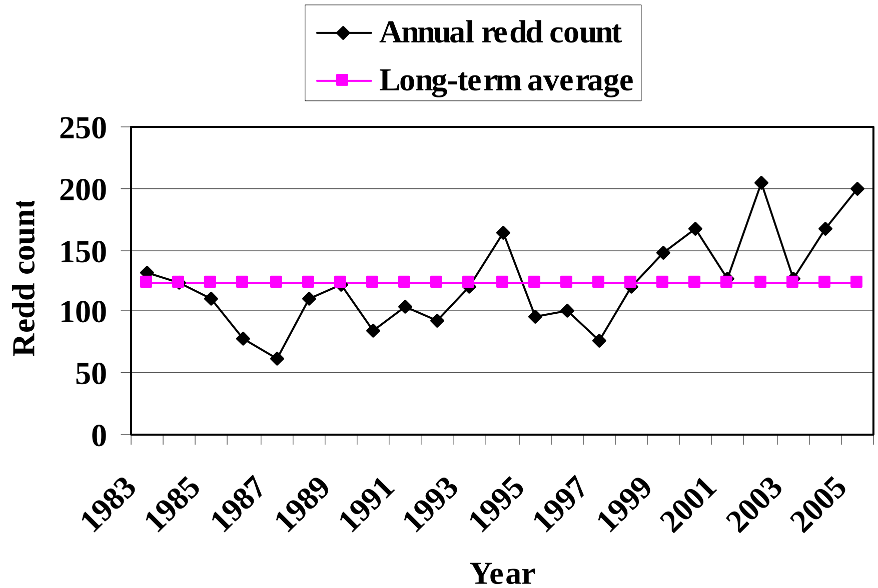

Figure 16. Annual Gold Creek bull trout redd counts and average redd count, 1983 through 2005, Lake Pend Oreille, Idaho.

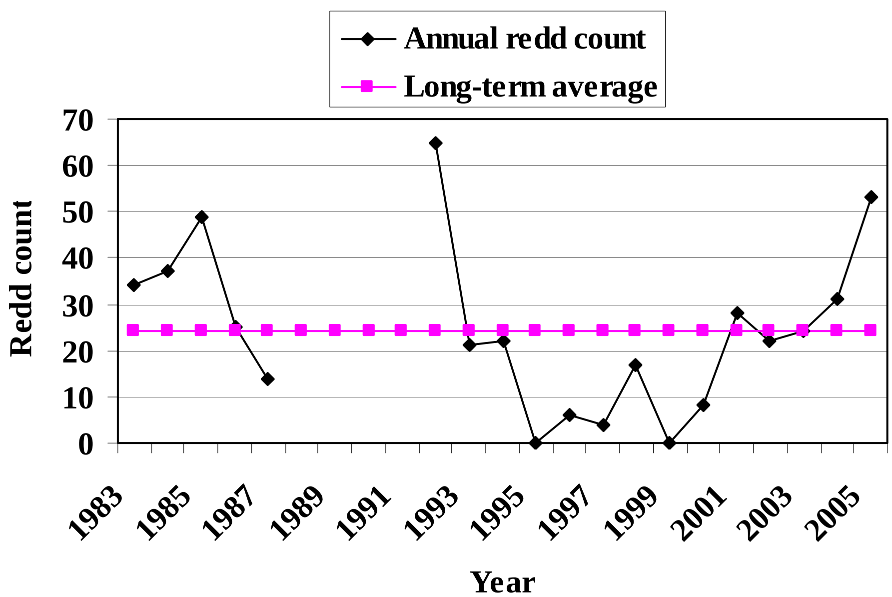

Figure 17. Annual Pack River bull trout redd counts and average redd count, 1983 through 1987, and 1992 through 2005, Lake Pend Oreille, Idaho.

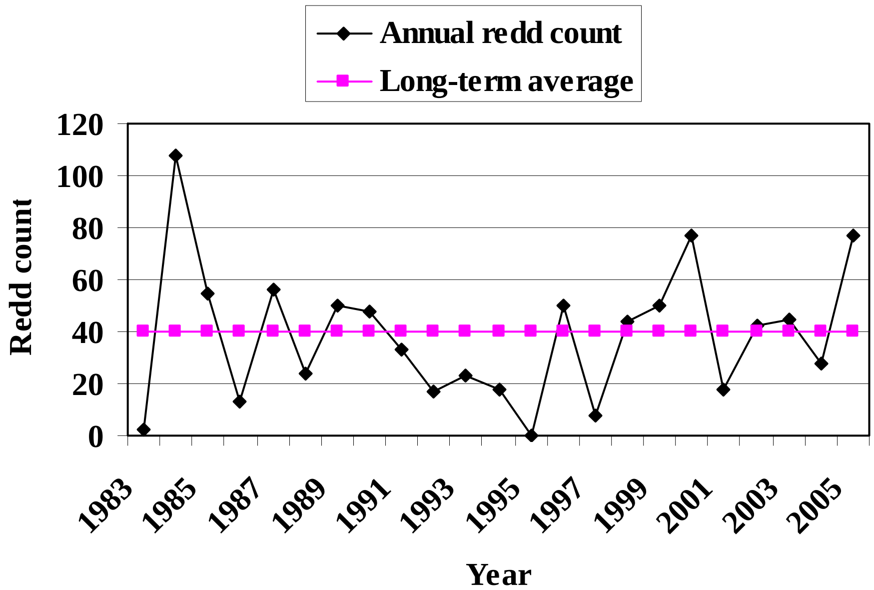

Figure 18. Annual Grouse Creek bull trout redd counts and average redd count, 1983 through 2005, Lake Pend Oreille, Idaho.

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 2005 redd count for these six streams combined (580) is higher than the long-term average of 508 redds. Total redd count numbers in the "index streams" declined drastically in 2004, but rebounded in 2005. The apparent decline in 2004 was driven by a very low count in Trestle Creek, which due to its large spawning run, has a large influence over this pooled count. The redd count in Trestle Creek in 2005 was an improvement over 2004, but remained well below the long-term average of 248 redds. Qualitatively, it appears as though bull trout spawning activity has declined throughout Trestle Creek, but most noticeably in the downstream half of the spawning area. Recent electrofishing surveys support this observation with relatively low densities of juvenile bull trout ($\geq$ 75 mm), estimated at 1.0 and 0.7 fish/100m^2 in the two abundance monitoring sections in the lower half of the spawning area (see Tributary Fish Population Monitoring Progress Report in this report). This compares to 14 fish/100m^2 in the upstream most monitoring section on Trestle Creek. Previous estimates of total annual juvenile bull trout outmigration from Trestle Creek (Downs and Jakubowski 2003) have averaged approximately 1,250 age-1 and older individuals from 2000 through 2002. To date, uncorrected return rates of marked juvenile bull trout to Trestle Creek have been approximately 11%. Therefore we could expect approximately 138 adults to return from each outmigration class. Our previous estimates of minimal annual survival of adult bull trout (Downs and Jakubowski 2005) have ranged from 38 to 61%. Using an average annual survival rate of 50% for repeat spawning adults combined with the outmigration and juvenile survival estimates, we would expect an annual spawning run of approximately 270 adult bull trout in Trestle Creek under current juvenile outmigration numbers. We captured a total of 106 adult bull trout in our downstream weir in September 2005, supporting this estimate. For comparison, we captured 635 adults in the downstream weir during the same time period in 2000. Clearly there has been a significant reduction in adult bull trout escapement in Trestle Creek from 2000 to 2005.

The reduction in adult escapement does not appear to be the result of changes in the rearing environment for juveniles in the lake because we have seen record or near record adult escapement, as evidenced by redd counts, in other tributaries in recent years. Annual survival of adults doesn't appear to be the primary factor, as changes in adult repeat spawner estimated annual survival aren't large enough to account for the dramatic reduction observed. Our initial juvenile trapping efforts on Trestle Creek in 2000 through 2002 utilized rotary screw trapping techniques and we did not observe significant injury or mortality we could attribute to the trapping method. Screw traps are widely recognized as an appropriate live-trapping technique for juvenile salmonids, including bull trout. We did observe dead or moribund juvenile bull and westslope cutthroat trout *Oncorhynchus clarki lewisi* in our catch in the spring of each of our trapping years (Downs and Jakubowski 2003). Water quality and disease samples were collected to search for the cause, but we did not detect anything unusual and ultimately attributed the dead and moribund fish to natural overwinter mortality being sampled by our screw trap as fish began to emerge from winter habitats (Downs and Jakubowski 2003). On some spring days, a substantial proportion of our catch was in this condition. Our remote PIT tag weir could have had an effect on adults entering Trestle Creek to spawn and impacted total spawning activity, but we have been running similar traps on Granite Creek (an east shore tributary to Lake Pend Oreille) for the past several years and have observed steady increases in redd counts in that tributary. It would appear that total outmigration of age-1 and older juvenile bull trout is driving the adult escapement levels. We speculate that age-1 and older juvenile outmigration numbers must have been considerably larger in the years prior to our sampling to account for annual adult escapements estimated at over 1,100 adults in 1998 and 2000 (Dunham et al. 2001, Downs et al. 2003). The low escapement we observed in 2004 and 2005 would have been progeny produced in Trestle Creek in the mid to late 1990's. Many factors may influence year class strength in streams (and eventual outmigration numbers). These would include differences in water years, rain-on-snow scour impacts on bull trout redds or overwintering juveniles, or tributary habitat degradation. Water year impacts or rain-on-snow would be expected to affect other tributaries as well (i.e. Lightning Creek tributaries), and we did not see similar reductions in bull trout redd counts in streams such as the E. Fk. Lightning and Rattle creeks. In contrast, we have seen very strong redd counts in other streams such as Granite and Gold creeks. Development pressure has been increasing in lower Trestle Creek over the past decade, and incremental changes in habitat conditions in the lower portion of the watershed over time may be playing a role in the reduced escapement observed in Trestle Creek. The observed declines in adult bull trout escapement in Trestle Creek are not unprecedented, as low redd counts have been followed by increasing trends and extremely high redd counts in this stream over time. Continued monitoring will be needed to determine if we are seeing a long-term downward trend in the Trestle Creek population, or some cyclic occurrence that will eventually lead the stream back to a larger population.

Trestle and Gold creeks have a large influence on the total number of redds counted in the entire LPO system. From 1983 to 2005, Trestle and Gold creeks together accounted on average for the majority (73%) of the total number of redds counted in the six index streams annually. Trend 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 bull trout in LPO. This is the approach taken in The Lake Pend Oreille Bull Trout Conservation Plan (PBTAT 1998). Over the length of the full data set, 11 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 (14 of 16) had positive correlation values. Six of these were statistically significant, indicating stable or increasing trends.

We identified two statistically significant correlations (trends) at the $\alpha = 0.05$ 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). These two streams, Gold and Granite creeks, have increasing redd count trends. 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. Granite Creek has been impacted in recent years by an intermittent reach of stream and head cut barrier, blocking late season access to the primary spawning area. Avista and IDFG initiated a trap and haul program as an interim solution which was very successful in increasing spawning activity. In 2005, Avista funded and implemented a cooperative restoration effort on Granite Creek involving IDFG, U.S. Forest Service, Trout Unlimited, and the USFWS to restore the impaired reach of Granite Creek. The stream channel restoration project is intended to restore connectivity, the primary reason for the declines in bull trout escapement observed in Granite Creek from 1997 to 2001.

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 et al. 1999). Assessing and addressing the cause for the bull trout decline in the Porcupine and Savage creek drainages, 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. 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.Fk. 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 some 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 five years have averaged 32. 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 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 appears to be 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; ten in 2005), and exceeded the threshold population size established in the Plan of 2,500 adults (estimated at 3,008 in 2005). 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. 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 be 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 *Salvelinus namaycush* 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 bull trout persistence in the LPO 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 remove lake trout in LPO are currently underway.

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APPENDICES

Appendix A. Annual bull trout redd counts (1983-2005) for tributaries to Lake Pend Oreille, Idaho.

Table A.1. Bull trout redd counts for Lake Pend Oreille, Idaho, basin tributaries, 1983-2005.

Stream	**1983[g,k]**	**1984[g]**	**1985[i]**	**1986[h]**	**1987[h,k]**	**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	0[b]
E. F. Lightning Cr.	110	24	132	8[j]	59	79	100	29	--	32	27	28	3[b]
Savage Cr.	36	12	29	--	0	--	--	--	--	1	6	6	0[b]
Char Cr.	18	9	11	0	2	--	--	--	--	9	37	13	2[b]
Porcupine Cr.	37[j]	52	32	1[j]	9	--	--	--	--	4	6	1	2[b]
Wellington Cr.	21	18	15	7	2	--	--	--	--	9	4	9	1[b]
Rattle Cr.	51	32	21	10[j]	35	--	--	--	--	10	8	0	1[b]
Johnson Cr.	13	33	23	36	10	4	17	33	25	16	23	3	4[b]
Twin Cr.	7	25	5	28	0	--	--	--	--	3	4	0	5[b]
Morris Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--
North Shore													
Trestle Cr.	298	272	298	147	230	236	217	274	220	134	304	276	140[b]
Pack River	34	37	49	25	14	--	--	--	--	65	21	22	0[b]
Grouse Cr.	2[j]	108	55	13[j]	56	24	50	48	33	17	23	18	0[b]
Strong Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--
East Shore													
Granite Cr.	3	81	37	37	30[j]	--	--	--	--	0	7	11	9[b]
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	111	78	62	111	122	84	104	93	120	164	95
Lower Priest R.													
M.F. East River	--	--	--	--	--	--	--	--	--	--	--	--	--
N.F. East River	--	--	--	--	--	--	--	--	--	--	--	--	--
Uleda Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--
Total 6 index streams[d]	570	598	671	290	453	478	543	503	423[a]	333	529	516	273[b]
Total of all streams	814	881	930	412	555	478	543	503	423[a]	447	656	631	320[b]

Table A.1. Continued.

Stream	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Clark Fork R.	3	7	8	5	5	6	7	8	1	0
Lightning Cr.	6	0	3	16	4	7	8	8	9	22
E. Fk. Light. Cr.	49	22	64	44	54	36	58	38	77	50
Savage Cr.	0	0	0	4	2	4	15	7	15	7
Char Cr.	14	1	16	17	11	2	8	7	14	15
Porcupine Cr.	0	0	0	4	4	0	0	5	10	14
Wellington Cr.	5	2	1	22	8	7	7	8	7	6
Rattle Cr.	10	2	15	13	12	67	33	37	34	34
Johnson Cr.	5	27	17	31	4[c]	34	31	0	32	45
Twin Cr.	16	6	10	19	10	1	8	3	6	7
Morris Cr.	--	--	--	1	1	0	7	1	1	3
North Shore										
Trestle Cr.	243	221	330	253	301	335[e]	333[e]	361	102[b]	174
Pack River	6	4	17	0	8	28	22	24	31	53
Grouse Cr.	50	8	44	50	77	18	42	45	28	77
Strong Cr.	2	--	--	--	--	--	0	--	0	--
East Shore										
Granite Cr.	47	90[f]	49	41	25	7	57	101	149	132
Sullivan Springs	15	42	10	22	19	8	15	12	14	15
North Gold Cr.	39	19	22	16	19	16	24	21	56	34
Gold Cr.	100	76	120	147	168	127	203	126	167	200
Lower Priest R.										
M.F. East River	--	--	--	--	--	4[k]	8[k]	21	20	48
N.F. East River	--	--	--	--	--	--	--	--	1	0
Uleda Cr.	--	--	--	--	--	3[k]	4[k]	3	7	4
6 index streams[d]	486	373	597	541	623	566	691	591	462	580
Total of all streams	610	527	726	705	732	710	890	836	781	940

Table A.1. Continued.

[a] Represents a partial count due to early snow fall because E. Fk. Lightning was not counted.
[b] Observation conditions impaired by high runoff.
[c] Head-cut barrier prevented access to most of the spawning area.
[d] Index streams include Gold, N. Gold, Trestle, Johnson, Grouse, and E. Fk. Lightning creeks.
[e] 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.
[f] Three additional redds observed in Dry Gulch.
[g] Data from Pratt (1985).
[h] Data from Hoelscher and Bjornn (1989).
[i] Data from Irving (1986).
[j] Partial survey and count of varying amounts. See Pratt (1985) and Holescher and Bjornn (1989) for details.
[k] Partial counts.

2005 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 cubic-feet-per-second) to 141.5 cms (5,000 cfs) in the Clark Fork River, Idaho. Mark-recapture population estimates were conducted in the fall of 2005 to estimate the abundance of rainbow *Oncorhynchus mykiss* and westslope cutthroat trout *O. clarki lewisi*. We estimated 127 rainbow and 170 westslope cutthroat trout greater than 200 mm total length in the study reach during the fall sampling period in 2005. 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 *Oncorhynchus 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 rainbow and westslope cutthroat trout in the fall of 2005 of 64 and 65, respectively. This indicates a large majority of the electrofishing catch was greater than 305 mm. We sampled Foster Bar side-channel in 2003 through 2005 with backpack electrofishing equipment, as well as electrofishing with a jet boat in 2005, in response to a habitat enhancement project to restore perennial flow to the side-channel. The only salmonid species captured in the side-channel with backpack electrofishing equipment was juvenile brown trout *Salmo trutta*, and we captured a total of three individuals. We also captured three non-salmonid species of juvenile fish (northern pikeminnow *Ptychocheilus oregonensis*, redside shiner *Richardsonius balteatus* and largescale sucker *Catostomus macrocheilus*), plus unidentified juvenile sucker *Catostomus sp*. While electrofishing with the jet boat we were able to capture eight species of fish, plus a single westslope X rainbow trout hybrid, with three of the eight species being salmonids.

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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 1).

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 flow was negotiated for Cabinet Gorge Dam as part of the relicensing agreement, which increased the base flow from 84.9 cms (3,000 cfs) to 141.5 cms (5,000 cfs) (Avista 1999). Cabinet Gorge Dam is operated as a "peaking" facility, and daily flow fluctuations ranged from 84.9 cms (3,000 cfs) to 1,010.3 cms (35,700 cfs) 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 Clark 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 salmonid species in the overall assessment are brown trout *Salmo trutta*, mountain whitefish *Prosopium williamsoni*, rainbow trout *Oncorhynchus mykiss*, and westslope cutthroat trout *O. clarki lewisi*. In addition, catch-per-unit-effort (CPUE) 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 non-salmonid species resulting from the increase in minimum flow.

In addition to enhancing minimum flows in the Clark Fork River, Avista and the Idaho Department 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 within the side-channel so that water would flow through the side-channel over the range of discharges from Cabinet Gorge Dam. Until the relicensing, when discharge from Cabinet Gorge Dam dropped below approximately 311.3 cms (11,000 cfs) (84.9 cms (3,000 cfs) 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 (11,000 cfs) again.

STUDY AREA

The Clark Fork River is the largest tributary to Lake Pend Oreille, contributing an estimated 92% of the annual inflow (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 from the USGS gauging station below Cabinet Gorge Dam downstream to the inlet of Foster side-channel (approximately river km 234 – 241) (Figure 1). There is approximately 17 km of river habitat between Cabinet Gorge Dam and Lake Pend Oreille. 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 streamflow through the side-channel is greatly slowed.

METHODS

Population Estimates and Catch-Per-Unit-Effort

Mark-recapture population estimates were conducted in the fall of 2005 for rainbow and westslope cutthroat trout (target species) greater than 200 mm total length (TL) in the approximately 6.6 km long study reach of the Clark Fork River. 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 km), using a laser range-finder. 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 cms (35,000 cfs)), 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 2005, we conducted our marking runs from October 18 through October 27 (six nights total), and our recapture runs from November 1 through November 3.

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-15 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 150-250 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 six-night period in the first and second week of sampling, and the “recapture” period was conducted over a three-night period the following week. The “marking” period was extended an additional week due to inconsistencies with differentiating between westslope cutthroat trout and possible hybrids. 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). We dip netted all fish encountered on one complete pass down each bank of the river during the recapture run to estimate CPUE for all species encountered.

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 fall sampling. We used these data to conduct the mark-recapture population estimates for rainbow and westslope cutthroat trout, and also to estimate CPUE for all salmonids encountered along both banks on the first night of fall sampling, over the entire study reach. However, only one electrode “boom” was used for two of the three sections along one bank on the first night of electrofishing, due to broken equipment. 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 1 g on a digital scale, measured (total length (TL), mm), marked with a fin clip, and released. Any captured bull trout *Salvelinus confluentus*, and westslope cutthroat trout were also scanned for the presence of a Passive Integrated Transponder (PIT) tag.

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

$$N = ((M+1)(C+1)/(R+1)) - 1 \qquad (1)$$

Where: N = Estimated population

M = Number of individuals marked in the first sample

C = 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).

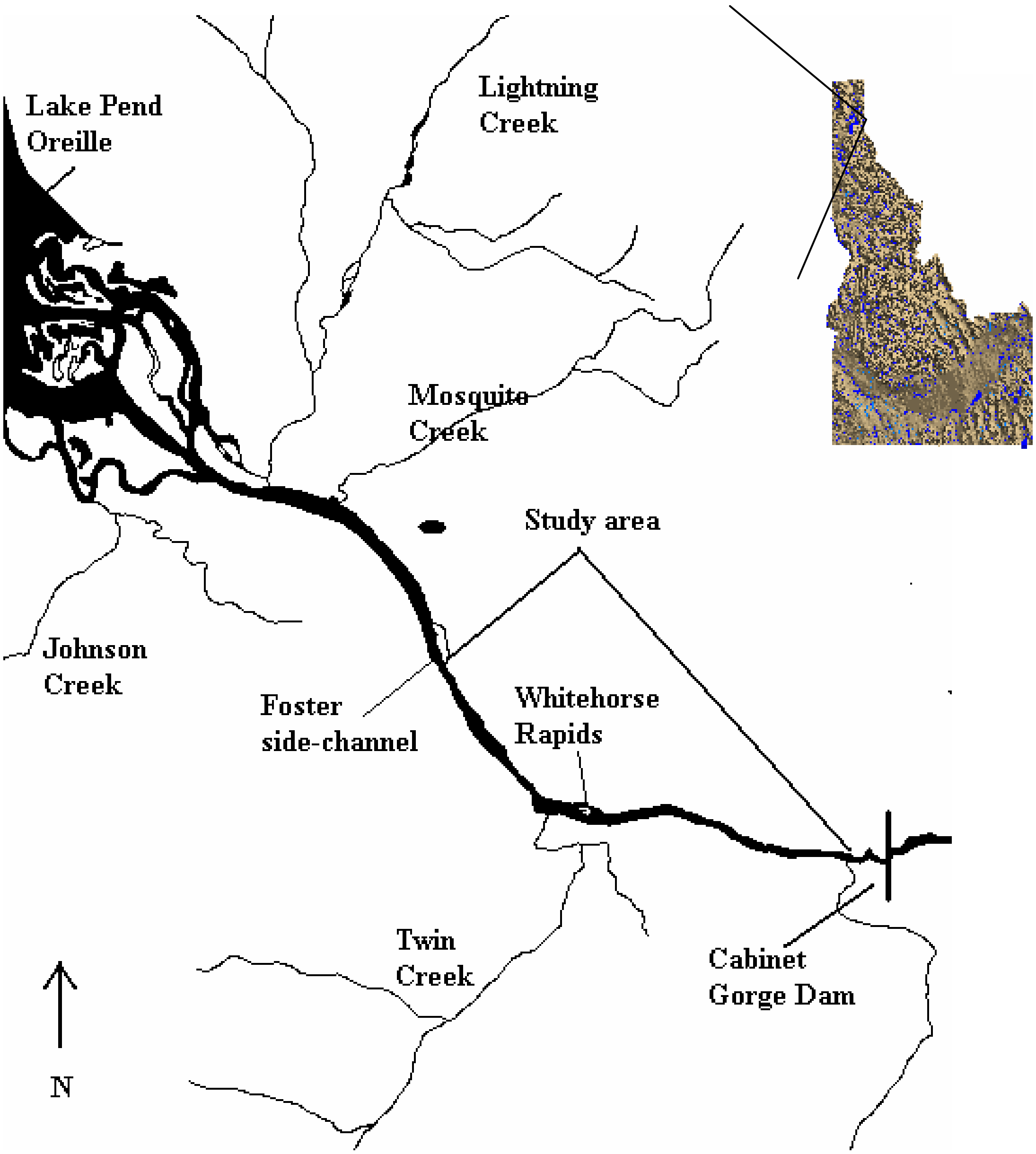

Figure 1. Fishery evaluation study area on the Clark Fork River, a tributary to Lake Pend Oreille, Idaho.

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 vitreus* (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 during lower flows for the presence of juvenile salmonids. Backpack electrofishing equipment was selected to sample these areas for juvenile salmonids during lower flows due to sampling efficiency considerations. We sampled July 7 and 8, 2005. Flows during this time were 32,810 and 21,480 cfs, respectively. We sampled six sections located along the longitudinal gradient of the stream channel (Figure 2). Two of the six sections were the same as in 2003 and 2004, while four new sections were added to better represent the entire channel. 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 at 40 htz. pulse frequency. We recorded time and distance sampled to estimate CPUE. All fish were anesthetized, identified to species, measured, weighed and released. In 2005, we also conducted boom-type electrofishing with a jet boat down the right (North) bank, along the entire reach of the primary side-channel during higher flows when adults were more likely to be utilizing the channel. The upstream portion of the channel from its' inlet off of the Clark Fork River downstream to the top of the secondary channel on the right bank was sampled on May 5, 2005. The downstream portion of the main channel, from the top of the secondary channel on the right bank downstream to the confluence with the Clark Fork River was sampled on May 10, 2005. Electrofishing settings used on the Coffelt VVP-15 electroshocker were set to generate approximately 7.5 amps at 200 volts. The same fish handling protocols used while backpack electrofishing the side-channel were followed, and time was recorded to estimate CPUE.

RESULTS

Population Estimates and Catch-Per-Unit-Effort

We estimated 118 rainbow and 170 westslope cutthroat trout greater than 200 mm total length occupied the study reach during the fall sampling period in 2005 (Table 1). We captured a total of 11 westslope cutthroat X rainbow trout hybrids greater than 200 mm total length and included them in with the rainbow trout population estimate. CPUE for all salmonids captured during the first night of the marking run reflected a dominance by brown trout (Table 2). Lake trout *Salvelinus namaycush* were the rarest fish in our catch based on CPUE.

We captured 16 species of fish during the fall 2005 sampling period (Table 3). CPUE for all fish species combined, sampled during the recapture run, was highest for northern pikeminnow *Ptychocheilus oregonensis* in the fall of 2005. Bull trout and longnose sucker *Catostomus catostomus* were the rarest fish in our catch based on CPUE during the recapture run (Table 3). We also captured a total of 16 fish identified as westslope cutthroat X rainbow trout hybrids (mean TL; mm = 323.2; range = 187-473; S.D. = 63.0) over the entire study period.

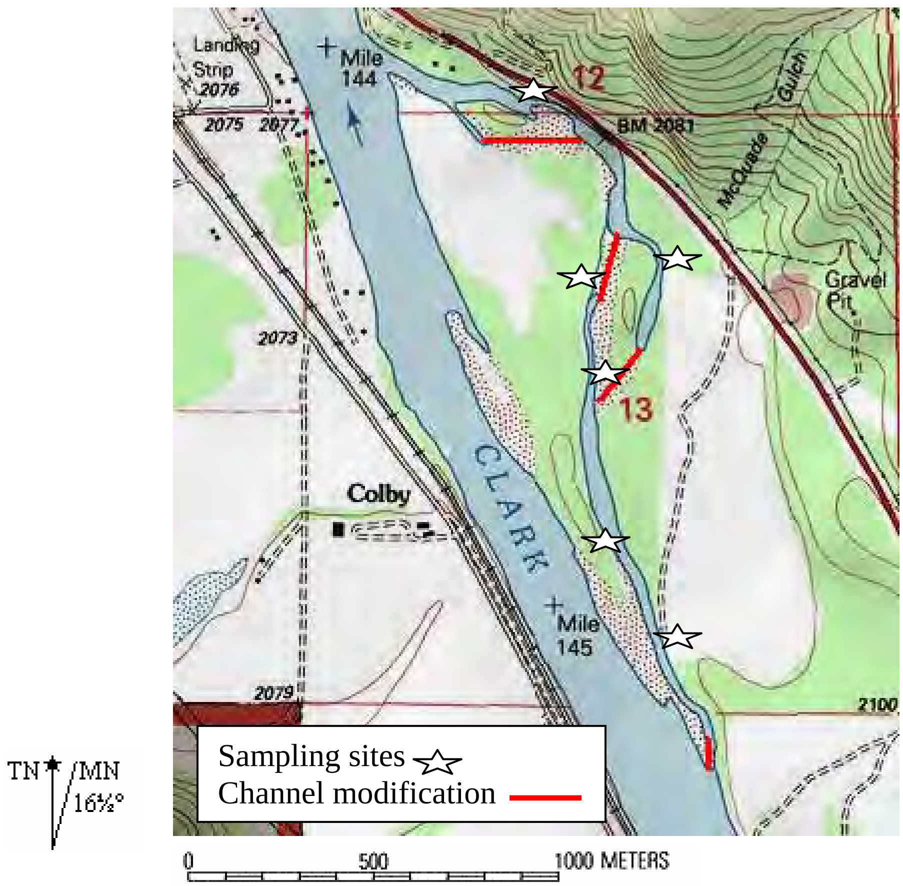

Figure 2. Locations of the six backpack sampling sections in Foster Bar side-channel as well as areas of channel modification to achieve perennial flow through the side-channel over the operational discharges from Cabinet Gorge Dam.

Table 1. Population estimate statistics for westslope cutthroat (Wct), and rainbow trout (Rbt) and rainbow trout X westslope cutthroat trout hybrids >200 mm captured in the 6.6 km study reach of the Clark Fork River, Idaho, below Cabinet Gorge Dam, during the third and fourth weeks of October and first week of November, 2005.

Species	**M**	**C**	**R**	**Population estimate**	**Lower 95% CI**	**Upper 95% CI**
Wct	30	21	3	170	82	993
Rbt/hybrids	50	19	7	127	81	309

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 October 2005.

Species	**Number captured**	**Time electrofished (minutes)**	**CPUE (fish/minute)**	**CPUE (fish/1000 m)**
Brown trout	28	304.28	0.09	2.12
Kokanee[a]	4	304.28	0.01	0.30
Lake trout	3	304.28	<0.01	0.23
Lake whitefish[b]	17	304.28	0.06	1.29
Mountain whitefish	25	304.28	0.08	1.89
Rainbow trout	12	304.28	0.04	0.91
Westslope cutthroat trout	9	304.28	0.03	0.68

[a]Kokanee *Oncorhynchus nerka*
[b]Lake whitefish *Coregonus clupeaformis*

Population Size Structure and Condition

During the report period, average length-at-capture across all salmonid species ranged from 327 mm for westslope cutthroat trout to 643.9 mm for lake trout (Table 4; Figures 3 through 9). PSD's (proportion of catch > 305 mm) for the target salmonid species ranged from 64 for rainbow trout to 88 for mountain whitefish. QSD's (proportion of the catch > 406 mm) ranged from 2 for westslope cutthroat trout to 48 for brown trout across the target salmonid species (Table 5). PSD (proportion of catch > 400 mm) for walleye was 100, and QSD (proportion of catch > 500 mm) was 67. Estimated relative weight (*Wr)* for westslope cutthroat and rainbow trout was 82.6 and 94.7, respectively. Average total lengths for non-salmonid species captured ranged from 105.2 mm for redside shiners to 538.3 mm for walleye (Table 6).

Table 3. Catch Per Unit Effort (CPUE) for all species captured over 344.3 minutes of electrofishing along both banks of the 6.6 km study reach in the Clark Fork River, Idaho, during the fall, 2005 recapture run.

Species	**Scientific name**	**Number captured**	**CPUE (fish/minute)**
Brown trout	Salmo trutta	19	0.055
Bull trout	Salvelinus confluentus	1	0.003
Kokanee[a]	Oncorhynchus nerka	0	0.000
Lake trout	Salvelinus namaycush	2	0.006
Lake whitefish	Coregonus clupeaformis	19	0.055
Largescale sucker	Catostomus macrocheilus	98	0.285
Longnose sucker	Catostomus catostomus	1	0.003
Mountain whitefish	Prosopium williamsoni	19	0.055
Northern pikeminnow	Ptychocheilus oregonensis	330	0.958
Peamouth	Mylocheilus caurinus	117	0.340
Rainbow trout	Oncorhynchus mykiss	7	0.020
Redside shiner	Richardsonius balteatus	26	0.076
Smallmouth bass	Micropterus dolomieui	4	0.012
Walleye	Sander vitreus	0	0.000
Westslope cutthroat trout	Oncorhynchus clarki lewisi	5	0.015
Yellow perch	Perca flavescens	3	0.009

[a]No effort made to capture kokanee due to extreme numbers

Table 4. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for salmonid species inhabiting the 6.6 km long study reach on the Clark Fork River, Idaho, during the marking and recapture runs, combined, in fall, 2005.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
Bull trout	546.0 (134.4) (9)	301-753	1,623.3 (1033.6) (9)
Brown trout	417.1 (122.9) (193)	197-864	914.4 (1165.3) (188)
Kokanee	368.3 (97.8) (4)	289-500	495.0 (324.3) (4)
Lake trout	643.9 (176.9) (13)	439-893	3,471.2 (2900.3) (13)
Lake whitefish	427.5 (24.8) (51)	374-493	746.8 (197.3) (50)
Mountain whitefish	340.1 (45.2) (244)	179-455	399.8 (124.5) (240)
Rainbow trout[a]	342.9 (82.6) (64)	223-556	457.7 (330.3) (64)
Westslope cutthroat trout	327.0 (37.4) (49)	247-412	345.1 (126.8) (48)

[a]Does not include one Gerrard strain “kamloop” rainbow trout 746 mm, 5,240 g

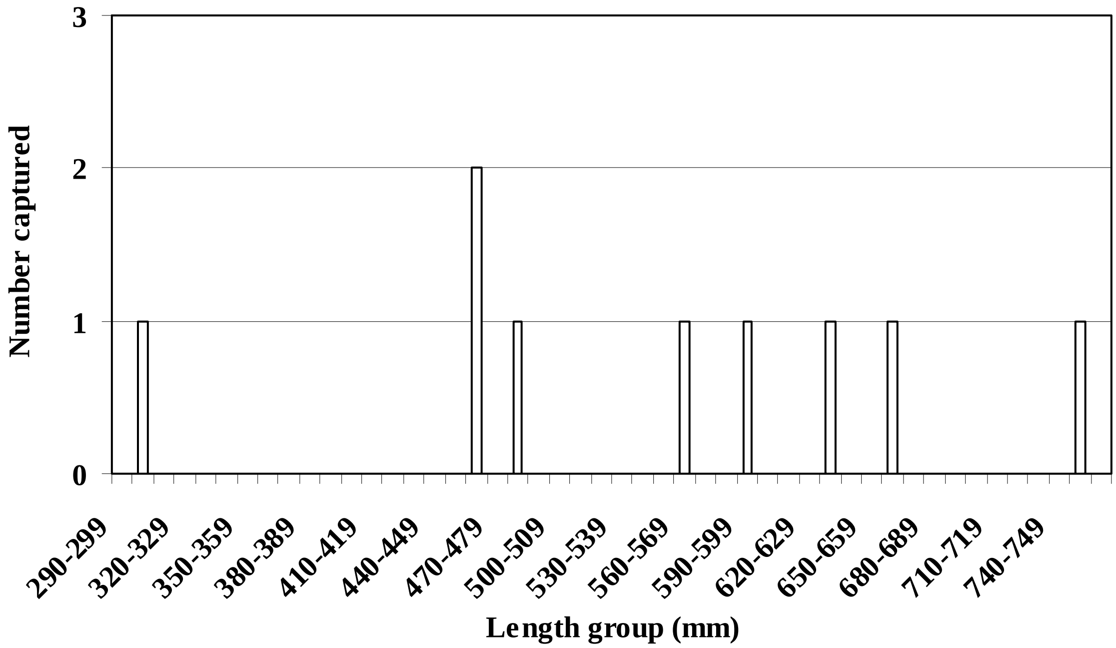

Figure 3. Length frequency histogram for bull trout (n = 9) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in fall, 2005.

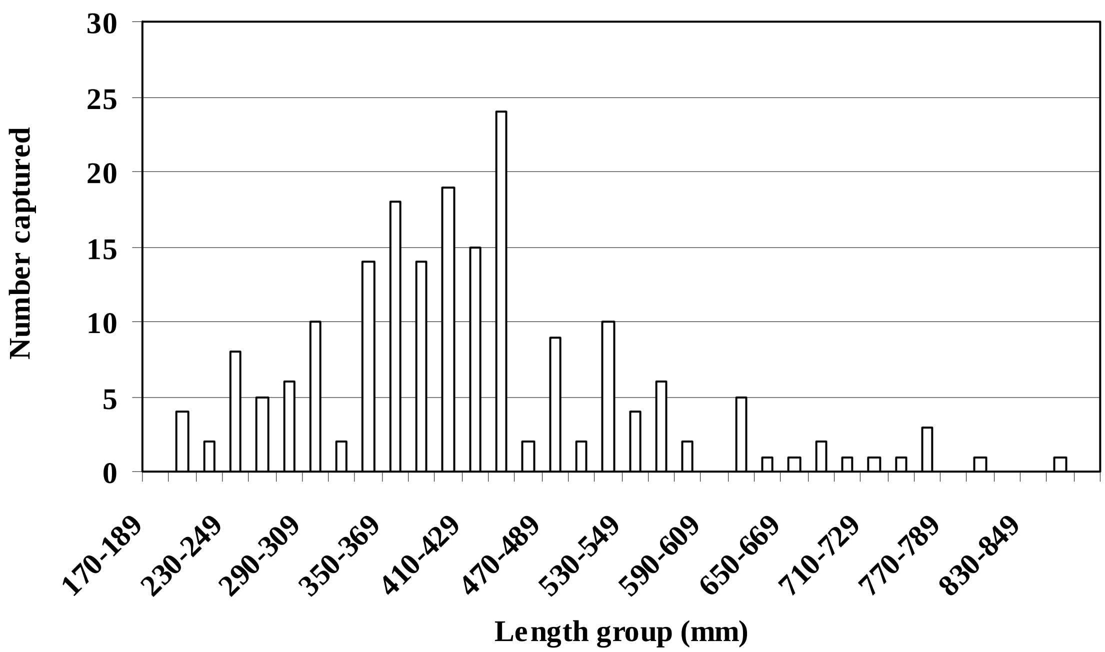

Figure 4. Length frequency histogram for brown trout (n = 193) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in fall, 2005.

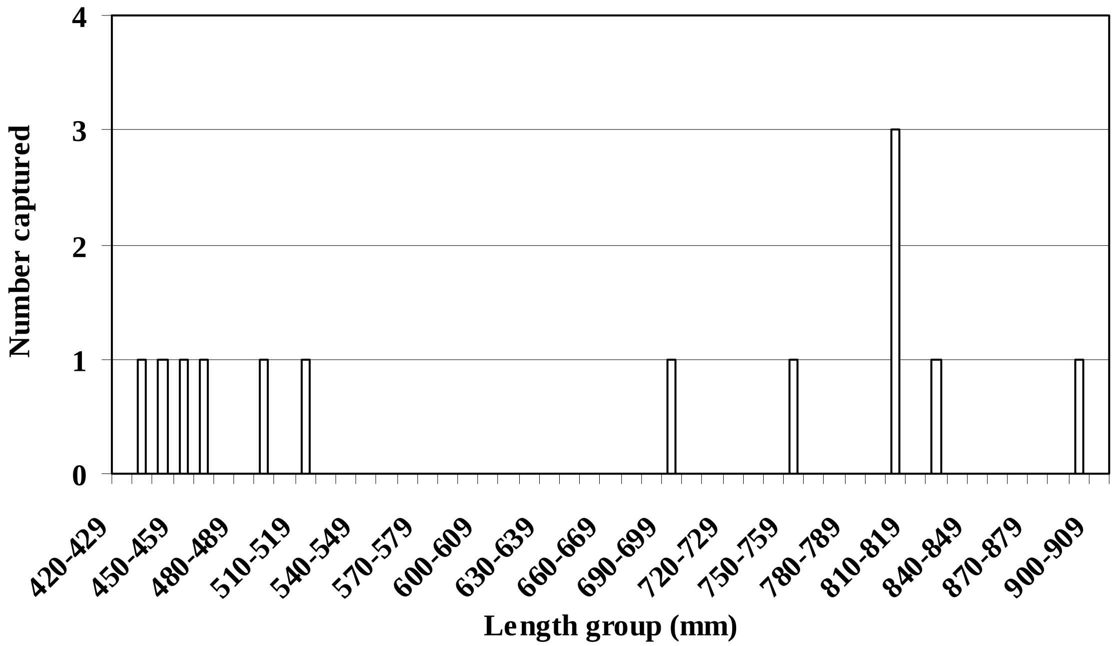

Figure 5. Length frequency histogram for lake trout (n = 13) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in fall, 2005.

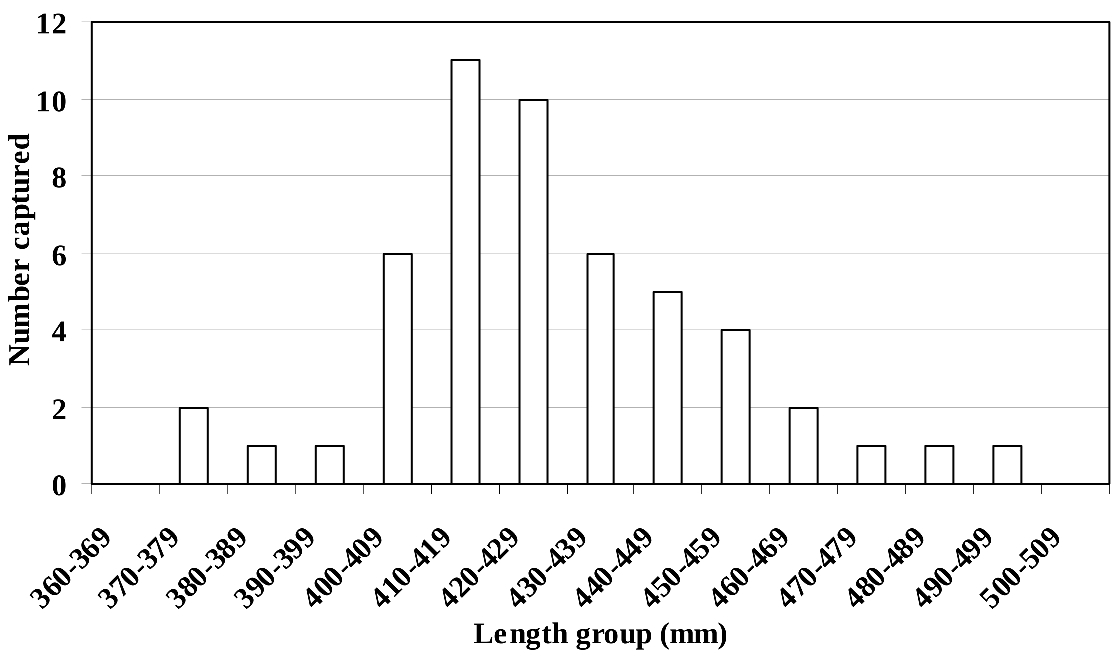

Figure 6. Length frequency histogram for lake whitefish (n = 51) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in fall, 2005.

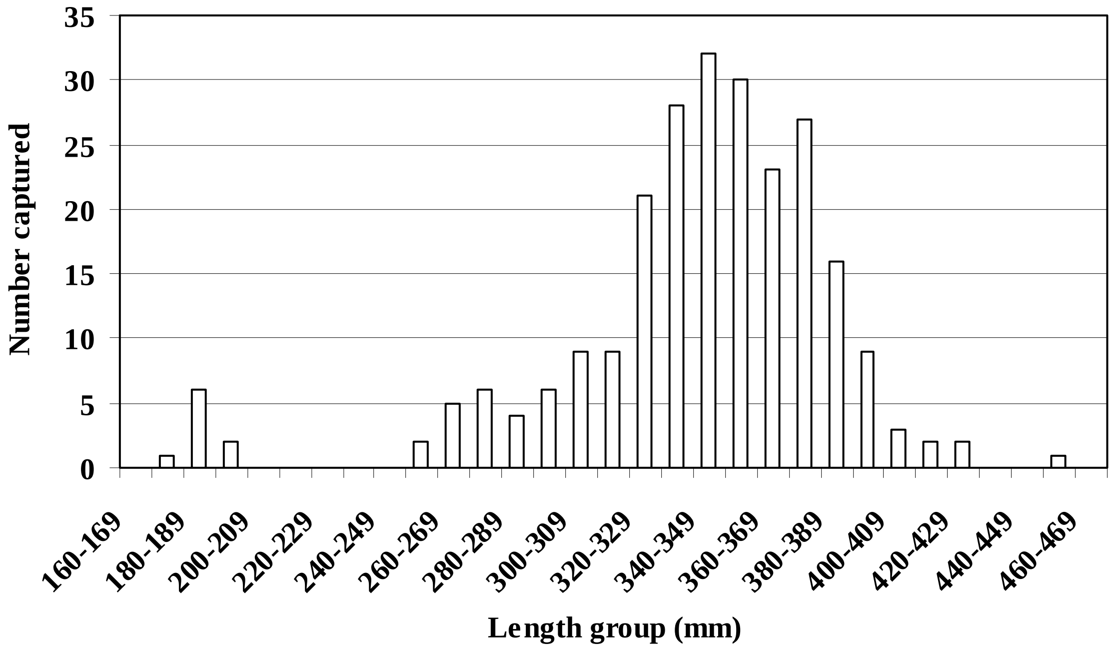

Figure 7. Length frequency histogram for mountain whitefish (n = 244) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in fall, 2005.

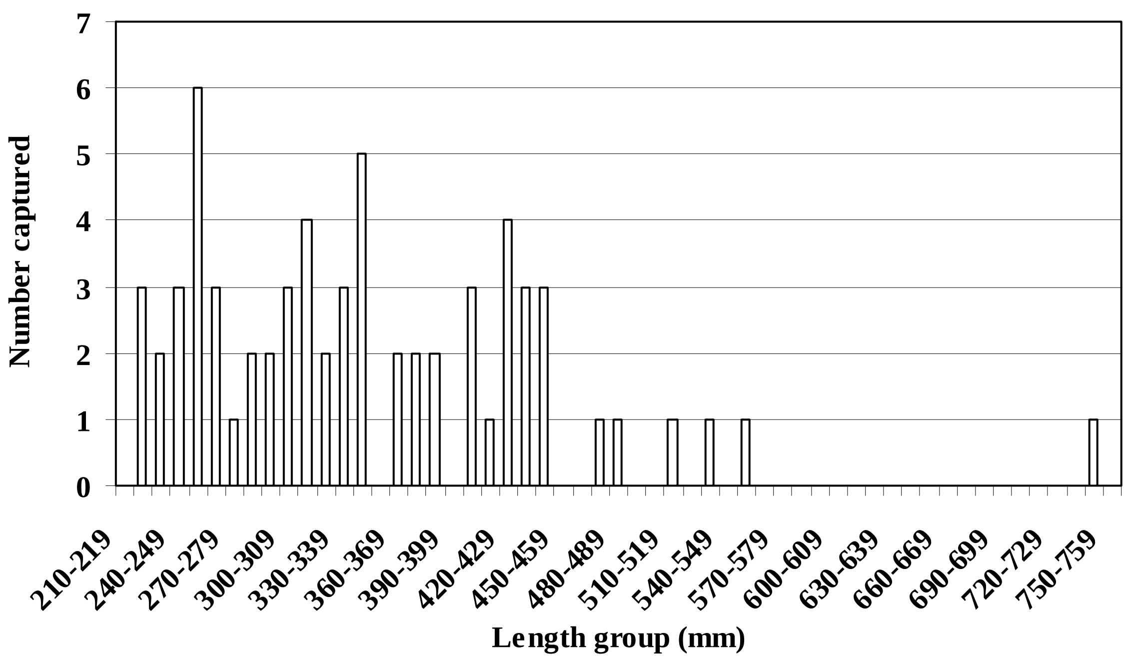

Figure 8. Length frequency histogram for rainbow trout (n = 64) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in fall, 2005.

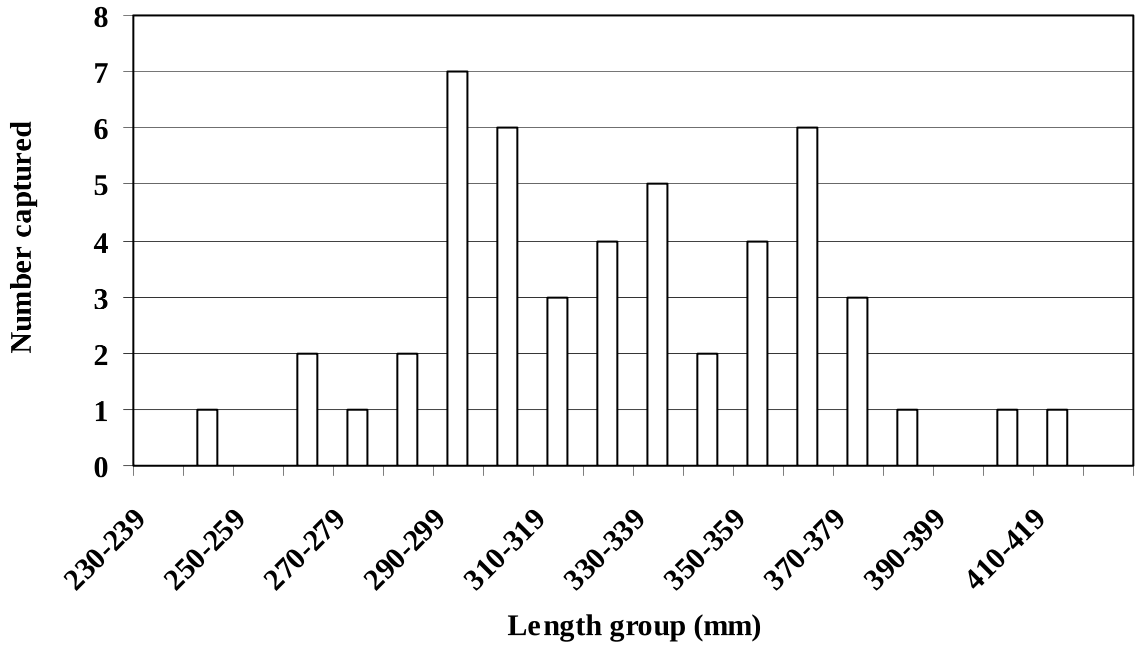

Figure 9. Length frequency histogram for westslope cutthroat trout (n = 49) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in fall, 2005.

Table 5. 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, in fall, 2005.

PSD >305 mm (QSD > 406 mm), stock length = 200 mm		
Species	**PSD (%)**	**QSD (%)**
Brown trout	83	48
Mountain whitefish	88	3
Rainbow trout	64	25
Westslope cutthroat trout	65	2

Table 6. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for non-salmonid species inhabiting the 6.6 km long study reach on the Clark Fork River, Idaho, during the recapture run, in fall, 2005.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
Largescale sucker	457.5 (41.5) (44)	376-553	1,012.5 (249.3) (44)
Northern pikeminnow	272.6 (142.9) (58)	127-670	412.6 (785.5) (58)
Peamouth	214.2 (48.8) (23)	72-301	92.7 (49.9) (23)
Redside shiner	105.2 (25.1) (10)	70-144	10.6 (8.0) (9)
Smallmouth bass	152.5 (103.6) (4)	72-290	90.5 (129.9) (4)
Walleye[a]	538.3 (61.7) (3)	470-590	1,853.3 (669.1) (3)
Yellow perch	106.0 (29.7) (2)	85-127	14.0 (11.3) (2)
Longnose sucker	N/A (N/A) (1)	N/A	N/A (N/A) (1)

[a]All walleye captured during the marking run

Foster Bar Side-channel Monitoring

We captured four species of juvenile fish and unidentified juvenile suckers *Catostomus sp*. while backpack electrofishing the Foster Bar side-channel. Of these, the only salmonid species encountered was brown trout. In 2005, mean juvenile brown trout length was 66 mm, and ranged from 61 to 75 mm. The mean weight was 3.3 g, and ranged from 2 to 4 g. In addition to juvenile brown trout and unidentified juvenile suckers, we also captured northern pikeminnow, redside shiner, and largescale sucker (Table 7). Water temperature during sampling ranged from 16^0 C to 18^0 C.

Table 7. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for species captured while backpack electrofishing in the Foster side-channel near Clark Fork, Idaho, during 2005.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
Brown trout	66.0 (7.8) (3)	61-75	3.3 (1.2) (3)
Largescale sucker	80.0 (N/A) (1)	N/A	4.0 (N/A) (1)
Northern pikeminnow	59.1 (12.6) (50)	40-110	2.1 (2.1) (50)
Redside shiner	57.8 (18.5) (5)	41-87	2.6 (2.1) (5)
Sucker *sp*.	68.0 (13.7) (4)	52-83	3.3 (2.1) (4)

In 2005, we captured eight species, in addition to a single apparent westslope X rainbow trout hybrid (TL; mm = 306; weight (g) = 246), while conducting boom-type electrofishing with a jet boat along one bank (North bank), over the entire length of the main Foster side-channel (Table 8). Of the eight species captured, three were salmonids (brown and rainbow trout, and mountain whitefish). Based on CPUE, northern pikeminnow were the most abundant species present, followed closely by largescale suckers and mountain whitefish (Table 9).

Table 8. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for species captured while electrofishing with a jet boat in the Foster side-channel near Clark Fork, Idaho, during 2005.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
Brown trout	402.7 (90.2) (13)	132-503	618.5 (259.1) (13)
Largescale sucker	481.7 (52.7) (35)	353-590	1,196.1 (351.7) (35)
Longnose sucker	419.2 (29.0) (18)	375-487	707.6 (188.0) (18)
Mountain whitefish	293.8 (59.7) (26)	184-380	243.2 (115.6) (26)
Northern pikeminnow	289.1 (85.6) (38)	97-520	269.2 (338.8) (38)
Peamouth	262.5 (26.0) (4)	243-300	153.8 (66.5) (4)
Rainbow trout	302.0 (N/A) (1)	N/A	289.0 (N/A) (1)
Redside shiner	97.6 (10.6) (5)	86-112	8.2 (2.6) (5)

Table 9. Electrofishing catch-per-unit-effort (CPUE) (fish/minute) for species captured along one bank while electrofishing with a jet boat in the Foster side-channel near Clark Fork, Idaho, during 2005.

Species	**Number captured**	**Time electrofished (minutes)**	**CPUE (fish/minute)**
Brown trout	13	45.6	0.29
Largescale sucker	35	45.6	0.77
Longnose sucker	18	45.6	0.39
Mountain whitefish	26	45.6	0.57
Northern pikeminnow	38	45.6	0.83
Peamouth	4	45.6	0.09
Rainbow trout	1	45.6	0.02
Redside shiner	5	45.6	0.11

DISCUSSION

Population Estimates and Catch-Per-Unit-Effort

Population estimates for westslope cutthroat trout in 2005 were higher than in previous years (Figure 10). However, the confidence intervals overlap across all years suggesting there is no statistically significant trend in abundance. The population point estimate for rainbow trout has been increasing in the past several sampling years, but overlapping confidence intervals suggest there is not a statistically significant trend in abundance (Figure 11). Annual variability is high in the population estimates overall, making detecting a statistically significant change difficult without dramatic changes in abundance. Fall CPUE for westslope cutthroat trout decreased slightly from 0.04 to 0.03 fish/minute of electrofishing from 2003 to 2005, respectively. This is not consistent with the increase observed in the population estimate. However, only one electrode boom was used for two of the three sections along one bank while conducting CPUE on the first night of marking, due to broken equipment, potentially biasing our effort. Fall CPUE for rainbow trout decreased slightly from 0.05 to 0.04 fish/minute of electrofishing from 2003 to 2005, which is also inconsistent with the increase observed in the population estimate, and may also be related to the equipment problem experienced in our 2005 effort. Overall, population point estimates for both westslope and rainbow trout have increased across the most recent three years of sampling (2001, 2003 and 2005). 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.

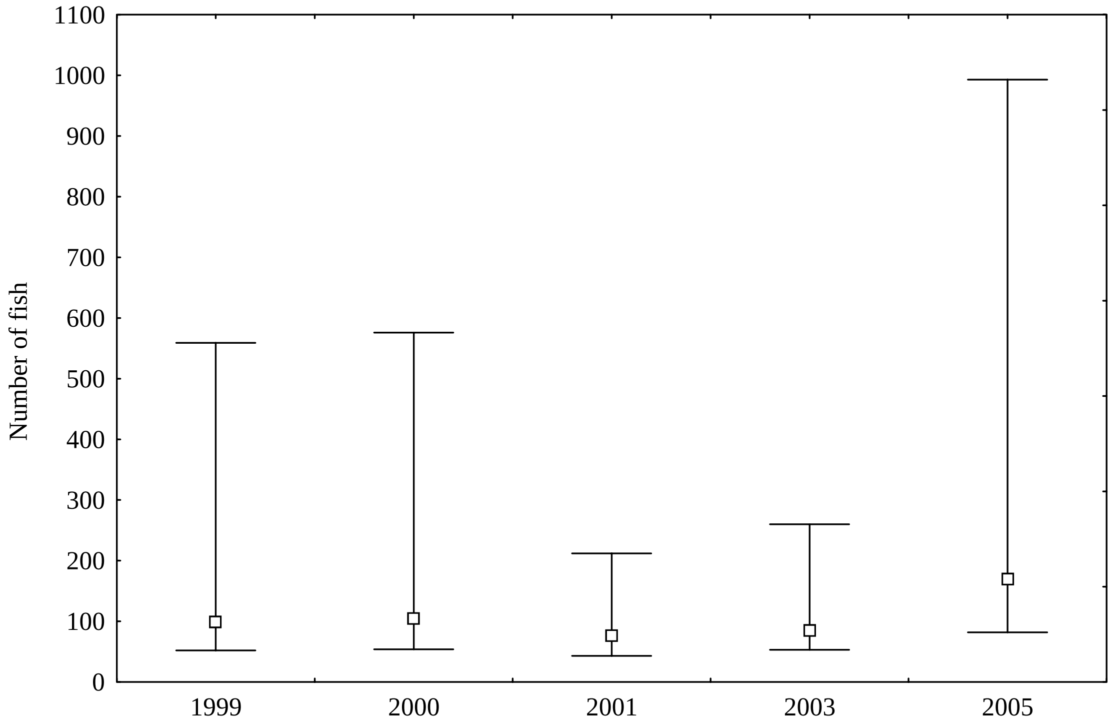

Figure 10. Comparison of population estimates and associated 95% confidence intervals, conducted for westslope cutthroat trout in the 6.6 km long study reach of the Clark Fork River, Idaho, 1999 through 2005.

Population Size Structure and Condition

Westslope cutthroat trout population size structure has remained relatively constant since sampling began in 1999, with the exception of the low PSD observed in 2000 (Table 10). We would attribute the low 2000 PSD value to sampling bias, as the PSD values were relatively consistent both before and after the 2000 sampling season. Rainbow trout PSD's showed greater variability than the westslope cutthroat trout PSD's, but do not reveal any consistent trends (Table 10). We did observe a decline in the rainbow trout PSD from 2003 to 2005, and the comparison of the length frequencies suggest increased numbers of smaller rainbows in the catch in 2005. There were no consistent trends apparent across years in the mean length data for either westslope cutthroat or rainbow trout (Table 11).

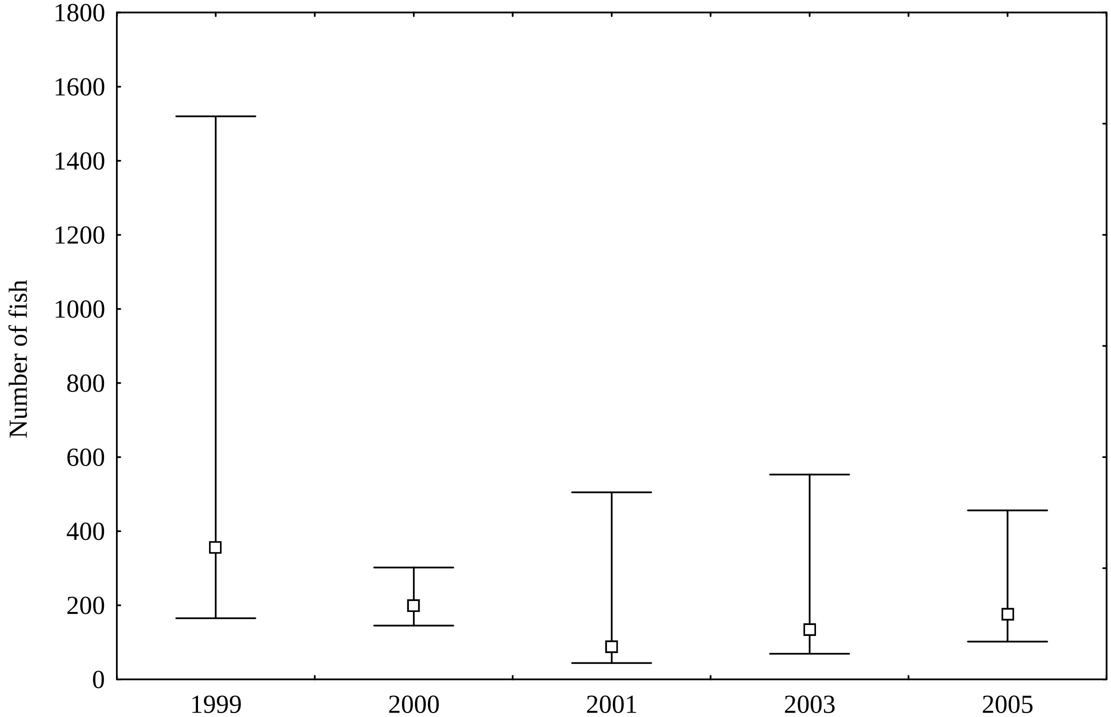

Figure 11. Comparison of population estimates and associated 95% confidence intervals, conducted for rainbow trout in the 6.6 km long study reach of the Clark Fork River, Idaho, 1999 through 2005.

Table 10. Proportional stock density (>305) and quality stock density (>406) estimated for westslope cutthroat and rainbow trout captured in the Clark Fork River, Idaho, during fall sampling from 1999 through 2005. Stock length is 200 mm.

	Westslope cutthroat trout		Rainbow trout	
	PSD	**QSD**	**PSD**	**QSD**
1999	69	0	72	10
2000	29	4	77	11
2001	62	0	89	19
2003	61	4	86	9
2005	65	2	64	25

Table 11. Mean total length (TL; mm) estimated for westslope cutthroat and rainbow trout captured in the Clark Fork River, Idaho, during fall sampling from 2001 through 2005.

	Westslope cutthroat trout		Rainbow trout	
	Mean TL (SD)	**Sample size**	**Mean TL (SD)**	**Sample size**
1999	319.0 (30.3)	36	341.1 (66.5)	78
2000	307.8 (41.2)	31	349.8 (52.4)	107
2001	325.9 (39.8)	32	364.1 (57.6)	37
2003	319.3 (39.6)	46	350.1 (44.9)	44
2005	327.0 (37.4)	49	342.9 (82.6)	64

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 westslope cutthroat and rainbow trout are consistently less than 100, suggesting less than optimum foraging conditions may exist in the Clark Fork River (Table 12). We have not observed any consistent trends in *Wr* across years for either westslope cutthroat trout or rainbow trout to date. However, westslope cutthroat trout condition has declined in the previous two sampling years and we will continue to monitor *Wr* to determine if a trend is developing.

Table 12. Mean relative weight (*Wr*) estimated for westslope cutthroat and rainbow trout captured in the Clark Fork River, Idaho, during fall sampling from 2001 through 2005.

	Westslope cutthroat trout		**Rainbow trout**	
	Mean *Wr* (SD)	**Sample size**	**Mean *Wr* (SD)**	**Sample size**
1999	84.4 (10.8)	21	81.9 (9.5)	34
2000	90.8 (13.3)	14	84.5 (13.0)	64
2001	90.0 (12.1)	32	83.2 (12.4)	26
2003	84.9 (9.4)	46	83.0 (10.7)	44
2005	82.6 (11.7)	48	94.7 (29.3)	64

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 (21^0C 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 monitoring

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 as well as 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. To date, we have only captured juvenile brown trout in the side-channel with our backpack electrofishing equipment. Juvenile mountain whitefish were captured with the jetboat electrofishing equipment in the side-channel. This may be 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. Backpack electrofishing is likely to be more effective at capturing juvenile salmonids in the side-channel than jet boat electrofishing and should be continued. The number of sites, as well as their distribution, have been 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 three years of sampling, we will reduce the sampling frequency to longer intervals (e.g. every three years, or as needed).

ACKNOWLEDGEMENTS

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2005 Trestle and Twin Creeks Bull Trout Outmigration and Lake Pend Oreille Survival Study Progress Report

ABSTRACT

We utilized a rotary screw trap and weirs to capture juvenile bull trout *Salvelinus confluentus* 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-1 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 2005, as well as a weir during 2005, 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. Twenty-nine of the 270 juveniles (10.7%) originally marked outmigrating from Trestle Creek in 2000, were detected again in Trestle Creek between 2003 and 2005, while 38 of the 350 juveniles (10.9%) originally marked outmigrating from Trestle Creek in 2001, were detected in Trestle Creek between 2003 and 2005. Three of the 302 juveniles (1.0%) originally marked outmigrating in 2002, were detected in 2005. Of the 245 adult bull trout marked with PIT tags in 2002, 76 were detected again in Trestle Creek in 2003, 28 were detected in 2004, and 23 were detected in 2005. Of these 23, 15 were repeat spawners from 2004. 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 six individual adult bull trout in 2005 at the weir on Twin Creek. Of these, five were new fish, while one had been captured and PIT tagged in Twin Creek during 2004.

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INTRODUCTION

Long-term data sets are available for bull trout *Salvelinus confluentus* 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 60 square-kilometers (km^2) of the Cabinet Mountains and supports an annual run of 500 to over 1,000 fish, representing on average 39% of the bull trout spawning escapement from LPO. 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.

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 Clark Fork Settlement Agreement, has purchased four riparian properties on Trestle Creek totaling 46.1 ha, reducing the risk of residential development.

Twin Creek is a spring-fed tributary to the lower Clark Fork River in Bonner County, Idaho, and drains approximately 28.5 km^2 of the Bitterroot Mountains. Twin Creek is used for spawning by bull trout and westslope cutthroat trout *Oncorhynchus clarki lewisi*, as well as brown trout *Salmo trutta*, mountain whitefish *Prosopium williamsoni*, rainbow trout *O. mykiss*, and kokanee *O. nerka* migrating from the Clark Fork River and LPO (Figure 1). Brook trout *Salvelinus fontinalis* 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 (Johnson and Granite creeks bull trout trapping project 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 seven. 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 2005 marks the sixth 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.

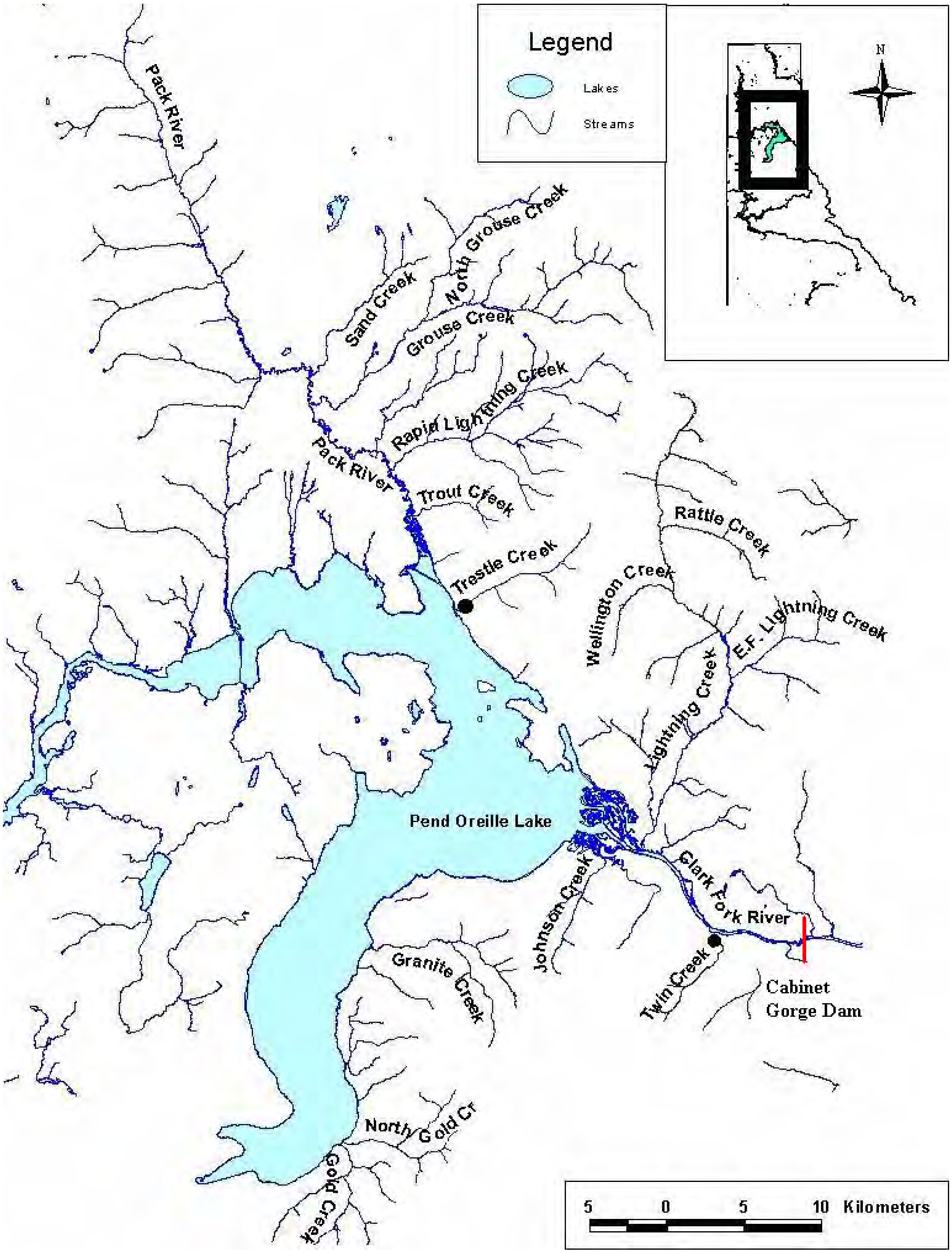

Figure 1. Trap locations on Trestle and Twin creeks, Idaho, tributaries to Pend Oreille Lake and the Clark Fork River, Idaho, below Cabinet Gorge Dam.

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 2005, the remote PIT tag detection weir was installed in Trestle Creek on June 29 and removed on October 24, having operated for all but one night.

In 2005, we also utilized a weir on Trestle Creek with both upstream and downstream trap boxes, to increase detection of returning adult bull trout, and to test the efficiency of the remote PIT tag receiving station. We also used the weir to check long-term tag retention by noting the presence of an adipose clip, and the presence/absence of a PIT tag in the abdomen of captured fish. The weir consisted of steel pickets with 25.4 mm spacing in a metal frame, with 1.22m x 0.91m x 0.91m steel frame trap boxes wrapped in 6 mm black plastic mesh used to capture the fish (Downs and Jakubowski 2003). The weir was located upstream of the remote PIT tag receiving station at the Bear Paw campground, where the screw trap had previously been located. It was installed on September 2, and removed on October 1, 2005. During the time the weir was in operation, a weir panel was also placed at the inlet of a side-channel to Trestle Creek, located downstream of the weir trapping site, to prevent out-migrating bull trout from entering and becoming stranded. This side-channel diverts approximately 10% of the total flow from Trestle Creek during low-flow conditions, and had previously been identified as an area of concern. In 2003, due to landowner in-stream modifications to increase flow into the side-channel, large rocks were placed at the inlet to prevent fish passage.

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).

A minimum annual survival rate (S) from 2000 to 2001, and 2002 to 2003 was estimated as the proportion of individual adult bull trout marked in Trestle Creek in 2000 or 2002, which have been detected in subsequent years (to date) in Trestle Creek (Ricker 1975) as:

$$S = N_{t+1} / N_t$$

where:

N_t = Number of fish alive at time t (marked in 2000)
N_{t+1} = Number of fish alive at time t+1 (cumulative detections of unique marked fish in subsequent years)

<u>Survival Estimation Twin Creek</u>

On July 8, 2005, we installed a weir on Twin Creek with both upstream and downstream trap boxes to capture migrating adult bull trout. The weir consisted of steel pickets with 25.4 mm 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). The weir was removed on October 24, 2005.

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 2005, an electronic temperature recorder was installed in Twin Creek on June 1 and removed on November 17.

RESULTS and DISCUSSION

<u>Trestle Creek</u>

To date, a total of 29 unique bull trout originally marked in 2000, have been detected in Trestle Creek as returning adults (10.7%). Of the 350 juveniles originally marked outmigrating from Trestle Creek in 2001, 38 unique individuals (10.9%) have returned to date. Only two individuals from the 2002 marking group have returned to date (Table 1). The 19 individual bull trout detected in 2004 in Trestle Creek from the 2000 juvenile marking group spent three full years in the lake (not including the year they outmigrated or returned as adults), while the six detected in 2005 spent four full years in the lake.

The average length of the individuals at tagging marked in 2000 that returned in 2004 was 169.6 mm (range = 127-220, S.D. = 21.7) while it was 163.0 mm (range = 136-197, S.D. = 23.4) for those returning in 2005. 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), while it was 173.2 mm (range = 138-220, S.D. = 21.9) for the 29 returning in 2005. The average length of the three individuals at tagging marked in 2002 that returned in 2005 was 190.3 mm (range = 164-233, S.D. = 37.3). Based on the trend observed to date, we anticipate decreasing adult returns from the 2000 and 2001 juvenile marking groups, as well as increasing adult returns from the 2002 juvenile marking group in 2006.

Table 1. Returning adult bull trout to Trestle Creek, a tributary to Lake Pend Oreille, Idaho, originally PIT tagged as juveniles in 2000, 2001 and 2002. New returns refer to bull trout that were tagged but had not been detected in a previous return year.

Return year	2000 tagged fish (n = 270)		2001 tagged fish (n = 350)		2002 tagged fish (n = 302)	
	Total returns	New returns	Total returns	New returns	Total returns	New returns
2001	0	0	N/A	N/A	N/A	N/A
2002	0	0	0	0	N/A	N/A
2003	4	4	1	1	0	0
2004	19	19	9	8	0	0
2005	7	6	32	29	3	3

By operating an upstream and downstream weir on Trestle Creek in 2005, we were able to visually inspect all bull trout captured for the presence or absence of an adipose fin in addition to checking for PIT tags. In 2001 and 2002, all juvenile bull trout captured and PIT tagged in the abdomen on Trestle Creek (n = 350 and n = 302) also had their adipose fin removed. In 2005, we captured 20 returning adult bull trout with a missing adipose fin, and 13 also contained a PIT tag in their abdomen. This gives a combined tag retention rate for juveniles tagged in 2001 and 2002 of 65%. Previous estimates of short-term (24-hour) PIT tag retention in juvenile bull trout were high, ranging from 94% to 98% (Downs and Jakubowski 2003). It is apparent that tag loss continued as the fish matured in the lake environment or during spawning in the tributary environment.

In Trestle Creek in 2005, a total of 88 adult bull trout were captured moving upstream in the weir, 17 of which were previously PIT tagged. Two of these were fish captured in the weir and tagged in Trestle Creek earlier in 2005. Of the 17 captured with a previous tag, 10 had the PIT tag located in the abdomen. Eight of those also had an adipose clip, signifying that they were originally tagged as juveniles in 2001 or 2002. One of the two abdomen tagged fish lacking an adipose clip was originally tagged in Trestle Creek as a juvenile in 2000 (PIT tagged juveniles were not adipose clipped in 2000), while the remaining fish was originally captured below Albenai Falls Dam, Idaho, on June 22, 2004. After receiving a radio-tag and PIT tag, it was transported upstream over the dam and released in the Pend Oreille River as part of an experimental fish passage program at Albenai Falls Dam. The remaining previously tagged fish were tagged as adults in Trestle Creek in previous years (Table 2). Adult bull trout moving upstream ranged in size from 390 to 760 mm (Table 3; Figure 2).

In the 2005 Trestle Creek downstream weir, a total of 106 adult and 29 juvenile bull trout were captured. Sixteen of the juvenile bull trout captured were not tagged due to small size. Thirty-three adults were captured with a previous PIT tag, 20 of which had been tagged in a previous year (thirteen were tagged moving upstream in 2005) (Table 2). Adult bull trout captured moving downstream ranged in size from 420 to 760 mm (Table 3; Figures 3 and 4). Six of those had an adipose clip in addition to a tag in their abdomen, indicating that they had originally been tagged as juveniles in Trestle Creek in 2001 or 2002. There were also three that had been tagged as juveniles in Trestle Creek in 2000.

Table 2. Returning adult bull trout to Trestle Creek, a tributary to Lake Pend Oreille, Idaho, originally PIT tagged as adults in 2000 and 2002. New returns refer to bull trout that were tagged but had not been detected in a previous return year.

Return year	2000 tagged fish		2002 tagged fish	
	Total returns	New returns	Total returns	New returns
2001	237	237	N/A	N/A
2002	161	18	N/A	N/A
2003	89	4	76	76
2004	30	2	28	16
2005	16	0	21	1

Table 3. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for adult and juvenile bull trout captured moving downstream and adult bull trout captured moving upstream in the weir on Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

	Mean length (SD) (n)	**Length range**	**Mean weight (SD) (n)**
Adult bull trout (down)	552.0 (68.2) (111)	420-760	1,370.7 (672.3) (110)
Juvenile bull trout (down)	111.9 (51.6) (29)	60-221	19.9 (25.1) (29)
Adult bull trout (up)	551.2 (90.0) (86)	390-760	1,545.1 (837.7) (84)

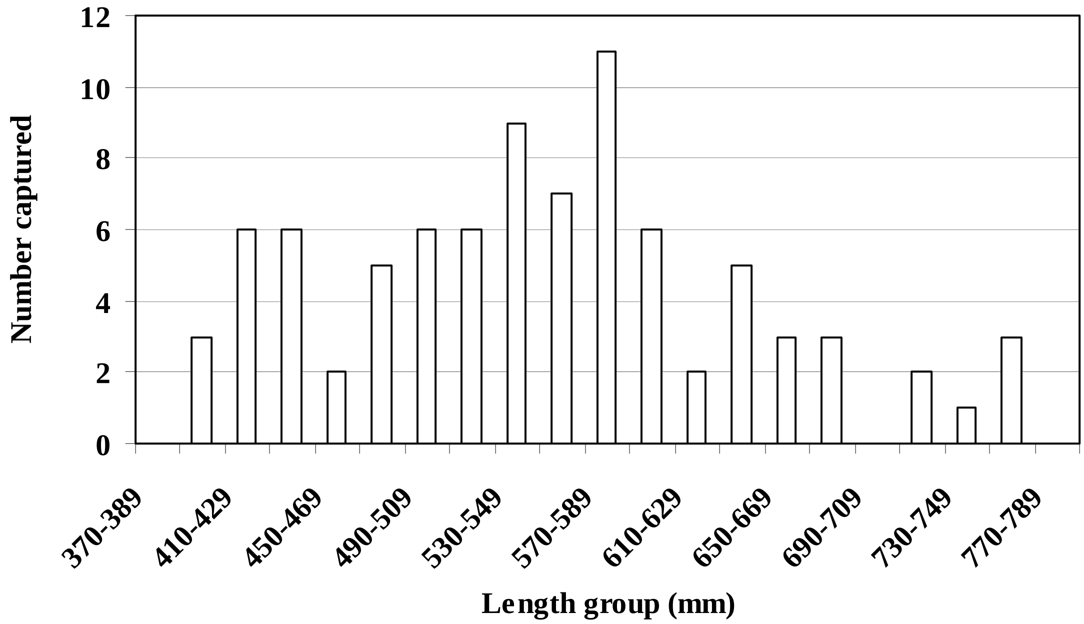

Figure 2. Length frequency histogram for adult bull trout (n = 86) captured in the upstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

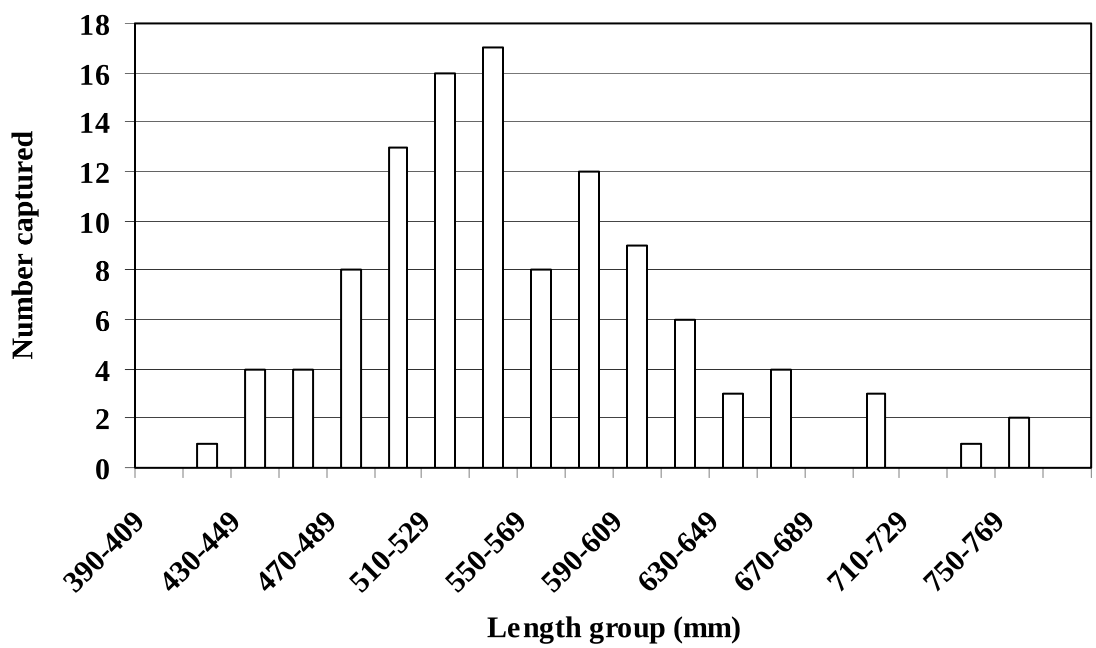

Figure 3. Length frequency histogram for adult bull trout (n = 111) captured in the downstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

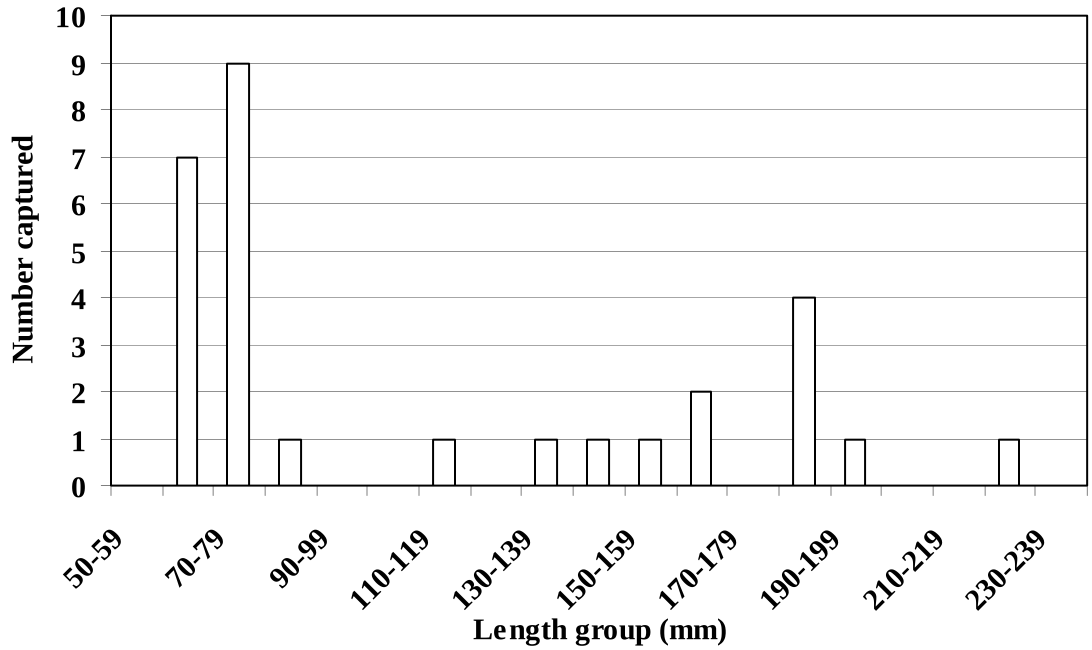

Figure 4. Length frequency histogram for juvenile bull trout (n = 29) captured in the downstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

We were able to use the number of PIT tagged adult bull trout last handled and released downstream from the weir on Trestle Creek in 2005 (n = 103), compared with the number of those same fish detected at the remote PIT tag station downstream of the weir (n = 90), to determine the remote PIT tag station efficiency (87.4%). Most adults released at the trap site moved downstream to the remote station within 48 hours (92%). Some individuals remained between the release site and remote station for up to one month. It is likely that some adults had not moved downstream to the remote station before it was removed for the season, and were therefore not detected. Some mortality also likely occurred as fish moved down from the weir release site and were also not detected.

In 2000, we marked 429 adult bull trout with PIT tags in Trestle Creek, most of which were captured moving downstream after spawning. To date, we have recaptured through PIT tag detection in Trestle Creek, a total of 261 of these fish (Table 2). This results in a minimum estimated survival rate from 2000 to 2001 of 61%. In 2002, we marked 245 adult bull trout in Trestle Creek captured in the screw trap. To date, we have recaptured through PIT tag detection in Trestle Creek, a total of 93 of these fish. This results in a minimum estimated survival rate from 2002 to 2003 of 38%. In 2005, 21 of the original 245 from the 2002 marking group were detected again in Trestle Creek, with 14 being repeat spawners from 2004. Of the 16 individuals detected returning from the 2000 adult marking group, 13 were repeat spawners from 2004. Seven were detected in all six years of the study. 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 or variability in tag loss between marking years. We suspect the latter as the primary cause because paired comparisons of return rates for the year following tagging showed a higher return for 2000 marked fish (55%) versus 2002 (31%). We can't foresee a situation that would cause this kind of differential mortality.

The return rate for the 2002 marking group improved dramatically from 2004 to 2005 (50%). The North Branch of Trestle Creek had been blocked by deposition of cobble material in the late 1990's. However, local residents removed some of this material by hand sometime between 2000 and 2003 resulting in a diversion of approximately 10% of the flow. Some fish may have avoided detection by using this channel. We blocked this channel with a weir panel in 2005, and will do so in the future to ensure we sample as many adults as possible.

We also captured five species of salmonids in addition to bull trout in Trestle Creek in 2005. In the upstream weir we captured adult kokanee, rainbow and westslope cutthroat trout, and unidentified *Oncorhynchus* species (Table 4). In the downstream weir we captured adult kokanee, rainbow and westslope cutthroat trout, unidentified *Oncorhynchus* species, and a single mountain whitefish (Table 5; Figure 5).

Table 4. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for salmonid species captured in the upstream weir on Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
Kokanee	335.2 (26.7) (37)	290-399	358.5 (103.2) (36)
Oncorhynchus sp.	60.0 (5.7) (2)	56-64	1.5 (0.7) (2)
Rainbow trout	211.2 (36.1) (4)	187-264	87.5 (54.8) (4)
Westslope cutthroat trout	212.0 (2.8) (2)	210-214	84.5 (4.9) (2)

Table 5. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for salmonid species captured in the downstream weir on Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
Kokanee	313.9 (19.9) (137)	264-384	301.2 (58.9) (137)
Mountain whitefish	203.0 (N/A) (1)	N/A	63 (N/A) (1)
Oncorhynchus sp.	54.6 (7.4) (7)	41-63	1.3 (0.5) (7)
Rainbow trout	188.2 (22.5) (17)	154-230	61.3 (19.0) (17)
Westslope cutthroat trout	159.0 (57.3) (8)	63-234	47.6 (36.7) (8)

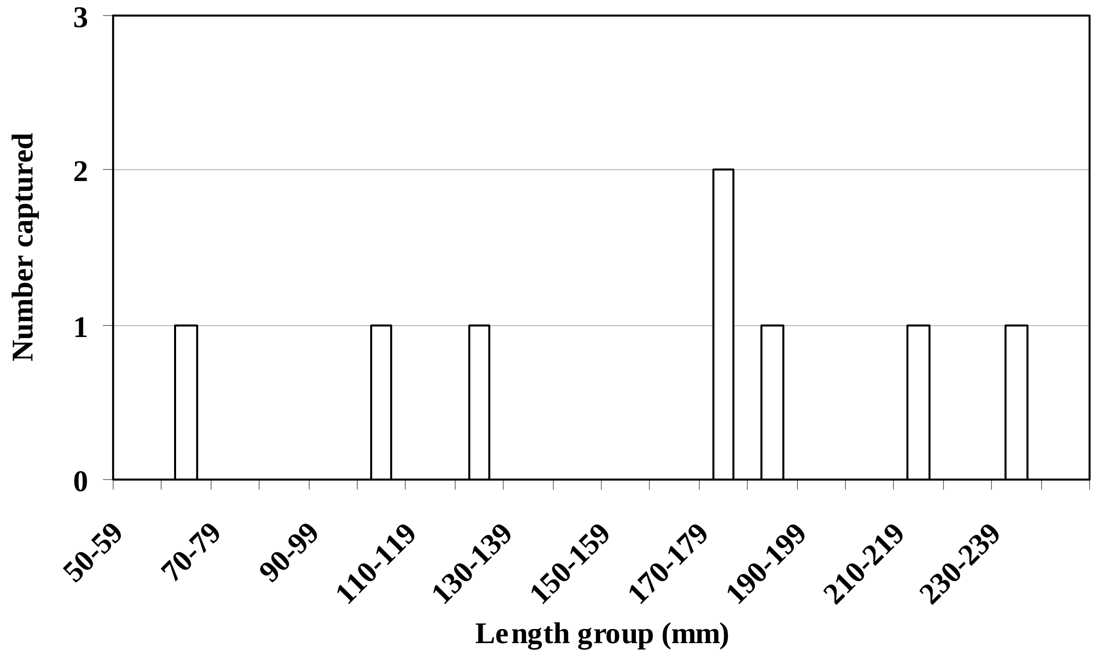

Figure 5. Length frequency histogram for westslope cutthroat trout (n = 8) captured in the downstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

<u>Twin Creek</u>

We captured 11 species of juvenile fish in the weir moving upstream and/or downstream in Twin Creek from July 8 to October 24 in 2005 (Table 6). Brook trout, black bullhead *Ictalurus melas* and sculpin *Cottus sp*. are included with the juvenile data due to uncertainty about their age and level of sexual maturity. Two juvenile bull X brook trout hybrids (96 and 178 mm) and one juvenile westslope X rainbow trout hybrid (117 mm) were also captured, but are not included in the species total (Tables 7 and 8). Unidentified juvenile *Oncorhynchus sp*. were the most abundant fish in both the upstream and downstream trap box (Tables 7 and 8). Average lengths of juvenile salmonids ranged from 55.4 mm for unidentified *Oncorhynchus sp*. to 154.5 mm for brook trout. (Tables 7 and 8).

In Twin Creek in 2005, we captured a total of 20 juvenile bull trout moving downstream (Table 8; Figure 6). Twelve of those were subsequently PIT tagged, the others were not due to small size. In the upstream weir box, there were five juvenile bull trout captured (Table 7). One of those was then PIT tagged, while another was released due to small size. The remaining three were all previously PIT tagged fish, two of which had been captured moving downstream and tagged earlier in the season in Twin Creek. The remaining fish (215 mm) had originally been captured and tagged in the E. Fk. Bull River in Montana on October 8, 2004. It was recaptured in the E. Fk. Bull River on July 21, 2005 and again on July 27, 2005, while moving downstream. It was then transported and released at the Cabinet Gorge Hatchery boat ramp in Idaho by the

Avista Corp. juvenile transport crew on July 27. It was then captured moving upstream in Twin Creek two days later on July 29, 2005.

Table 6. Species captured in Twin Creek, a tributary to the Clark Fork River, Idaho, during 2005.

Species	**Abbreviation**
Black bullhead *Ictalurus melas*	BBH
Bull trout *Salvelinus confluentus*	BLT
Brook trout *Salvelinus fontinalis*	BRK
Brown trout *Salmo trutta*	BRN
Kokanee *Oncorhynchus nerka*	KOK
Mountain whitefish *Prosopium williamsoni*	MWF
Northern pikeminnow *Ptychocheilus oregonensis*	NPM
Oncorhynchus species (unidentified)	ONC
Rainbow trout *Oncorhynchus mykiss*	RBT
Sculpin *Cottus Spp.*	SCL
Westslope cutthroat trout *Oncorhynchus clarki lewisi*	WCT

We captured four species of adult fish moving upstream and/or downstream in Twin Creek during 2005; bull trout, brown trout, westslope cutthroat trout and kokanee (Table 9). A total of six individual adult bull trout were captured moving upstream between September 26 and October 12. Five of the six had not been previously tagged and were subsequently PIT tagged. The remaining fish had been PIT tagged as an adult in Twin Creek on September 7, 2004.

Table 7. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for juvenile species and bull X brook trout hybrids (BBHY) captured in the upstream weir on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2005.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**
BLT	110.8 (60.1) (5)	68-215	19.0 (30.3) (5)
BBHY	178.0 (N/A) (1)	N/A	42.0 (N/A) (1)
BRK	154.5 (24.7) (2)	137-172	41.0 (18.4) (2)
BRN	99.2 (52.1) (6)	61-177	17.8 (25.0) (6)
MWF	89.0 (5.7) (2)	85-93	5.0 (1.4) (2)
ONC	60.2 (7.3) (21)	44-69	1.8 (0.7) (21)
RBT	104.7 (22.9) (15)	71-142	12.7 (8.0) (15)
SCL	57.0 (16.2) (14)	26-82	2.3 (1.3) (14)

Table 8. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), length range, and catch-per-unit-effort (CPUE) for juvenile species, bull X brook trout hybrids (BBHY), and westslope X rainbow trout hybrids (WRHY) captured in the downstream weir on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2005.

Species	**Mean length (SD) (n)**	**Length range**	**Mean weight (SD) (n)**	**CPUE (fish/trap night)**
BBH	149.5 (6.4) (2)	145-154	49.5 (0.7) (2)	0.02
BLT	84.7 (29.9) (20)	63-197	7.1 (12.3) (20)	0.19
BBHY	96.0 (N/A) (1)	N/A	8.0 (N/A) (1)	0.01
BRK	114.0 (N/A) (1)	N/A	11.0 (N/A) (1)	0.01
BRN	67.5 (14.2) (315)	43-213	3.4 (5.7) (315)	2.92
KOK	71.6 (16.3) (5)	56-92	3.2 (2.3) (5)	0.05
MWF	110.5 (21.1) (12)	86-165	11.1 (9.1) (12)	0.11
NPM	42.1 (4.1) (14)	33-50	1.0 (0.0) (14)	0.13
ONC	55.4 (6.1) (533)	33-69	1.6 (0.6) (533)	4.94
RBT	102.0 (27.6) (158)	70-204	12.3 (12.3) (158)	1.46
SCL	62.6 (12.9) (56)	30-89	3.0 (1.6) (56)	0.52
WCT	104.3 (26.6) (3)	75-127	10.7 (6.5) (3)	0.03
WRHY	117.0 (N/A) (1)	N/A	11.0 (N/A) (1)	0.01

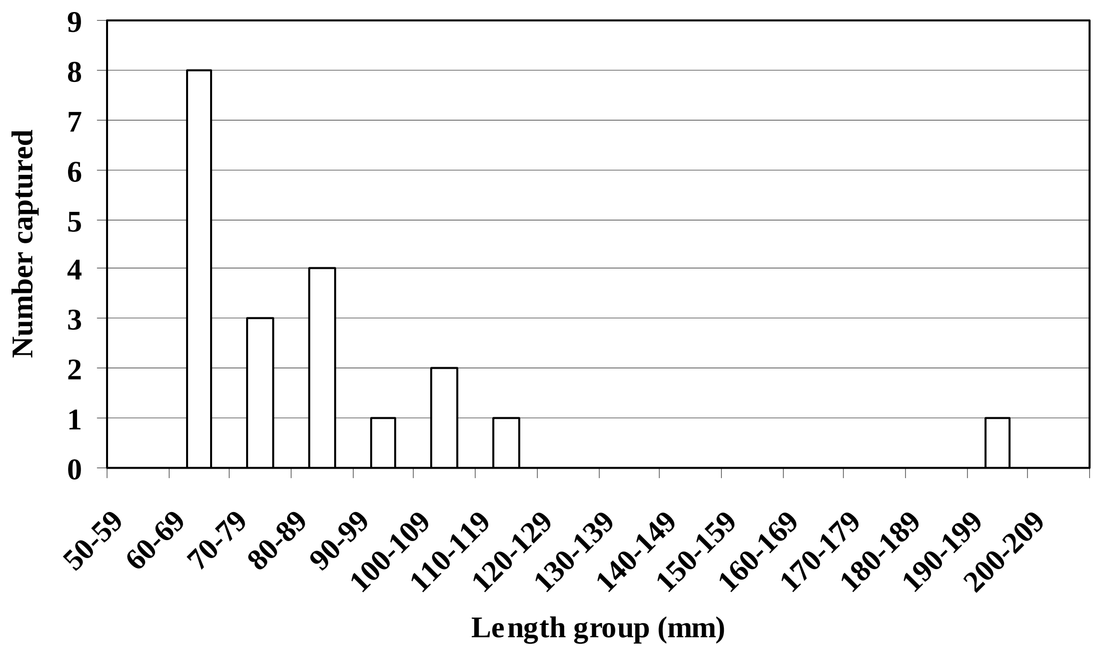

Figure 6. Length frequency histogram for juvenile bull trout (n = 20) captured in the downstream weir in Twin Creek, a tributary to the Clark Fork River, Idaho, during 2005.

Table 9. 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 brown trout, kokanee and westslope cutthroat trout captured in the upstream and downstream weir combined, on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2005.

Species	Mean length (SD) (n)	Length range	Mean weight (SD) (n)
BLT	556.3 (56.9) (6)	503-631	1,575.0 (631.1) (6)
BRN	445.0 (N/A) (1)	N/A	820.0 (N/A) (1)
KOK	302.7 (18.2) (33)	277-366	250.1 (53.7) (33)
WCT	304.0 (N/A) (1)	N/A	249.0 (N/A) (1)

Timing of upstream migration of bull trout in Twin Creek is later than that observed in other LPO tributaries, with most upstream movement occurring from late September and early October (Downs et al. 2003, Downs and Jakubowski 2003). In 2005, we observed a continuation of this trend (Figure 7). This lends 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 2001-2005) despite relatively strong catches of adult bull trout using electrofishing in the Clark Fork River, and trapping in Cabinet Gorge Hatchery ladder. Recent advances in rapid response genetic testing have made it possible to identify the tributary of origin for bull trout collected in the Clark Fork River in Idaho which should reduce 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.

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 1990'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. 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. In

2005, upstream migration of adult kokanee began on September 5, and ended on October 23 (n = 24), with the peak of the run occurring during the first week of October (Figure 8). This is similar to what was observed in 2004.

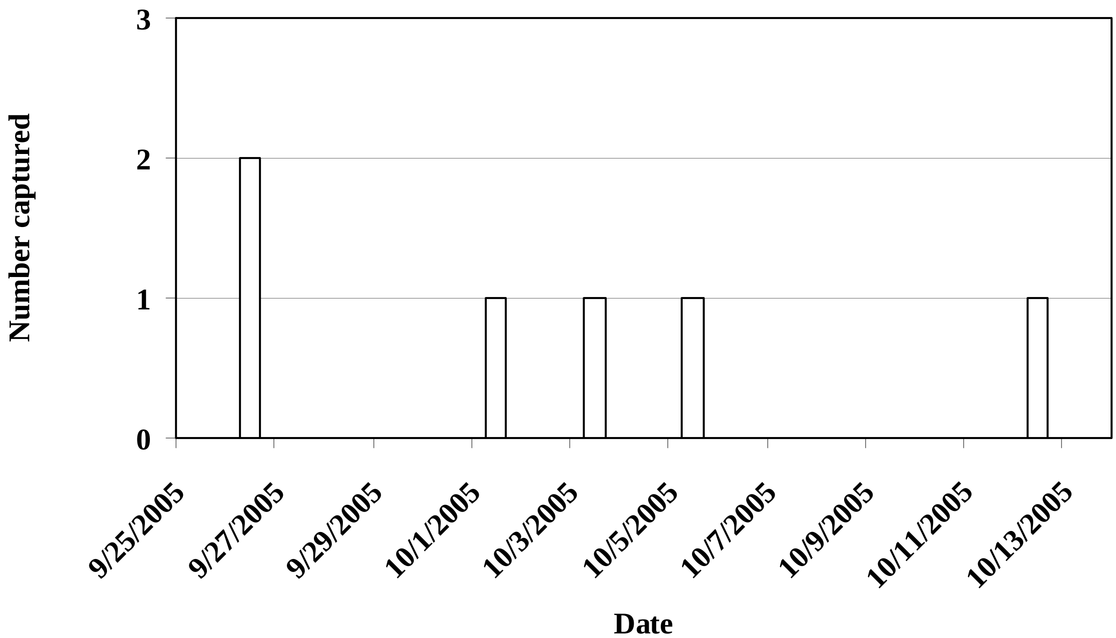

Figure 7. Timing of upstream migration of adult bull trout in Twin Creek, a tributary to the Clark Fork River, Idaho, in 2005.

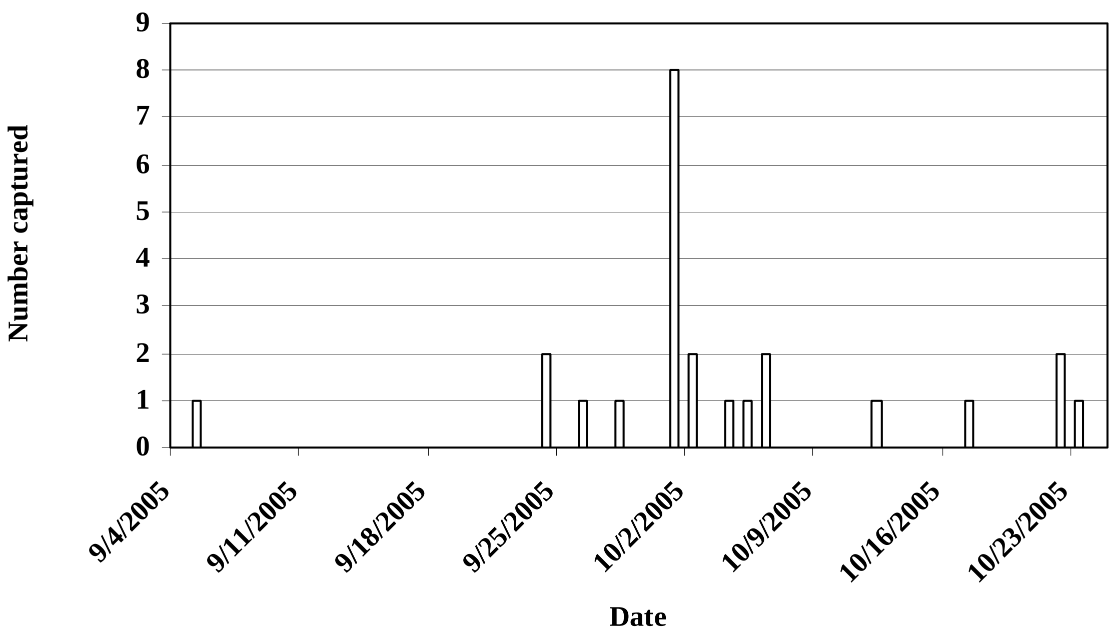

Figure 8. Timing of upstream migration of adult kokanee in Twin Creek, a tributary to the Clark Fork River, Idaho, in 2005.

Twin Creek Water Temperature

Water temperature was recorded using an electronic temperature logger from June 1 through November 17, 2005. The maximum daily water temperature observed over the course of the trapping season in 2005 was 18.8 ^{0}C on July 31 (Figure 9). In comparison, the maximum daily water temperature observed in 2000 was 17.3 ^{0}C on August 1; 20.0 ^{0}C on August 3, 2001; 16.8 ^{0}C on July 10, 2002; 18.8 ^{0}C on July 22, 2003 and 18.0 ^{0}C on July 23, 2004. We would anticipate maximum temperatures to decline over time as vegetation continues to grow and shade the restored channel of Twin Creek.

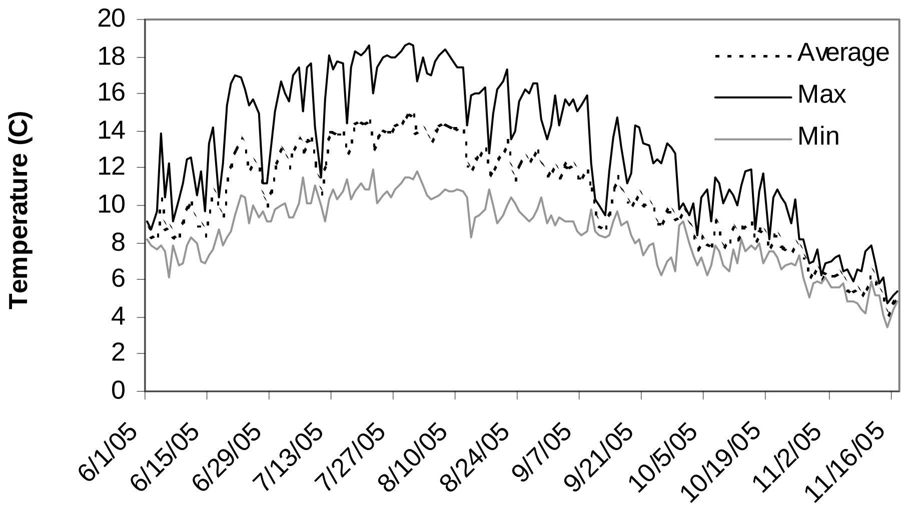

Figure 9. Mean daily water temperatures recorded by thermograph for Twin Creek, a tributary to the Clark Fork River, Idaho, in 2005.

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2005 Johnson and Granite Creeks Bull Trout Trapping Progress Report

ABSTRACT

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. In 2005, a portion of root-wad was removed from the head-cut, and fish were able to ascend the head-cut naturally. We subsequently counted 45 redds during the October 13, 2005 survey, the highest count on record.

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 had a diffuse and largely sub-surface flow pattern during low flow conditions. Fish passage was impaired during summer/fall months, or in low flow years in this location on Granite Creek, reducing the numbers of bull trout that could 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 2005. In 2005, a total of 166 adult bull trout were captured and transported above the barrier. Of these, 114 were unmarked, 113 of which were subsequently PIT tagged. Mean length of adult bull trout captured moving upstream in 2005 was 541 mm (range = 370-753 mm). In 2005, we captured and transported downstream 198 adults after spawning, 119 of which were previously PIT tagged. Fifty-seven of those had been captured and tagged while moving upstream in 2005. In 2005, we derived a mark-recapture population estimate of 390 adults (95% CI = 311-513), and counted 132 redds, the second highest count on record. A stream restoration project was completed on Granite Creek in 2005.The project should restore natural fish passage to the lower reaches of Granite Creek.

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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 2005, with an average count of 20 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.

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 2005, and have averaged 48 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 had a diffuse and largely sub-surface flow pattern during low flow conditions (PBTAT 1998). Fish passage was impaired due to the subsurface flow and a head-cut in the channel during summer/fall months, reducing the numbers of bull trout that could 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 Creek. 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.

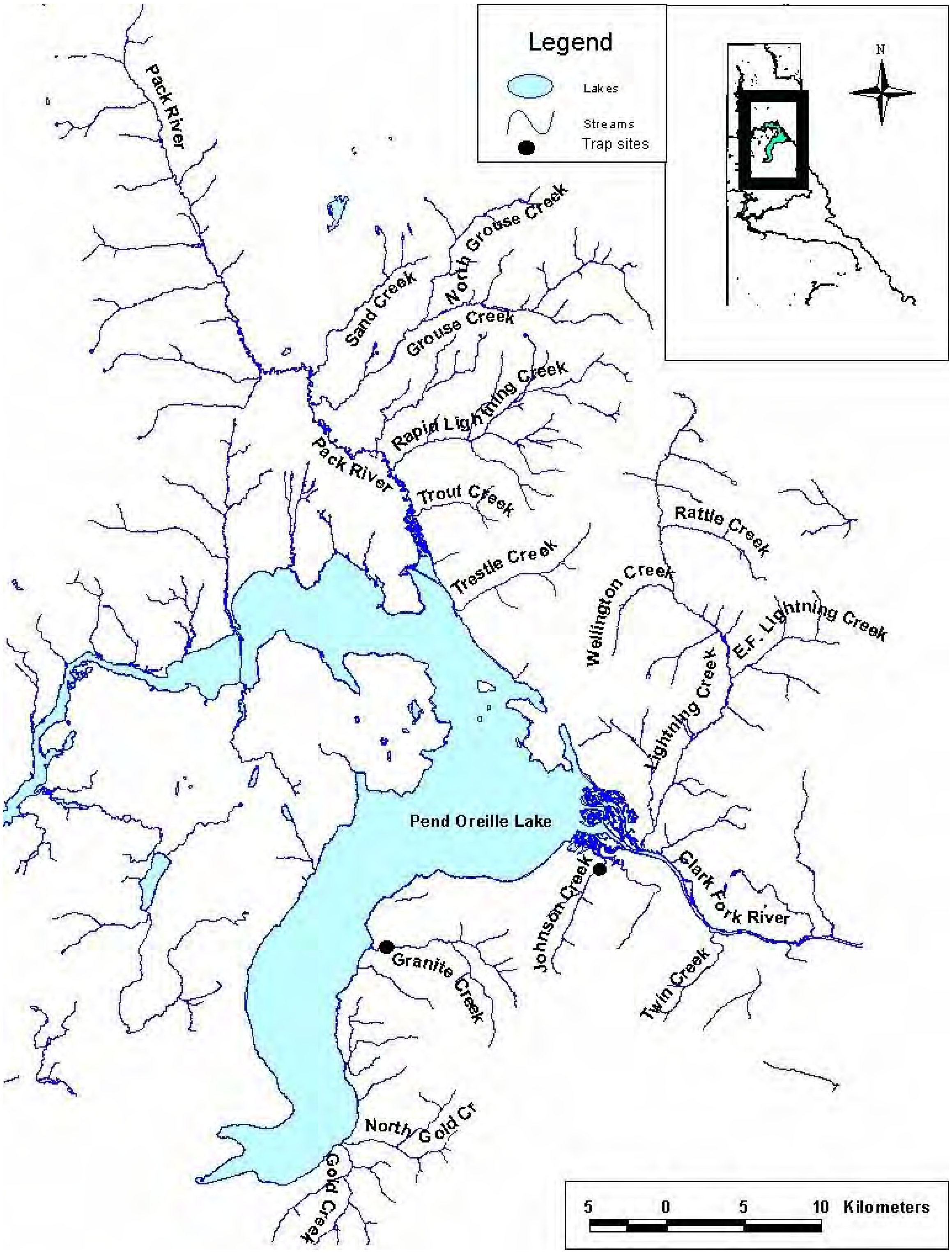

Figure 1. Trap locations in Johnson (2001-2004) and Granite (2002-2005) creeks, tributaries to the Clark Fork River and Pend Oreille Lake, Idaho.

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 barrier. 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 was 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

Johnson Creek

On July 15, 2005, we removed a portion of the root-mass barrier on Johnson Creek with a handsaw. Because water depth in the plunge-pool below the barrier was sufficient to allow unimpeded movement upstream by spawners, no trapping effort was necessary in 2005.

After removing a portion of root-mass forming the head-cut on Johnson Creek, a redd count was conducted on October 13, 2005. Redds were located visually by walking upstream from the mouth of Johnson Creek to Johnson Creek 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). In areas of superimposition, each distinct depression was counted as a redd.

Granite Creek

On July 8, 2005, upstream and downstream weir boxes were installed in Granite Creek. The upstream weir box was located approximately 50 m upstream of the confluence of Granite Creek with Sullivan Springs Creek, which is used each fall by the IDFG as a kokanee *Oncorhynchus 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 3). 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 bull 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.

The traps were checked each day, and water temperature (C) recorded using a hand-held thermometer. 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.

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. The 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 12-volt battery was used to run the pump. Fish captured 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.

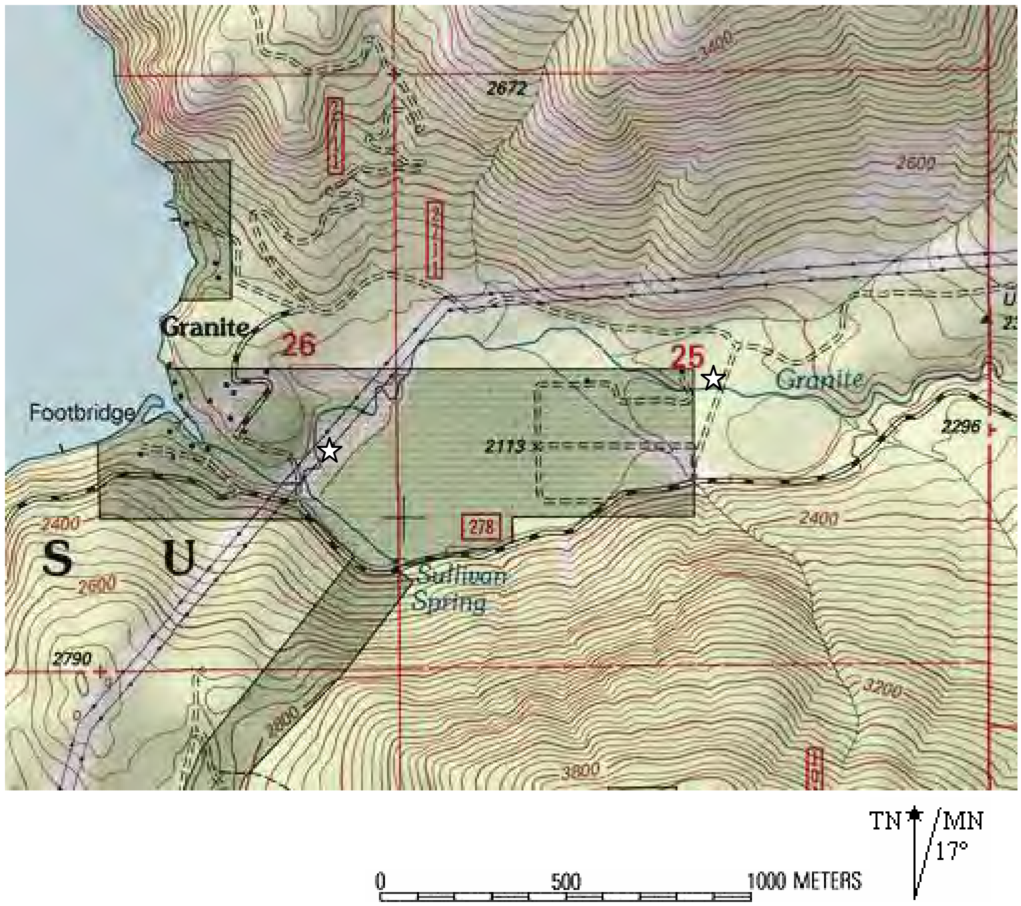

Figure 3. Bull trout trap locations on Granite Creek, a tributary to Lake Pend Oreille, Idaho.

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

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

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 relationship between the F distribution and the binomial distribution (Krebs 1998; Zar 1996).

We also conducted a large-scale removal of fish from the section of Granite Creek that would become dewatered once construction of the new stream channel was completed, and water was diverted into the new channel. We used a temporary downstream weir and trap box between the upper and lower ends of the "old" stream channel and used up to three backpack electrofishing units to conduct the removal. We employed multiple removal events between July 26 and August 23, 2005. We utilized crews of up to 30 individuals consisting of volunteers and employees from the Panhandle Chapter of Trout Unlimited, US Forest Service, US Fish and Wildlife Service, Avista, and the Idaho Department of Fish and Game. Fish were weighed, measured, and released outside of the restoration project area.

RESULTS

Johnson Creek

Because we removed a portion of the root-mass impeding upstream movement of adult bull trout in Johnson Creek, no trapping effort was necessary in 2005.

A complete redd count was conducted in Johnson Creek from the mouth upstream to the falls on October 13, 2005. Forty-five redds were observed during the redd count, the highest count on record (Figure 4).

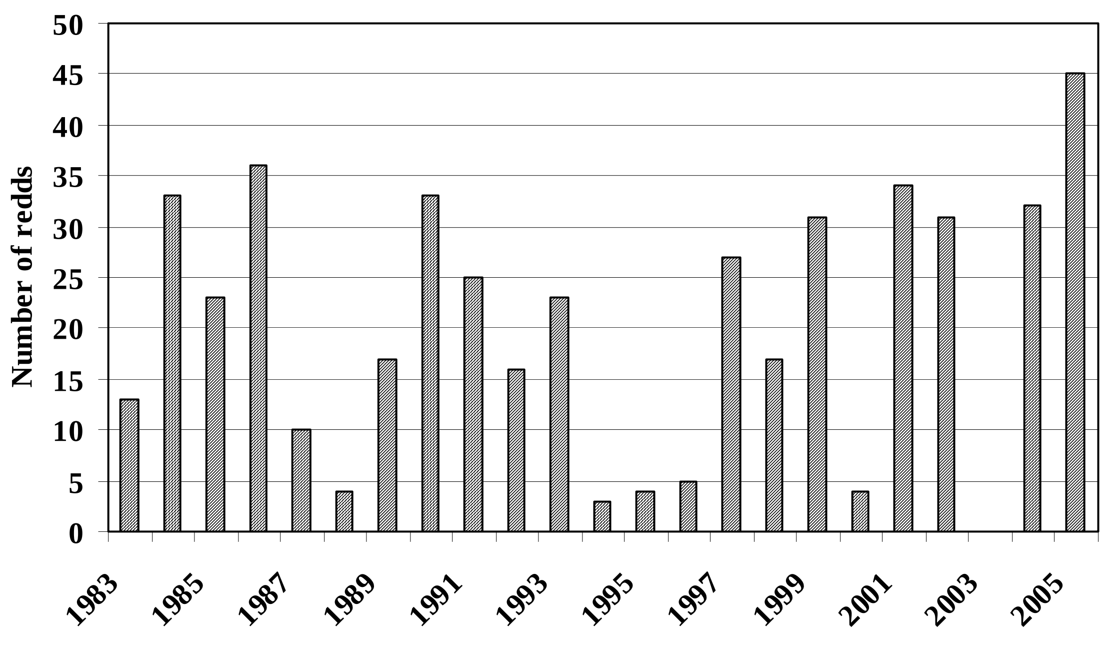

Figure 4. Bull trout redd counts in Johnson Creek, a tributary to the Clark Fork River, Idaho, from 1983 through 2005.

Granite Creek

Both the upstream and downstream weirs were installed on July 8, and removed on October 17, 2005. During this time, water temperatures taken during trap checks, typically occurring during late morning or early afternoon, ranged from 6^{o} C to 12^{o} C (Figure 5). In the upstream weir, a total of 166 adult bull trout were captured and transported above the barrier (Figure 6).

The mean total length for adult bull trout moving upstream was 541.1 mm (range: 370-753; S.D. = 76.5; n = 166). The mean weight was 1,429 g (S.D. = 634.4; n = 166) (Figure 7). Of the 166 adults captured moving upstream, 52 were PIT tag recaptures tagged in Granite Creek in 2002 through 2004. The remaining 114 were unmarked fish, of which 113 were subsequently PIT tagged and released to spawn. In addition, 40 juvenile bull trout (< 300 mm total length) were also captured moving upstream and PIT tagged. Of those, 21 were transported upstream while the remaining 19 were released back downstream to keep them out of the restoration area during construction.

In the downstream weir, a total of 198 adult bull trout were captured and transported below the barrier after spawning (Figure 8). One hundred nineteen of these were previously PIT tagged. Of the 119 recaptures, 57 were fish tagged moving upstream in 2005. Seventy-five unmarked adults captured moving downstream were subsequently PIT tagged. An additional seven PIT tagged and four unmarked adult bull trout were found dead in the trap and appeared to be natural post-spawn mortalities. We also captured 562 juvenile bull trout (including six mortalities) moving downstream, 267 of which we subsequently PIT tagged (Table 1; Figure 9).

We derived a mark-recapture population estimate of adult escapement of 390 (95% CI: 311-513) 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.

A redd count was conducted on October 11, 2005 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 132 redds were counted in 2005 (Figure 10).

In addition to adult and juvenile bull trout captured in the downstream weir, we also captured juvenile rainbow *Oncorhynchus mykiss* and westslope cutthroat trout *O. clarki lewisi*, sculpin *Cottus* sp., and a single 53 mm unidentified *Oncorhynchus* sp. (Table 1; Figure 11).

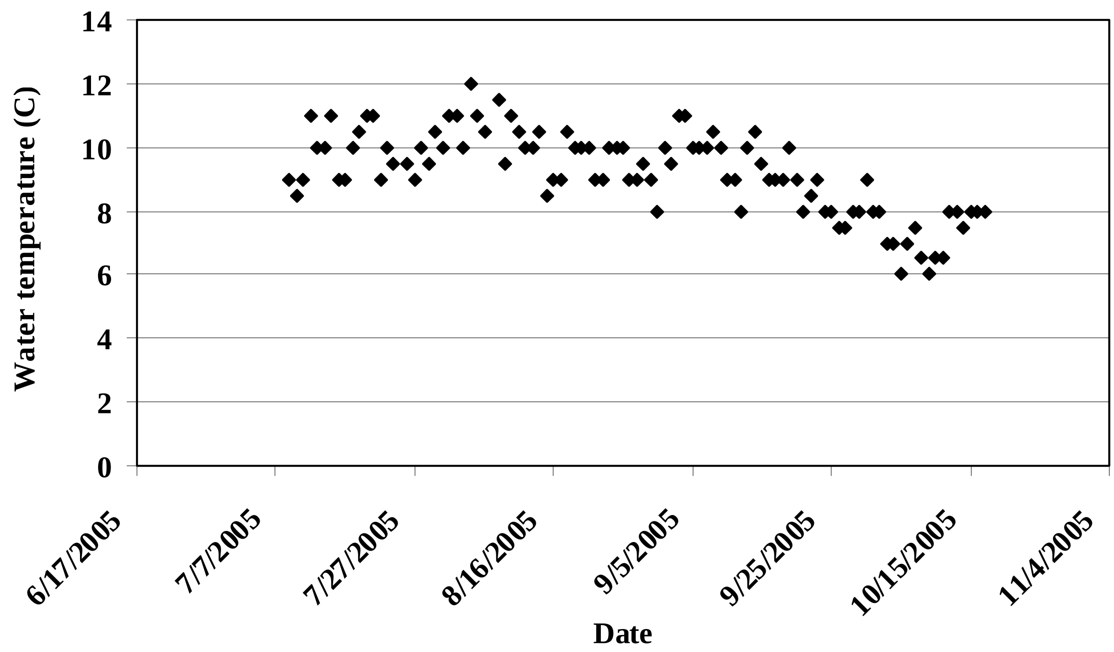

Figure 5. Daily water temperatures typically recorded during late morning/early afternoon trap checks in Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

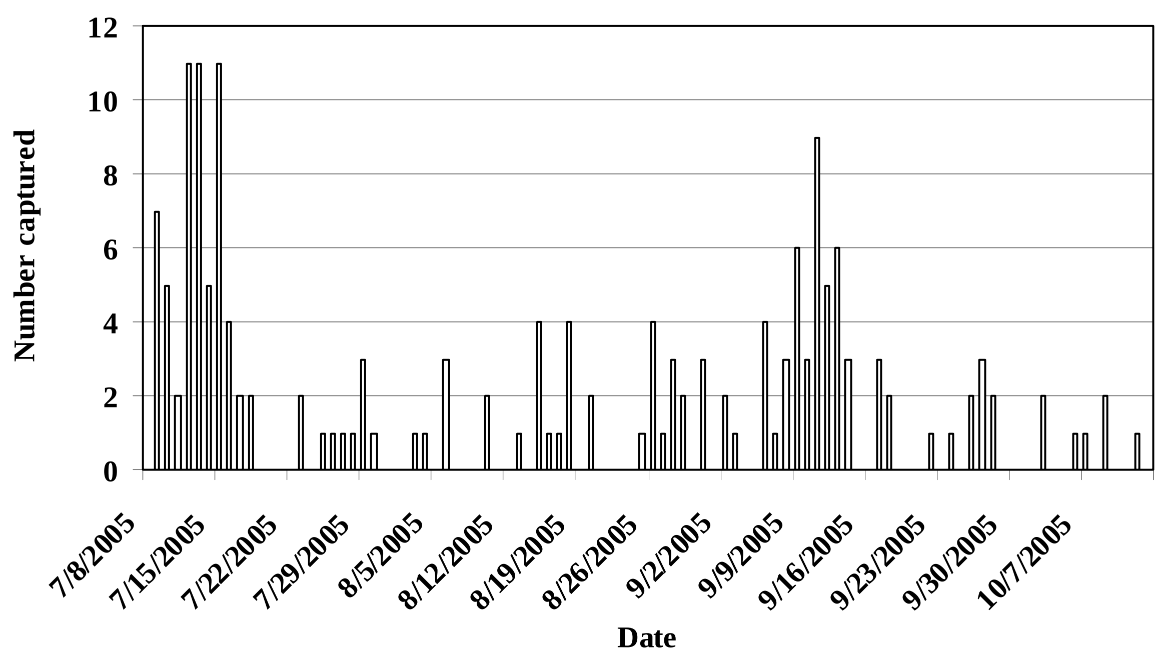

Figure 6. Timing of upstream migration of adult bull trout (n = 168) in Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

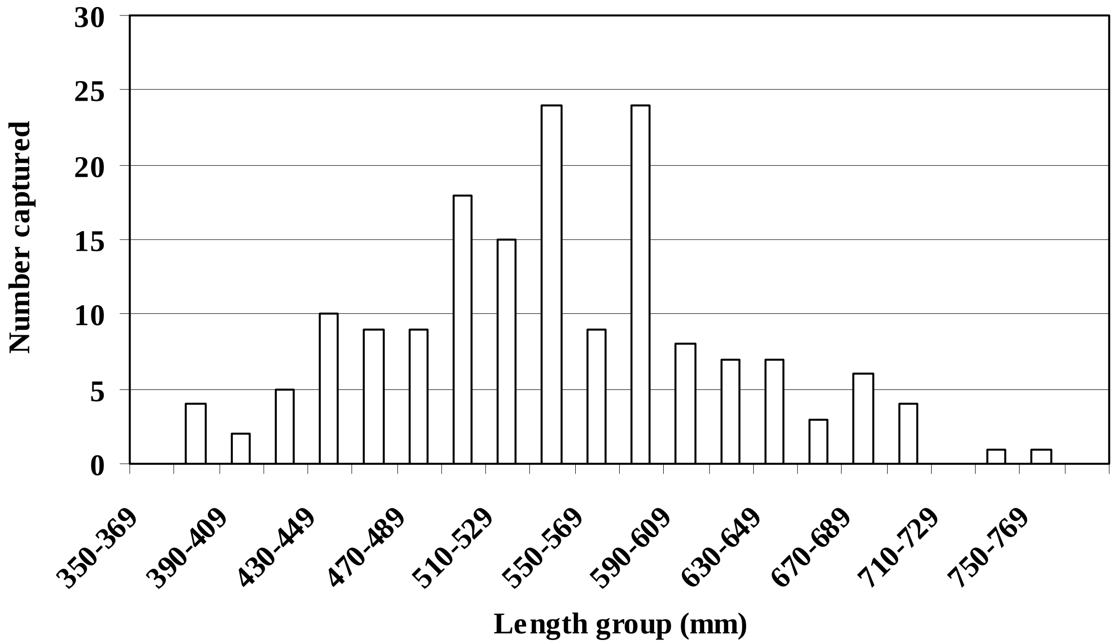

Figure 7. Length frequency histogram for adult bull trout captured moving upstream in the weir on Granite Creek (n = 166), a tributary to Lake Pend Oreille, Idaho, during 2005.

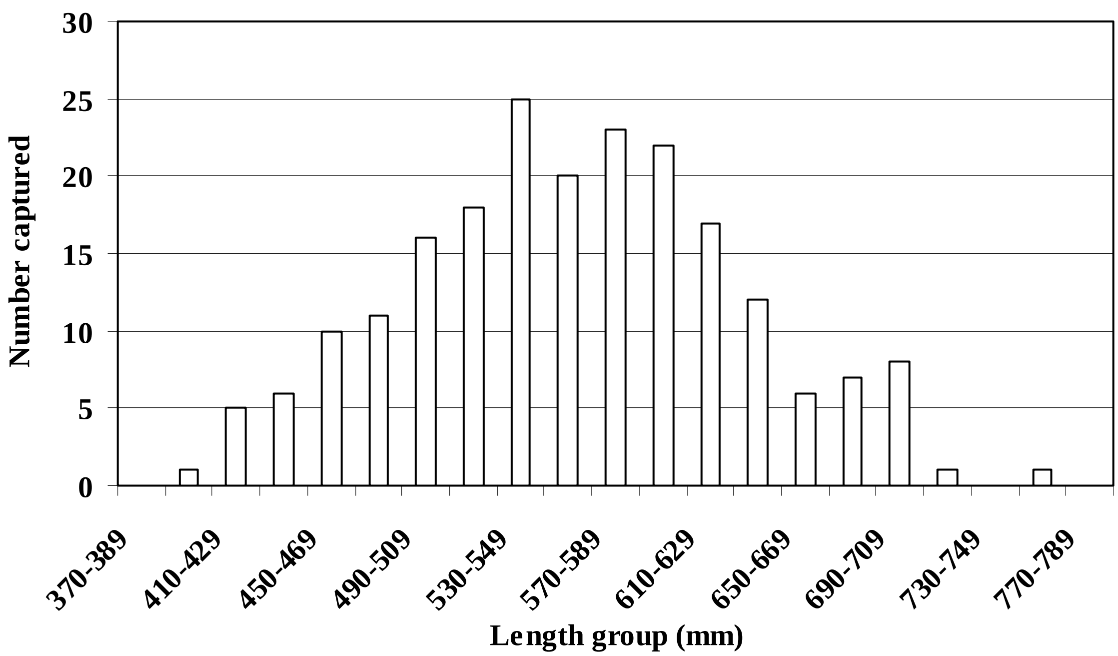

Figure 8. Length frequency histogram for adult bull trout (n = 209) captured moving downstream in Granite Creek, a tributary to Lake Pend Oreille, Idaho, during 2005.

Table 1. Mean lengths (TL; mm), mean weights (g), standard deviation (S.D.), sample size (n), and length range for all juvenile species captured in the downstream weir in Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Species	Mean length (S.D.) (n)	Length range	Mean weight (S.D.) (n)
Bull trout	104.3 (46.2) (562)	50-220	13.5 (15.8) (523)
Westslope cutthroat trout	145.6 (47.4) (58)	65-281	39.2 (44.1) (58)
Rainbow trout	135.5 (6.4) (2)	131-140	27.0 (2.8) (2)
Sculpin *Cottus* sp.	88.0 (29.7) (2)	67-109	8.5 (7.8) (2)

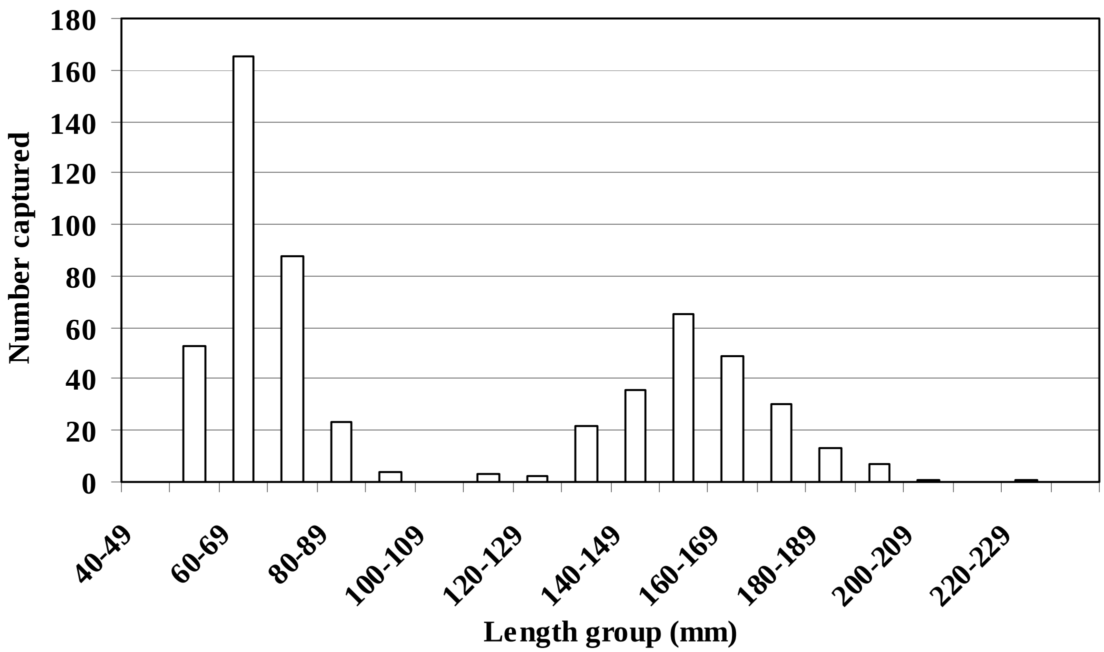

Figure 9. Length frequency histogram for juvenile bull trout captured moving downstream in the weir on Granite Creek (n = 562), a tributary to Lake Pend Oreille, Idaho, during 2005.

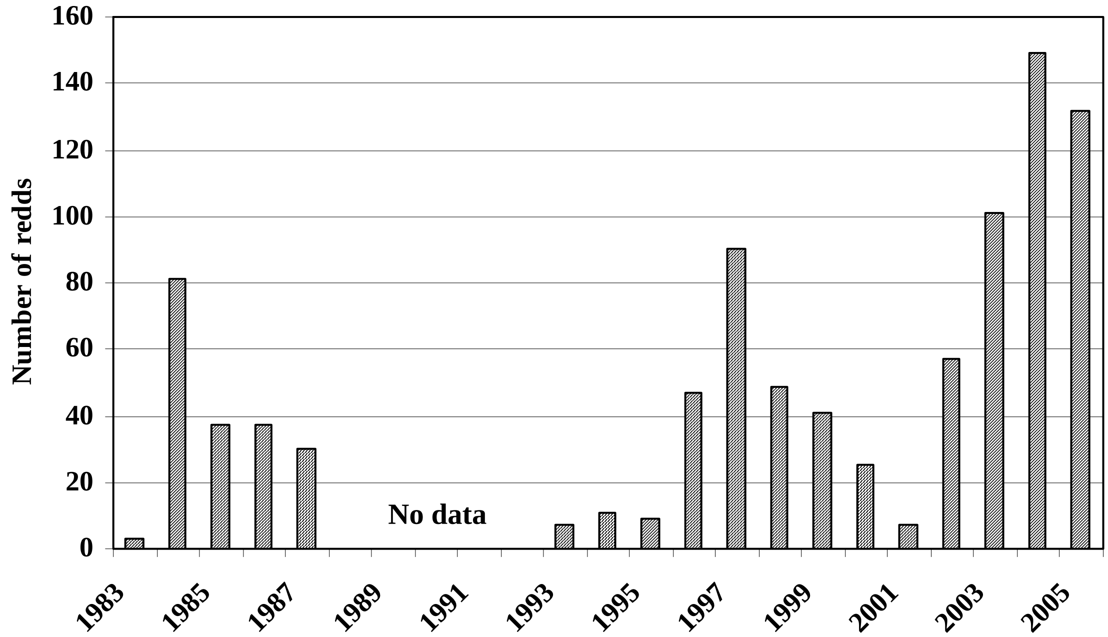

Figure 10. Bull trout redd counts in Granite Creek, a tributary to Lake Pend Oreille, Idaho, from 1983 through 1987, and 1992 through 2005.

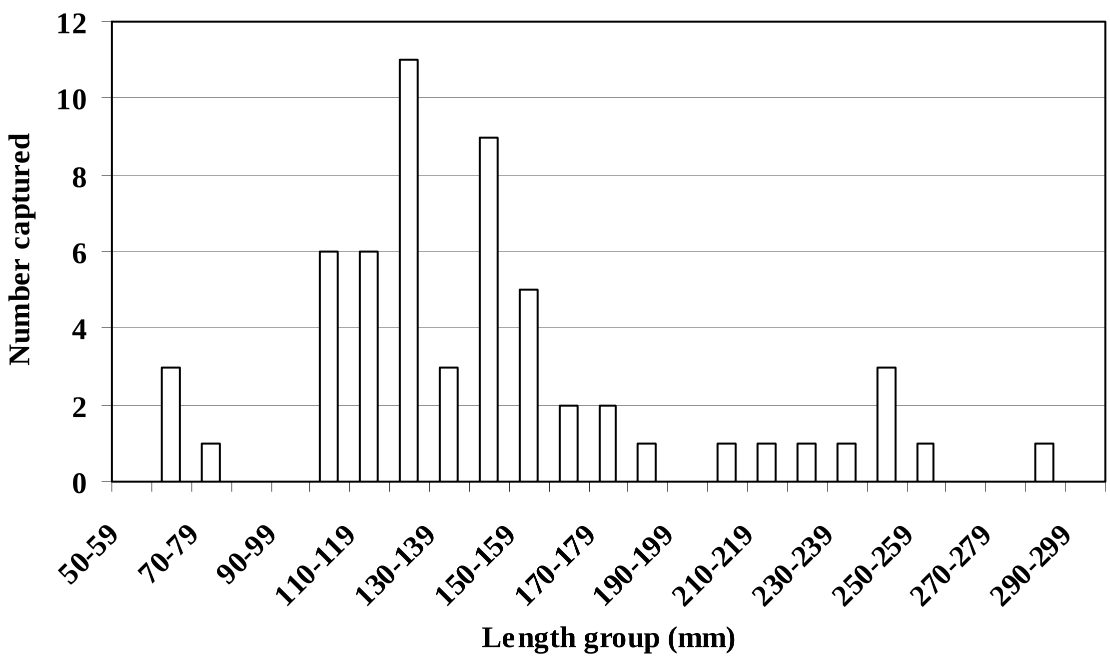

Figure 11. Length frequency histogram for juvenile westslope cutthroat trout captured moving downstream in the weir on Granite Creek (n = 58), a tributary to Lake Pend Oreille, Idaho, during 2005.

Ten times between July 26 and August 23, 2005 we attempted to remove as many fish as possible from the section of stream channel in Granite Creek that would become dry once the restoration project was completed and water was diverted into the new channel. Personnel from IDFG, Avista Corp., U.S. Fish and Wildlife Service, U.S Forest Service, and the Idaho Panhandle Chapter of Trout Unlimited were able to capture and transport 2,284 salmonids, with an additional estimated 350 salmonids that were not tallied due to fish stress, downstream of the restoration project. Of the 2,284 salmonids that were counted, 1,648 were age-0 bull trout, 272 were age-1 and older juvenile bull trout, and four were adults. There were also 151 age-1 and older westslope cutthroat trout captured. In addition to salmonids, 58 sculpin *Cottus* sp. were also captured and moved.

DISCUSSION

Johnson Creek

Because we did not need to conduct a trap and haul program on Johnson Creek in 2005, instead relying on providing natural spawner access through a partial barrier removal, the exact number of adults that were able to ascend the head-cut and reach their spawning areas is not known. However, using an approximate of three adults/redd, based on the average spawner:redd ratio for LPO as a whole, we can estimate that approximately 135 adults were able to ascend the head-cut and reach their spawning areas.

The record count of 45 redds during the October 13, 2005 survey of Johnson Creek should result in a relatively strong year class of juveniles in Johnson Creek. Combined with what should be a fairly strong year class of juveniles produced in 2004, when 32 redds were counted, this will hopefully offset some of the 2003 spawning failure that occurred in Johnson Creek.

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 through partial barrier removal, or with a temporary ladder or continued trapping.

Granite Creek

We captured and transported 166 individual adult bull trout around the low flow barrier on Granite Creek during the summer and fall of 2005 to provide access to the majority of the spawning habitat in Granite Creek. This number is far greater than the nearly 100 adults passed upstream past the low flow barrier in 1997, and 131 passed in 2002, although it is considerably lower than the 264 and 223 passed upstream in 2003 and 2004, respectively. Based on the population estimate (390) and redd counts (132), a considerable amount of the reproduction in Granite Creek in 2005 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 12).

The 2005 population estimate of 390 (95% CI: 311-513) adult bull trout is considerably higher than the 289 and 294 individuals estimated in 2002 and 2003, respectively. It is however, similar to the 2004 estimate of 425 individuals. The spawner:redd ratio of 3.0:1 estimated from the 2005 data is almost identical to the 2004 ratio, but lower than the 5.1:1 observed in 2002. The 3.0:1 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).

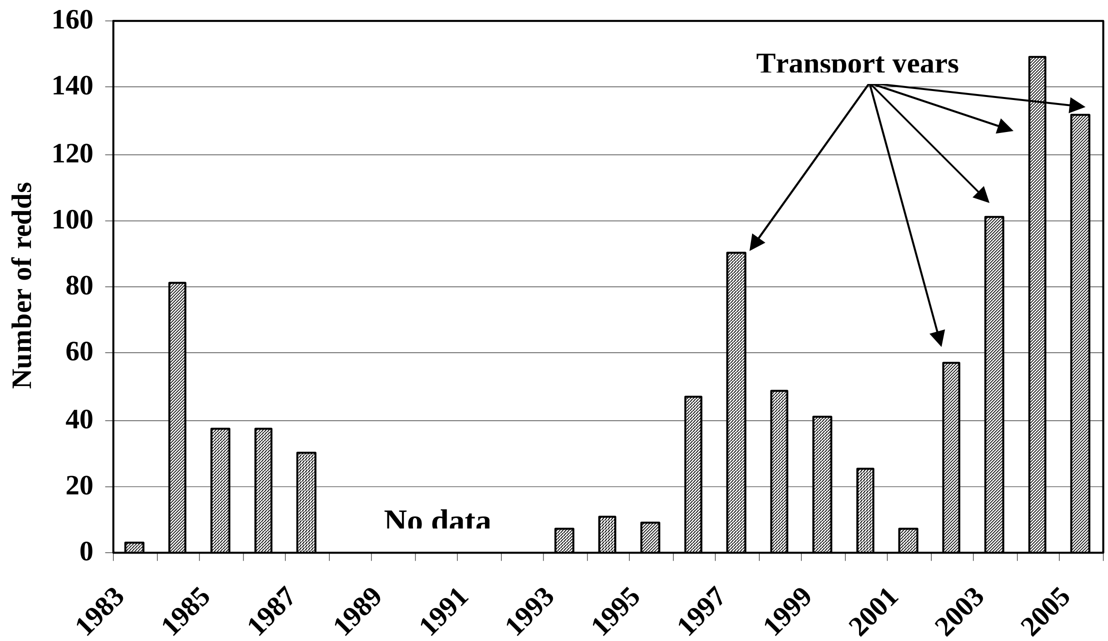

Figure 12. Annual bull trout redd counts compared to transport years on Granite Creek, a tributary to Lake Pend Oreille, Idaho.

Table 2. Bull trout spawner to redd ratios estimated for individual tributaries to Lake Pend Oreille, Idaho, sampled from 2000 through 2005.

Stream	**Year**	**Spawner:redd ratio**
Trestle Creek[a]	2000	3.7:1
Gold Creek[a]	2000	1.9:1
Granite Creek[b]	2002	5.1:1
Granite Creek[c]	2003	2.9:1
Granite Creek[d]	2004	2.9:1
Granite Creek	2005	3.0:1
Grouse Creek[a]	2000	2.9:1
Average		3.2:1

[a] Downs et al. 2003
[b] Downs and Jakubowski 2003
[c] Downs and Jakubowski 2004
[d] Downs and Jakubowski 2005

The old Granite Creek intermittent/impaired reach was 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 required a significant investment of financial resources on an annual basis, didn't address the cause of the problem, and didn'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 had persisted for six years and annually inhibited migration of relatively large numbers of bull trout. For those reasons, a long-term solution was desired. A stream channel assessment and restoration design was completed in 2003 (River Design Group 2004). We implemented a stream restoration project to restore yearlong natural fish passage in 2005 to this reach of Granite Creek, and will evaluate its' effectiveness through ongoing population monitoring and annual redd counts.

ACKNOWLEDGEMENTS

The authors wish to thank John Suhfras and Tyler Long of Avista for their contributions to completing the field work associated with this project. We would also like to thank all the personnel from the Idaho Department of Fish and Game, U.S. Forest Service, U.S. Fish and Wildlife Service, and especially the volunteers from the Idaho Panhandle Chapter of Trout Unlimited, who assisted with the Granite Creek restoration project. We would also like to thank Ned Horner and Steve Yundt of the Idaho Department of Fish and Game, Joe DosSantos of Avista Corp., Brad Liermann of Montana Fish, Wildlife, and Parks, and Larry Lockard of the U.S. Fish and Wildlife Service for their reviews of this report.

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2005 Twin Creek Restoration Monitoring Progress Report

ABSTRACT

In 2005 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 *Salvelinus confluentus* and westslope cutthroat trout *Oncorhynchus clarki lewisi* were both 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. However, abundance of bull trout ≥ 100 mm abundance remains low in all sections monitored, with none captured in 2005. Rainbow trout (≥ 75 mm) are the 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.

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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 *Salvelinus confluentus*, westslope cutthroat trout *Oncorhynchus clarki lewisi*, brown trout *Salmo trutta* and rainbow trout *O. mykiss* 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 Dam 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 seven, 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.

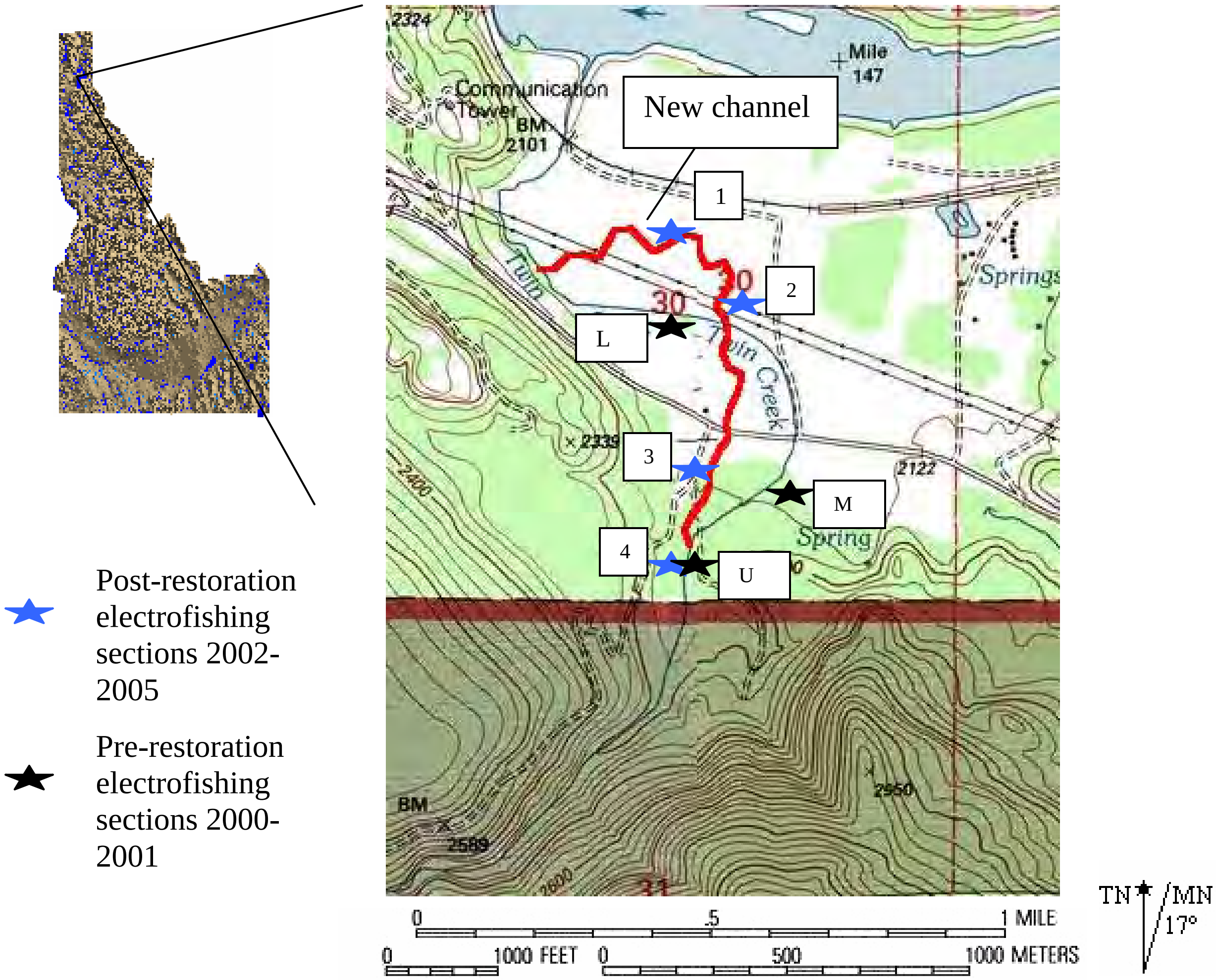

Figure 1. Vicinity map and sample site locations for Twin Creek, a tributary to the Clark Fork River, Idaho (L = lower, M = middle, U = upper pre-restoration sampling sites).

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; 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 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 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. Fish 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 5 and 6, 2005. Fish were anesthetized, measured (total length; mm), and weighed (g). Genetic samples were also collected from 31 bull trout and 30 brook trout *Salvelinus fontinalis* for future analysis. Fish were allowed to recover their equilibrium and were released back into the stream below the section. All brook trout 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 five salmonid species in Twin Creek in 2005 (Table 1), while conducting electrofishing depletion population estimates in four sections (Table 2). Brook and rainbow trout $\geq$ 75 mm were found in all sections, while bull trout $\geq$ 75 mm were found in the two lowest sections, associated with the known spawning area for bull trout in Twin Creek. Two bull trout (70 and 73 mm), as well as a single bull trout hybrid (147 mm) (based on visual classification) were also captured in Section 3. Westslope cutthroat trout and westslope X rainbow trout hybrids $\geq$ 75 mm were found in the two uppermost sections, with westslope X rainbow trout hybrids of 115 mm and 96 mm being captured in Section 3 and Section 4, respectively (Table 3). In Section 3, we were not able to generate an estimate for westslope cutthroat trout because of the non-declining catch pattern. However, we did capture one westslope cutthroat trout $\geq$ 75 mm in this section. Rainbow trout $\geq$ 75 mm were the dominant species captured in all sections, with the highest density ($21.08/100m^2$) recorded in Section 4 (Table 2). Average size of salmonids $\geq$ 75 mm captured ranged from 77 mm for a single bull trout captured in Section 2, to 188 mm for a single bull trout hybrid (based on visual classification) captured in Section 1 (Table 3). In Section

1, a total of 31 bull trout including fish < 75 mm were captured, while in Section 2 a total of six bull trout including fish < 75 mm were captured. The length-frequency histograms for bull trout captured in Section 1 and Section 2 indicate the presence of a single age-class, likely age-0 (Figures 2 and 3). A single brown trout (56 mm) was also captured in Section 1, while a single unidentified *Oncorhynchus* species (60 mm) was captured in Section 4.

Table 1. Species captured in Twin Creek, a tributary to the Clark Fork River, Idaho, in 2005.

Species	Abbreviation
Brook trout *Salvelinus fontinalis*	BRK
Brown trout *Salmo trutta*	BRN
Bull trout *Salvelinus confluentus*	BLT
Rainbow trout *Oncorhynchus mykiss*	RBT
Westslope cutthroat trout *O. clarki lewisi*	WCT

Table 2. Total number captured (all lengths) and population estimates for salmonid species (≥ 75 mm; TL) captured in all four sections in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2005.

Location	Species	Total captured	Estimate (95% CI)	N/100m^2	CPUE (fish/minute)
Section 1	BLT	31	1 (1-1)	0.24	0.03
	BRK	2	2 (2-2)	0.49	0.06
	RBT	13	13 (13-13)	3.18	0.23
Section 2	BLT	6	1 (1-1)	0.31	0.03
	BRK	3	3 (3-3)	0.93	0.06
	RBT	27	27 (27-27)	8.35	0.55
Section 3	BRK	17	15 (14-16)	4.11	0.28
	RBT	63	62 (57-67)	16.99	1.05
	WCT	1	N/A[a]	N/A	0.0
Section 4	BRK	8	8 (8-8)	2.59	0.09
	RBT	63	65 (63-77)	21.08	0.7
	WCT	1	1 (1-1)	0.32	0.02

[a]No estimate. One westslope cutthroat trout ≥ 75 mm captured.

Table 3. Mean lengths (TL; mm), mean weights (g), standard deviation (SD) and sample size (n) for individuals ≥ 75 mm, and length range for all individuals captured in all four sections in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2005.

Location	**Species**	**Mean length (S.D.) (n)**	**Length range**	**Mean weight (S.D.) (n)**
Section 1	BLT x BRK	188.0 (N/A) (1)	N/A	59.0 (N/A) (1)
	BLT	79.0 (N/A) (1)	57-79	6.0 (N/A) (1)
	BRK	142.5 (17.7) (2)	130-155	31.0 (11.3) (2)
	RBT	102.8 (22.4) (13)	75-148	12.4 (7.9) (13)
Section 2	BLT	77.0 (N/A) (1)	59-77	4.0 (N/A) (1)
	BRK	137.3 (34.0) (3)	104-172	28.3 (19.2) (3)
	RBT	109.5 (19.1) (27)	80-167	14.6 (9.1) (27)
Section 3	BLT x BRK	147.0 (N/A) (1)	N/A	29.0 (N/A) (1)
	BRK	128.8 (37.7) (15)	59-240	25.8 (32.7) (15)
	RBT	101.4 (22.7) (60)	70-205	12.2 (13.0) (60)
	WCT	86.0 (N/A) (1)	N/A	5.0 (N/A) (1)
	WCT x RBT	115.0 (N/A) (1)	N/A	13.0 (N/A) (1)
Section 4	BRK	113.4 (9.2) (8)	95-123	14.1 (3.3) (8)
	RBT	101.7 (23.4) (62)	73-210	12.4 (13.5) (62)
	WCT	165.0 (N/A) (1)	N/A	46.0 (N/A) (1)
	WCT x RBT	96.0 (N/A) (1)	N/A	9.0 (N/A) (1)

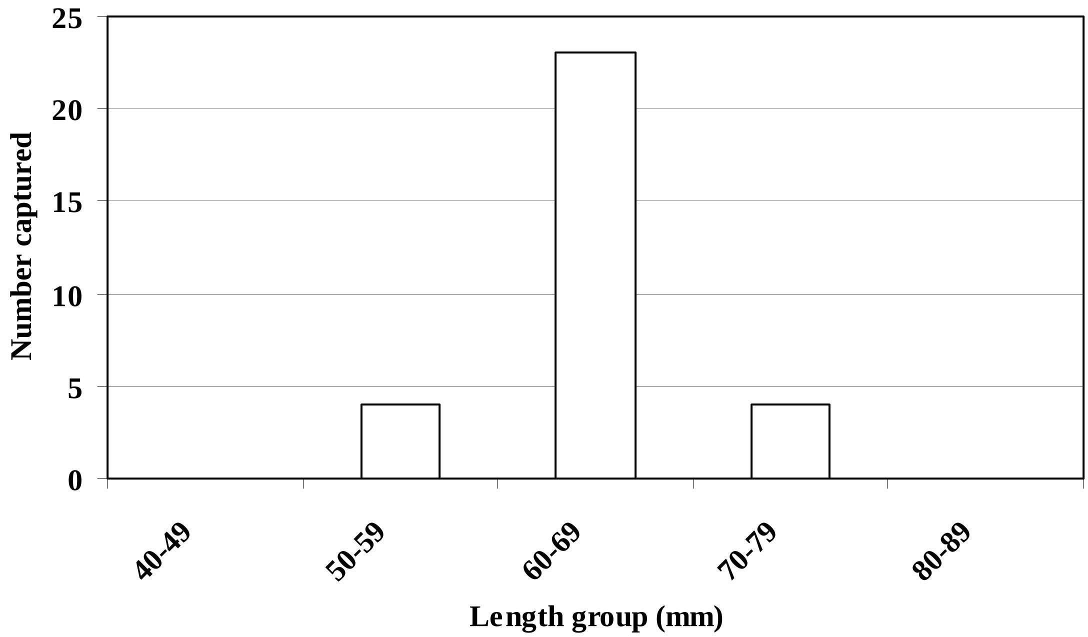

Figure 2. Length frequency histogram for all bull trout (n = 31) captured in Section 1, Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2005.

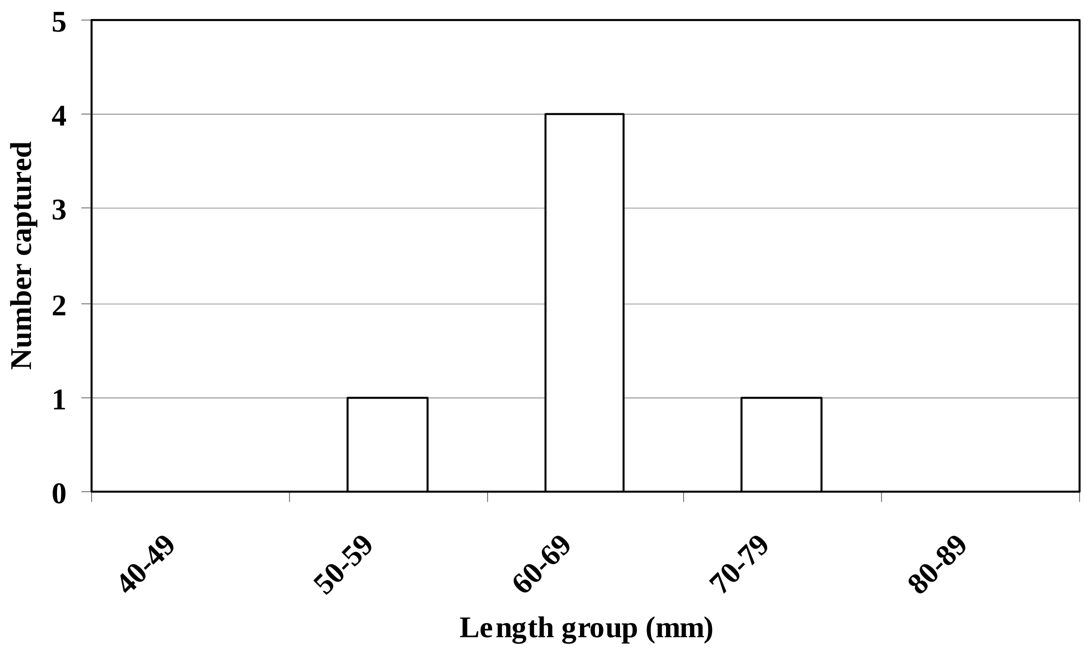

Figure 3. Length frequency histogram for all bull trout (n = 6) captured in Section 2, Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2005.

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 2005. 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 2005; Downs and Jakubowski 2006). 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. In 2005 we removed 30 brook trout and 2 hybrids. 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.

Across the six years compared (2000 through 2005), 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 Creek, which occurs between the mouth of Twin Creek and River Road. Total catch of age-1 and older bull trout remains low in all sections over the six years compared, with no obvious trends apparent.

In the lower reach of Twin Creek in 2000, two bull trout, 75 mm and 77 mm were captured, while in 2001, a total of 30 bull trout (mean TL = 58 mm; range = 51-64 mm) were captured. In 2002, the year following the completion of the restoration project, a single 167 mm bull trout and four bull X brook trout hybrids, ranging from 184 mm to 216 mm were captured in the comparison Section 2. In 2003, a total of 47 bull trout ranging from 65 mm to 106 mm were captured in the comparison Section 2, while no bull X brook trout hybrids were captured. In the comparison Section 2 in 2004, a total of seven bull trout were captured, with one individual being

163 mm total length. The other six ranged from 70 mm to 81 mm. A single 102 mm bull X brook trout hybrid was also captured. In 2005 we captured six bull trout ranging from 59 mm to 77 mm in the comparison Section 2.

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. 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 appeared 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. In 2005, only two bull trout, 70 mm and 73 mm were captured in the comparison Section 3, while 17 brook trout were captured, with 13 of those being greater than 100 mm total length. The largest brook trout captured was 240 mm. A single bull X brook trout hybrid 147 mm was also captured. 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 of Twin Creek.

Section 4 (Upper sampling reach) has been consistently sampled from 2000 through 2005 and was not impacted by stream restoration. We observed consistently low numbers of bull trout in this section across all years. With the exception of 2005, when eight brook trout were captured, 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. In 2005, a single westslope cutthroat trout and westslope X rainbow trout hybrid, 165 mm and 96 mm respectively, were captured. Although not used for direct comparison due to a later sampling date, relatively high densities (12 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, 2004 or 2005. 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.

A comparison of depletion estimates and densities for the four sections on Twin Creek, post-restoration (2002-2005), indicates continued low abundance of juvenile bull trout, particularly of older age classes (Table 4). Abundance of juvenile bull trout > 75 mm was quite high in 2003 compared to other years, however sampling was conducted later in the year in 2003 (early August) and age-0 bull trout grew into the estimate size group prior to sampling that year.

The earlier sampling dates in other years (July) reduced, but did not eliminate, this effect. Overall abundance of age-1 and older bull trout remains low in Twin Creek. To date we have not seen a significant positive response from the native fish populations to the restoration work, but additional monitoring is needed to determine longer-term trends in species abundance.

Table 4. Comparison of depletion population estimates and densities for salmonid species ≥ 75 mm (TL) captured in all four sections of Twin Creek, a tributary to the Clark Fork River, Idaho, during 2002-2005.

Location	Species	Year	Estimate (95% CI)	N/100m^2
Section 1	BLT	2002	2 (2-2)	0.49
		2003	18 (17-22)	4.39
		2004	N/A[a]	N/A
		2005	1 (1-1)	0.24
	BRK	2002	2 (2-2)	0.49
		2003	12 (12-12)	2.93
		2004	2 (2-2)	0.49
		2005	2 (2-2)	0.49
	BRN	2002	2 (2-2)	0.49
		2003	17 (16-18)	4.15
		2004	N/A	0.0
		2005	N/A	0.0
	RBT	2002	9 (8-10)	2.21
		2003	2 (0-4)	0.49
		2004	6 (6-6)	1.46
		2005	13 (13-13)	3.18
Section 2	BLT	2002	N/A[a]	N/A
		2003	39 (38-40)	12.19
		2004	5 (5-5)	1.56
		2005	1 (1-1)	0.31
	BRK	2002	6 (6-6)	1.23
		2003	27 (27-28)	8.44
		2004	10 (10-10)	3.13
		2005	3 (3-3)	0.93
	BRN	2002	7 (7-7)	1.44
		2003	30 (29-31)	9.38
		2004	6 (6-6)	1.88
		2005	N/A	0.0
	MWF	2002	N/A	0.0
		2003	1 (1-1)	0.31
		2004	N/A	0.0
		2005	N/A	0.0
	RBT	2002	13 (12-14)	2.67
		2003	12 (10-14)	3.75
		2004	8 (8-8)	2.50
		2005	27 (27-27)	8.35
	WCT	2002	N/A	0.0
		2003	1 (1-1)	0.31
		2004	N/A	0.0
		2005	N/A	0.0

Table 4 continued.

Location	Species	Year	Estimate (95% CI)	N/100m^2
Section 3	BLT	2002	N/A	0.0
		2003	5 (5-8)	1.36
		2004	4 (4-4)	1.09
		2005	N/A	0.0
	BRK	2002	2 (2-2)	0.53
		2003	6 (5-7)	1.64
		2004	1 (1-1)	0.27
		2005	15 (14-16)	4.11
	BRN	2002	1 (1-1)	0.27
		2003	2 (2-2)	0.55
		2004	1 (1-1)	0.27
		2005	N/A	0.0
	MWF	2002	N/A	0.0
		2003	2 (2-2)	0.55
		2004	N/A	0.0
		2005	N/A	0.0
	RBT	2002	15 (13-17)	4.0
		2003	6 (3-9)	1.64
		2004	7 (7-7)	1.91
		2005	62 (57-67)	16.99
	WCT	2002	N/A	0.0
		2003	15 (2-28)	4.09
		2004	2 (2-2)	0.55
		2005	N/A[a]	N/A
Section 4	BRK	2002	1 (1-1)	0.33
		2003	1 (1-1)	0.33
		2004	N/A	0.0
		2005	8 (8-8)	2.59
	RBT	2002	31 (29-33)	9.94
		2003	32 (30-34)	10.42
		2004	26 (26-34)	8.48
		2005	65 (63-77)	21.08
	WCT	2002	N/A	0.0
		2003	35 (33-37)	11.41
		2004	N/A	0.0
		2005	1 (1-1)	0.32

[a]No estimate possible due to non-declining catch pattern. Two bull trout $\geq$ 75 mm were captured in Section 2 in 2002, Three bull trout $\geq$ 75 mm were captured in Section 1 in 2004, and one westslope cutthroat trout $\geq$ 75 mm was captured in Section 3 in 2005.

For comparison, depletion population estimates and densities for salmonid species ≥ 75 mm captured in the lower, middle and upper sections in Twin Creek, pre-restoration, show low densities of bull trout, particularly age-1 and older individuals (Table 5).

Table 5. Comparison of depletion population estimates and densities for salmonid species ≥ 75 mm (TL) captured in the Lower, Middle and Upper sections (pre-restoration) of Twin Creek, a tributary to the Clark Fork River, Idaho, during 2000 and 2001.

Location	Species	Year	Estimate (95% CI)	N/100m^2
Lower	BLT	2000	2 (2-2)	0.3
		2001	N/A	0.0
	BRK	2000	4 (N/A)	0.7
		2001	4 (4-4)	0.7
	BRN	2000	N/A	0.0
		2001	5 (5-6)	0.8
	RBT	2000	N/A	0.0
		2001	3 (3-3)	0.5
Middle	BLT	2000	N/A	0.0
		2001	1 (1-1)	0.4
	BRK	2000	6 (6-6)	2.2
		2001	N/A	0.0
	RBT	2000	6 (6-6)	2.2
		2001	4 (4-4)	1.5
	WCT	2000	13 (13-25)	4.7
		2001	N/A	0.0
Upper	BLT	2000	1 (1-1)	0.3
		2001	N/A	0.0
	BRK	2000	7 (7-7)	1.9
		2001	2 (2-2)	0.5
	RBT	2000	28 (28-28)	7.6
		2001	14 (13-19)	3.8
	WCT	2000	18 (18-18)	4.9
		2001	N/A	0.0

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2005 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 2005 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 confluentus* were present at widely varying densities in all sections sampled. Gold Creek supported the highest densities of juveniles (≥75 mm) observed (16.2/100m^2). In general, the highest densities were estimated in the sections located highest in each tributary, with Gold Creek being the notable exception. Westslope cutthroat trout *Oncorhynchus clarki lewisi* were found in all sections sampled, with the exception of the lowest section in both the E. Fk. Lightning Creek and Rattle Creek. Densities of juvenile westslope cutthroat trout (≥75 mm) were highest in the E. Fk. Lightning Creek (17.1/100m^2). Juvenile mountain whitefish *Prosopium williamsoni* were only present in the lowest section in Trestle Creek. Brook trout *S. fontinalis* do not appear to be widely distributed or abundant in any of the study streams evaluated.

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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 *Salvelinus confluentus* and westslope cutthroat trout *Oncorhynchus clarki lewisi*, as well as mountain whitefish *Prosopium williamsoni*. 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. Construction began in 2005, and by fall, the restoration project was completed. 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^2 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 ^{0}C near the mouth on August 11, 2001, but remained below 13^{0}C during summer months farther upstream, near the mouth of Char Creek, during the same year (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 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 2005. 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; Downs and Jakubowski 2006). The Lightning Creek Watershed Assessment (Philip Williams and Associates 2004) identified several areas in the East Fork Lightning Creek drainage for future restoration.

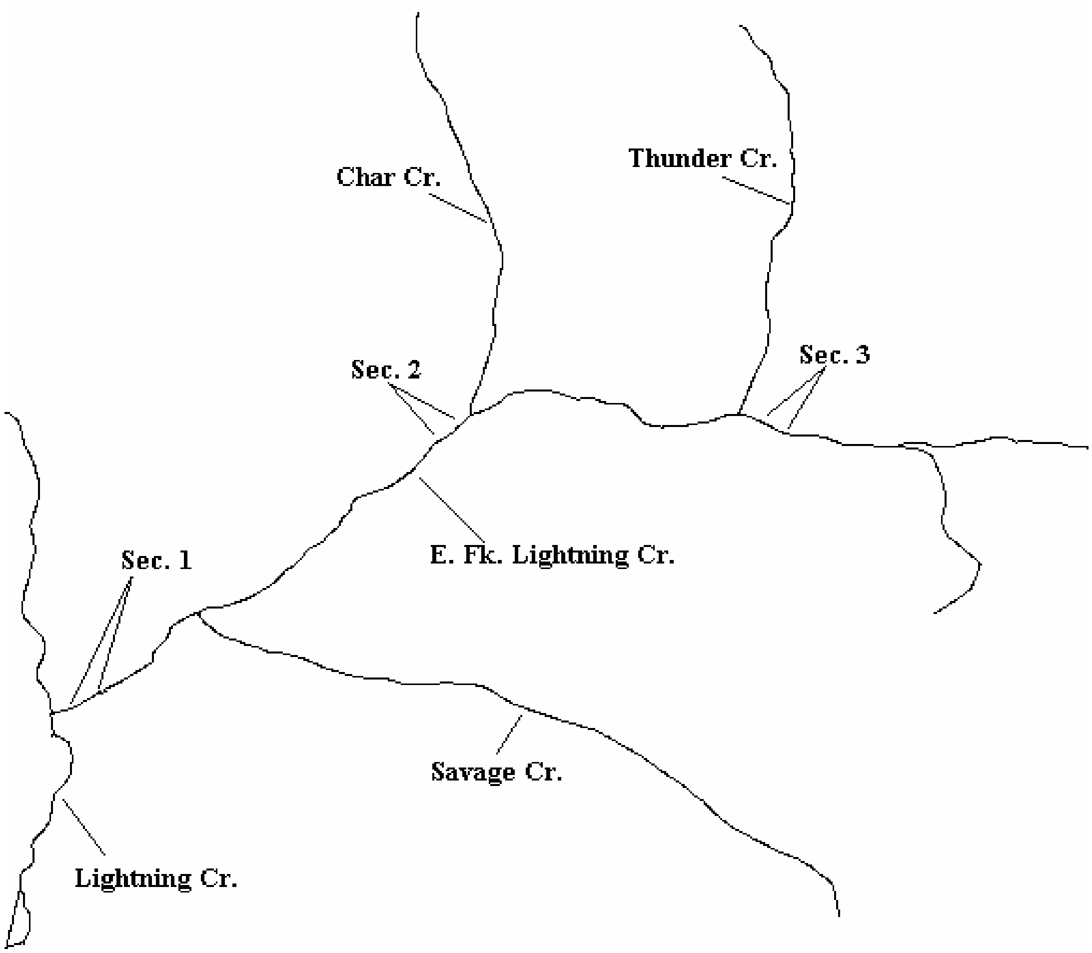

Figure 1. Electrofishing sections on East Fork Lightning Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, sampled in 2005.

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 m 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 ^{0}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 119 from 1983 through 2005. 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; Downs and Jakubowski 2006). 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.

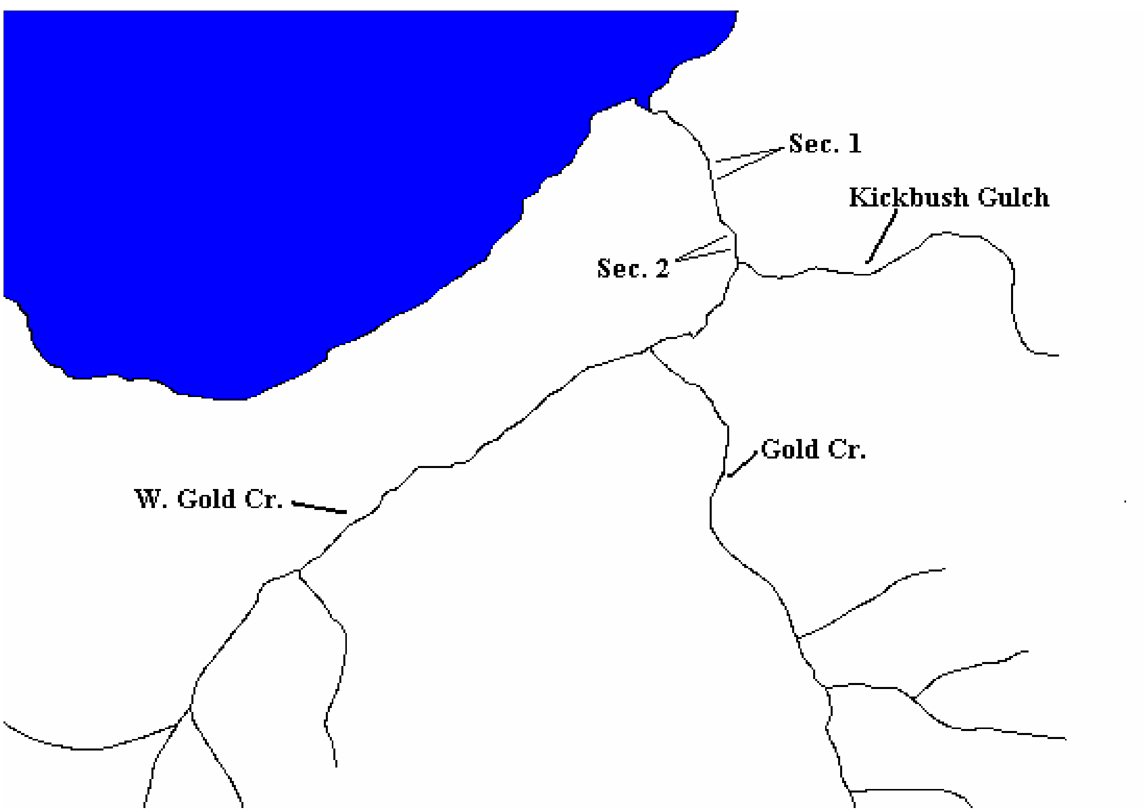

Figure 2. Electrofishing sections on Gold Creek, a tributary to Lake Pend Oreille, Idaho, sampled in 2005.

Granite Creek

Granite Creek is an east shoreline tributary to Lake Pend Oreille and drains approximately 68 km^2 of the northern end of the Bitterroot Mountains (PBTAT 1998) (Figure 3). Bankfull discharge for Granite Creek is approximately 6.2 cms (River Design Group 2004). Maximum water temperature reached 14.8 ^{0}C at the USFS Road 2711 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 ^{0}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 48 annually from 1983 through 2005. Recent trends in redd counts suggest a stable or increasing population (Downs and Jakubowski 2006). 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 had a diffuse and largely sub-surface flow pattern during low flow conditions. Fish passage was impaired during summer/fall months in this location on Granite Creek. Continued channel instability in this reach threatened to degrade fish habitat further in Granite Creek. A restoration project was completed in Granite Creek in 2005, constructing/restoring approximately 946 m of stream channel in the impaired reach.

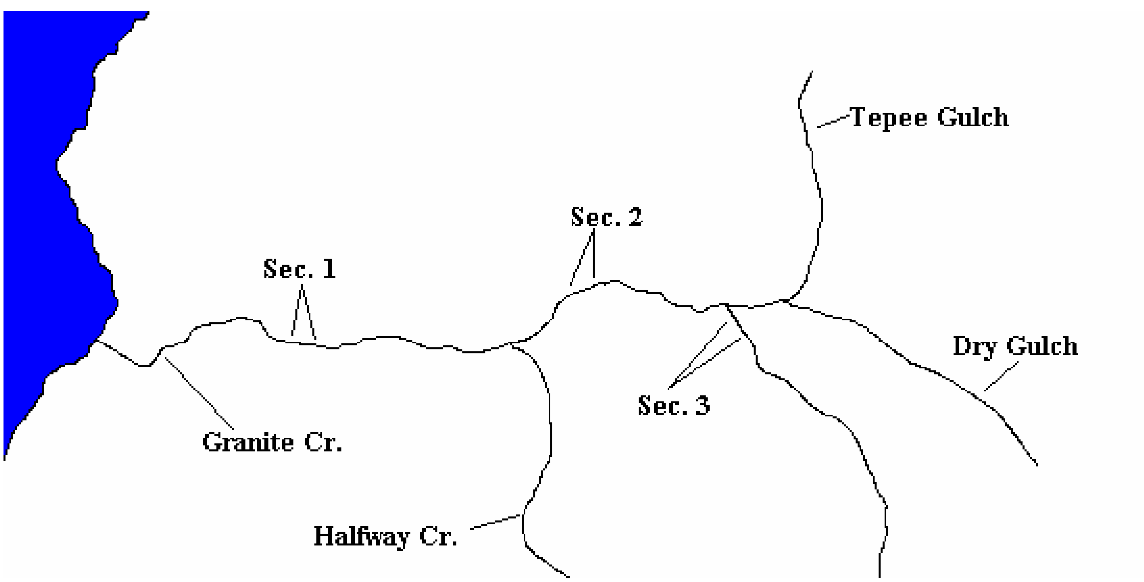

Figure 3. Electrofishing sections on Granite Creek, a tributary to Lake Pend Oreille, Idaho, sampled in 2005.

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 ^{0}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 2005. 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 positive trend in spawning escapement (Downs and Jakubowski 2006). The Lightning Creek Watershed Assessment (Philip Williams and Associates 2004) identified multiple sites for potential restoration projects in the Rattle Creek drainage.

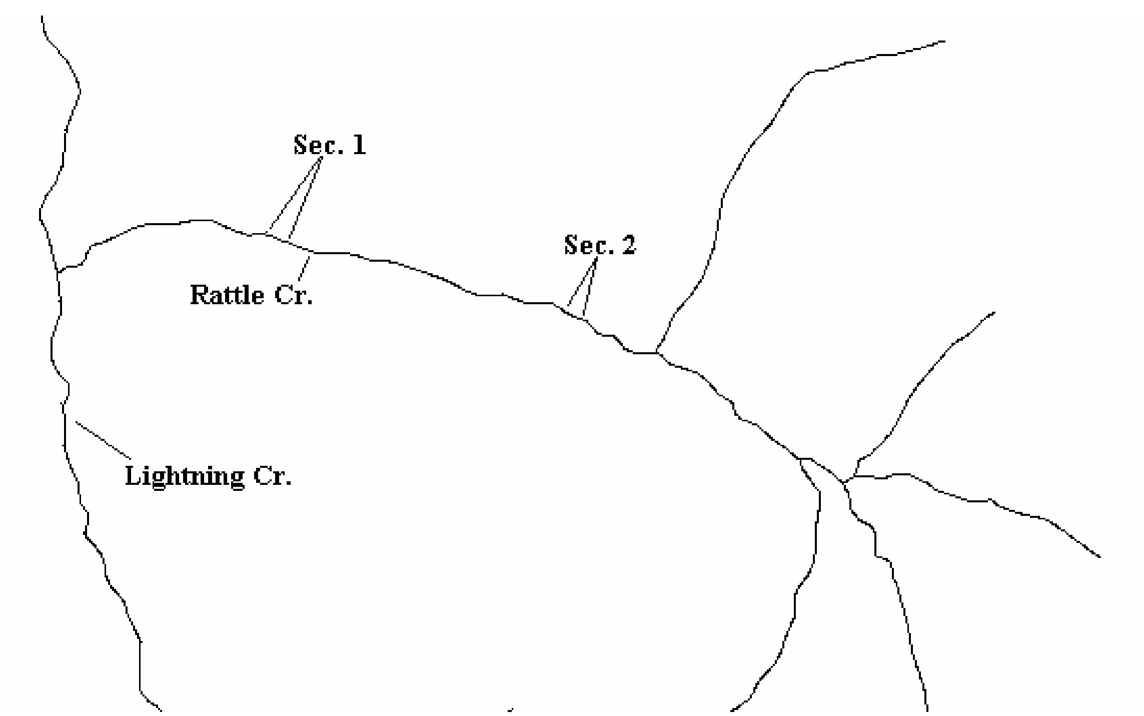

Figure 4. Electrofishing sections on Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, sampled in 2005.

Trestle Creek

Trestle Creek is a third-order northeast shore tributary to Lake Pend Oreille (Figure 5). Trestle Creek drains approximately 60 km^2 of the Cabinet Mountains (PBTAT 1998). Trestle Creek contains some of the highest quality bull trout habitat in the Lake Pend Oreille system. Trestle Creek'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 has historically supported the strongest run of bull trout in the Lake Pend Oreille system, accounting for on average 39% of the total redds counted annually. Bull trout redd counts have averaged 248 from 1983 through 2005. 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 comes 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.

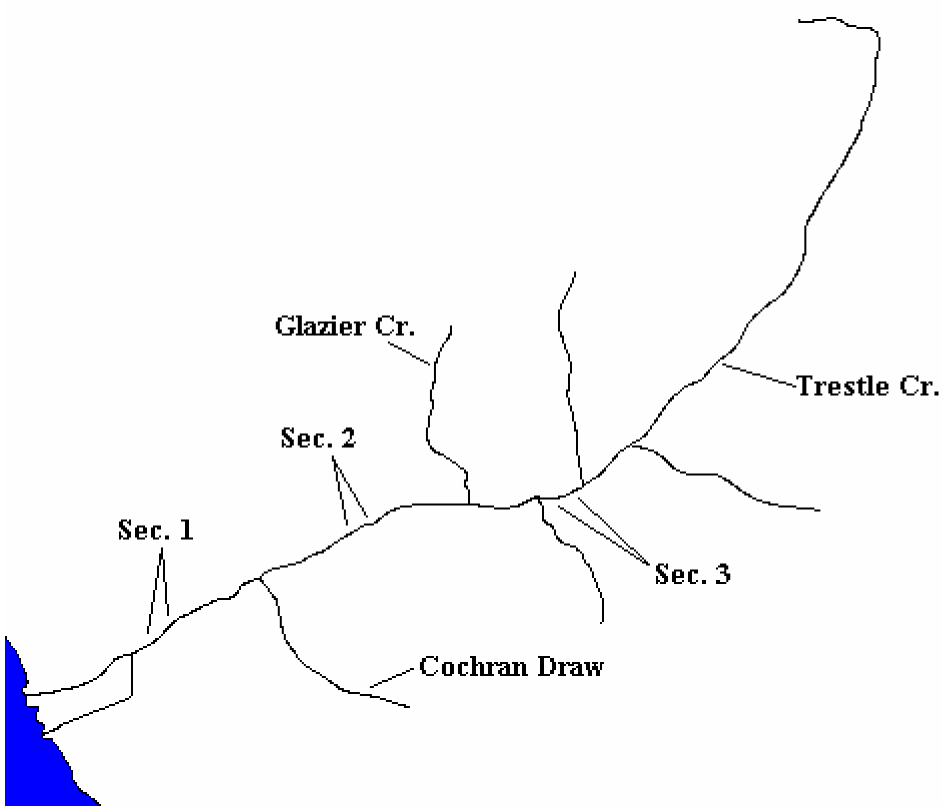

Figure 5. Electrofishing sections on Trestle Creek, a tributary to Lake Pend Oreille, Idaho, sampled in 2005.

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 $\geq$ 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). Wetted-widths were measured every 20 m along the transect to estimate the total area of the section. A crew of two individuals slowly progressed downstream 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. Fish 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, identified, measured (total length; mm) and weighed (g) (Table 1). In addition, genetic samples were collected from 60 juvenile bull trout per stream when present, for future analysis. Fish were allowed to recover their equilibrium and were released back into the stream below the section. All brook trout *Salvelinus fontinalis* 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 1. Species abbreviations for salmonids captured in the five streams surveyed near Clark Fork, Idaho, during 2005.

Species	**Abbreviation**
Brook trout *Salvelinus fontinalis*	BRK
Bull trout *Salvelinus confluentus*	BLT
Rainbow trout *Oncorhynchus mykiss*	RBT
Westslope cutthroat trout *O. clarki lewisi*	WCT
Mountain whitefish *Prosopium williamsoni*	MWF

RESULTS

East Fork Lightning Creek

We captured brook, bull, rainbow and westslope cutthroat trout in the East Fork Lightning Creek on July 29, and August 3 and 4, in 2005. In Section 1, densities ranged from 0.32/100m^2 for brook trout to 9.61/100m^2 for rainbow trout. Bull trout density in Section 1 was 0.64/100m^2. No westslope cutthroat trout were captured in Section 1 (Table 2). In Section 2, we captured bull, rainbow and westslope cutthroat trout. Densities ranged from 1.24/100m^2 for bull trout to 3.87/100m^2 for rainbow trout. The density for westslope cutthroat trout was 2.94/100m^2 (Table 2). In Section 3 we captured bull and westslope cutthroat trout. Densities were 3.95/100m^2 for bull trout and 17.13/100m^2 for westslope cutthroat trout (Table 2).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 102 mm for rainbow trout to 144 mm for three brook trout (Table 3). The length-frequency histograms for bull and rainbow trout indicate the presence of multiple age-classes (Figure 6). In Section 2, average size of salmonids $\geq$ 75 mm ranged from 124 mm for westslope cutthroat trout to 143 mm for both rainbow and bull trout (Table 3). Length-frequency histograms for bull, rainbow and westslope cutthroat trout indicate multiple age-classes present (Figures 7 and 8). Average size of salmonids $\geq$ 75 mm in Section 3 ranged from 101 mm for bull trout to 124 mm for westslope cutthroat trout (Table 3). Length-frequency histograms for bull and westslope cutthroat trout indicate the presence of likely a single age-class of bull trout, and multiple age-classes of westslope cutthroat trout (Figure 9).

Table 2. Total number captured (all lengths) and population estimates for salmonid species (≥ 75 mm; TL) captured in the three sections in the East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2005.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/minute)**
Section 1	BLT	7	6 (6-6)	0.64	0.06
	BRK	3	3 (3-3)	0.32	0.04
	RBT	92	90 (89-97)	9.61	0.73
Section 2	BLT	9	8 (7-9)	1.24	0.16
	RBT	25	25 (23-27)	3.87	0.48
	WCT	20	19 (17-21)	2.94	0.36
Section 3	BLT	6	6 (5-7)	3.95	0.23
	WCT	26	26 (24-28)	17.13	0.99

Table 3. Mean lengths (TL; mm), mean weights (g), standard deviation (SD) and sample size (n) for individuals ≥ 75 mm, and length range for all individuals captured in the three sections in the East Fork Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2005.

Location	**Species**	**Mean length (S.D.) (n)**	**Length range**	**Mean weight (S.D.) (n)**
Section 1	BLT	108.3 (14.7) (6)	63-137	12.2 (4.4) (6)
	BRK	144.0 (11.3) (3)	137-157	27.0 (6.9) (3)
	RBT	101.8 (18.8) (88)	70-175	12.3 (9.4) (64)
Section 2	BLT	142.5 (22.6) (8)	71-170	26.4 (10.2) (8)
	RBT	143.0 (43.4) (25)	93-221	37.7 (33.1) (25)
	WCT	123.5 (38.9) (19)	73-201	24.3 (21.8) (19)
Section 3	BLT	100.8 (7.1) (6)	90-110	9.3 (2.2) (6)
	WCT	123.5 (41.6) (26)	77-225	25.9 (27.8) (26)

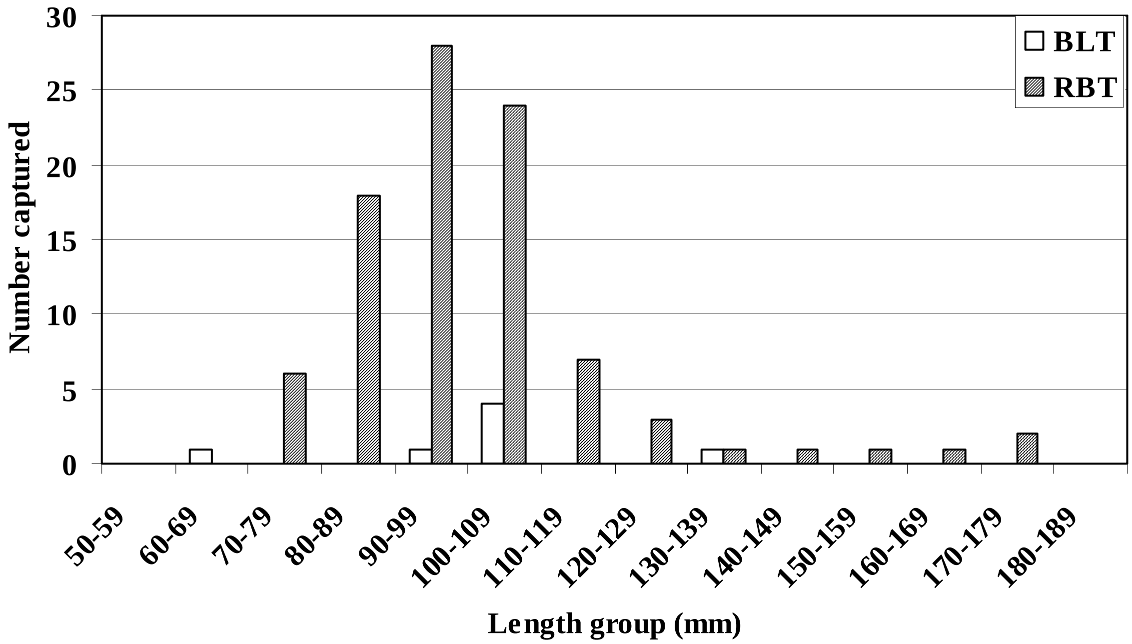

Figure 6. Length frequency histograms for all bull trout (n = 7) and rainbow trout (n = 92) captured in Section 1, East Fork Lightning Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2005.

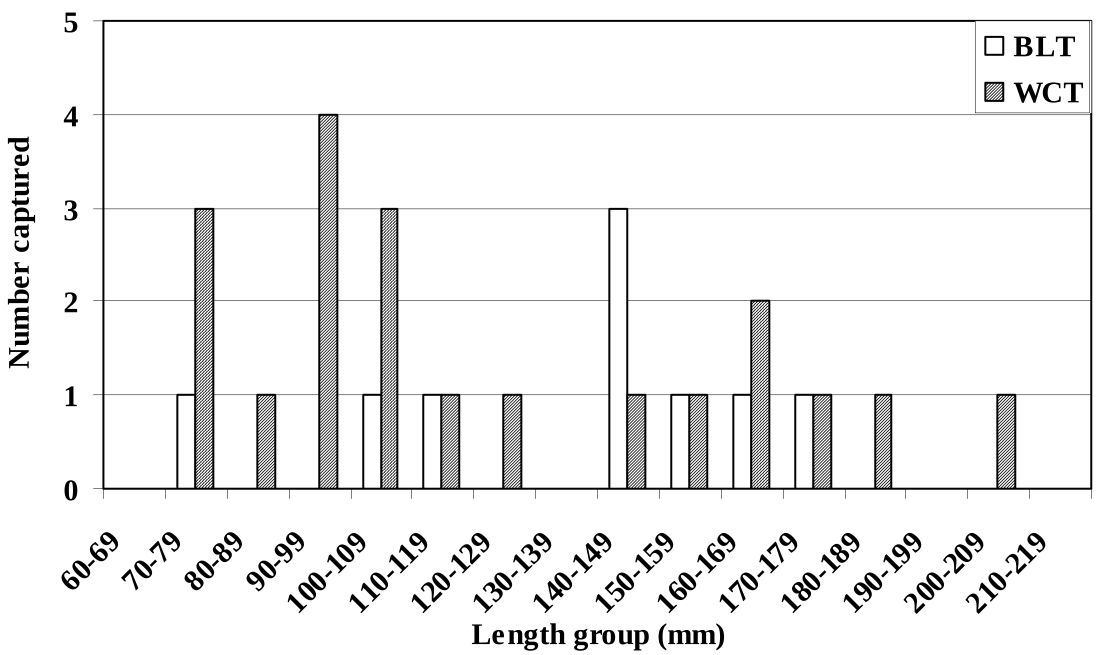

Figure 7. Length frequency histograms for all bull trout (n = 9) and westslope cutthroat trout (n = 20) captured in Section 2, East Fork Lightning Creek, a tributary to Lightning Creek, near Clark Fork Idaho, in 2005.

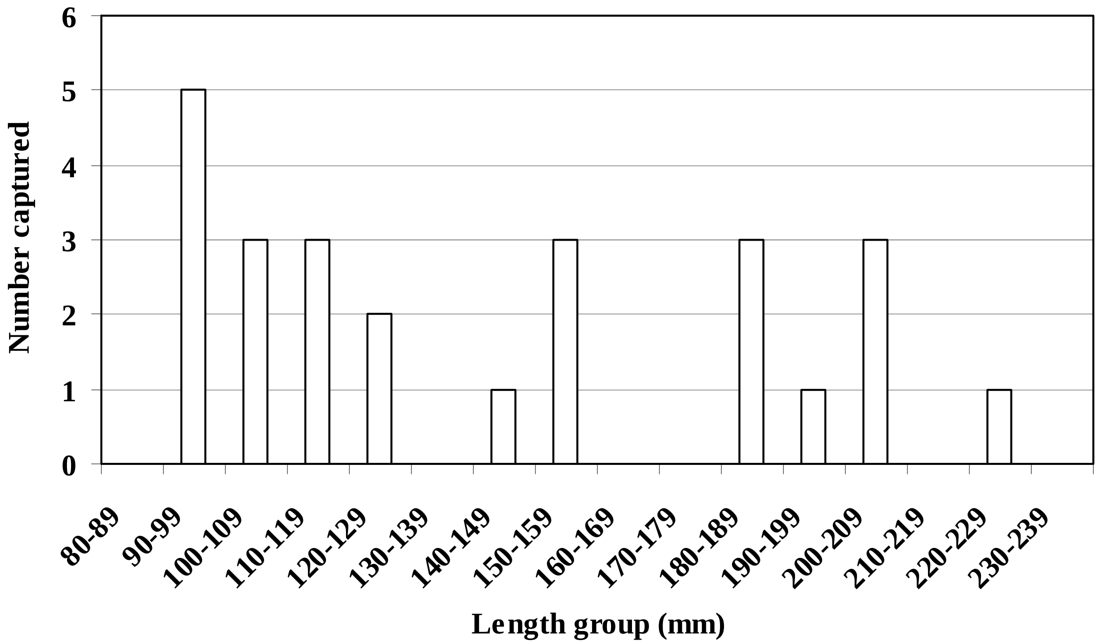

Figure 8. Length frequency histogram for all rainbow trout (n = 25) captured in Section 2, East Fork Lightning Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2005.

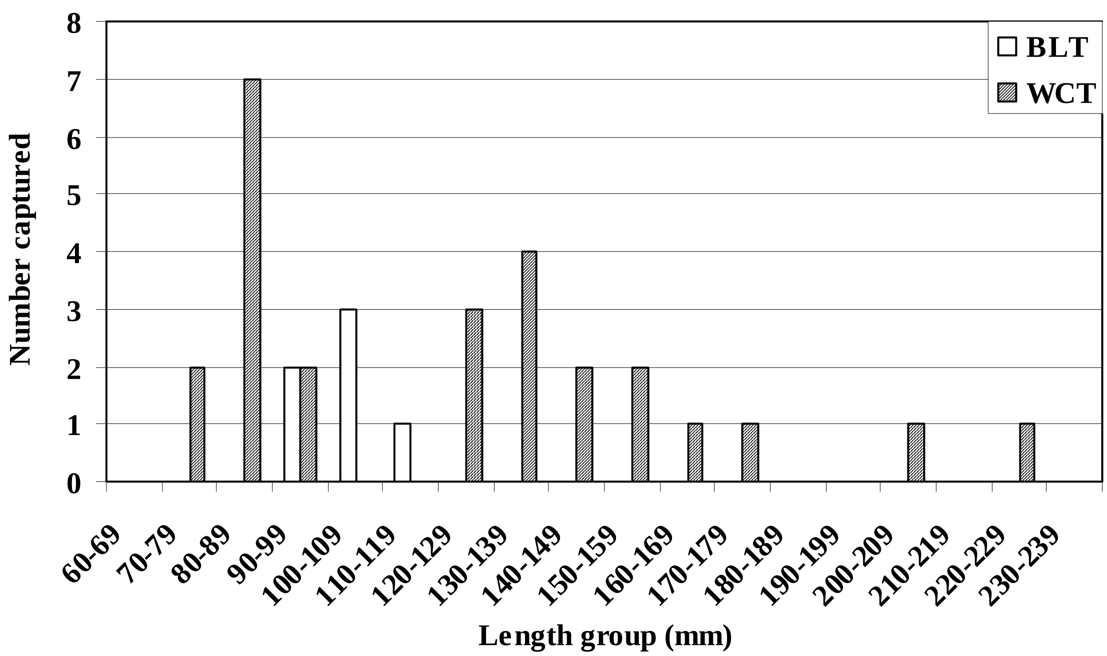

Figure 9. Length frequency histograms for all bull trout (n = 6) and westslope cutthroat trout (n = 26) captured in Section 3, East Fork Lightning Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2005.

Gold Creek

We captured bull and westslope cutthroat trout in Gold Creek on July 13 and 14, 2005. In Section 1, bull trout had the highest density (16.24/100m^2), while the density for westslope cutthroat trout was 0.46/100m^2 (Table 4). In Section 2, bull trout also had the highest density (8.30/100m^2), while the density for westslope cutthroat trout was 1.48/100m^2 (Table 4).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 92 mm for westslope cutthroat trout to 130 mm for bull trout (Table 5). Length-frequency histograms from Section 1 indicate the presence of multiple age-classes of bull trout, and likely two age classes of westslope cutthroat trout (Figure 10). In Section 2, average size of salmonids $\geq$ 75 mm ranged from 127 mm for bull trout to 130 mm for westslope cutthroat trout (Table 5). Length-frequency histograms indicate multiple age-classes of both species present (Figure 11).

Table 4. Total number captured (all lengths) and population estimates for salmonid species ($\geq$ 75 mm; TL) captured in the two sections in Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/minute)**
Section 1	BLT	179	105 (105-113)	16.24	1.03
	WCT	4	3 (3-3)	0.46	0.03
Section 2	BLT	57	56 (56-62)	8.30	1.02
	WCT	10	10 (10-10)	1.48	0.20

Table 5. Mean lengths (TL; mm), mean weights (g), standard deviation (SD) and sample size (n) for individuals $\geq$ 75 mm, and length range for all individuals captured in the two sections in Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Location	**Species**	**Mean length (S.D.) (n)**	**Length range**	**Mean weight (S.D.) (n)**
Section 1	BLT	130.0 (23.2) (104)	40-199	20.9 (13.0) (104)
	WCT	91.7 (15.0) (3)	74-107	7.7 (4.0) (3)
Section 2	BLT	126.9 (22.7) (56)	67-188	19.2 (10.7) (56)
	WCT	130.4 (33.4) (10)	88-193	25.0 (19.6) (10)

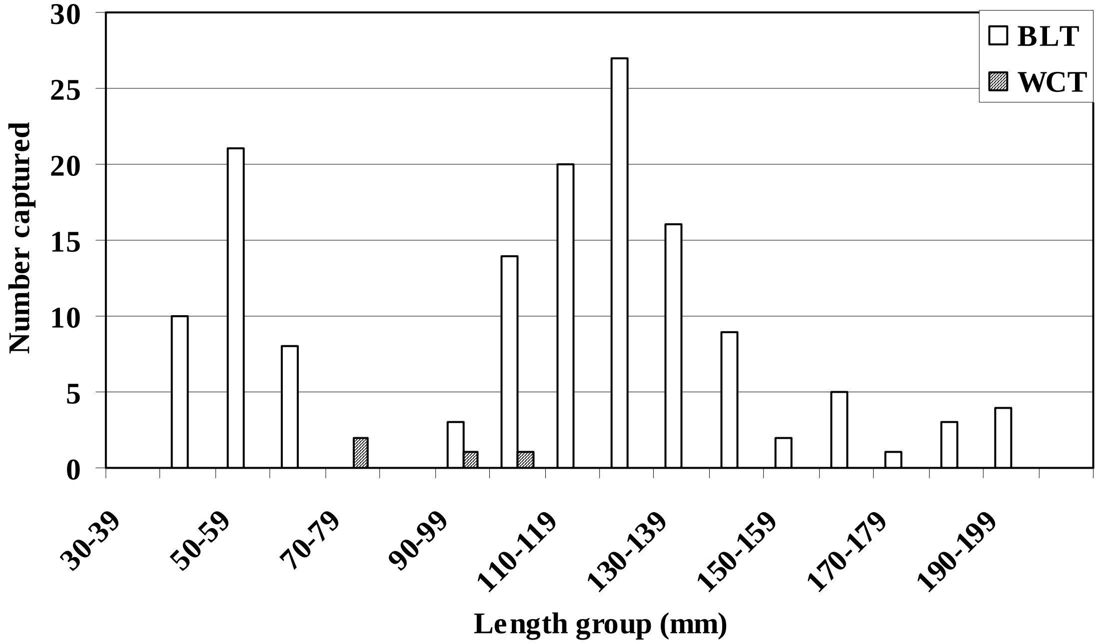

Figure 10. Length frequency histograms for bull trout (n = 143) and all westslope cutthroat trout (n = 4) captured in Section 1, Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

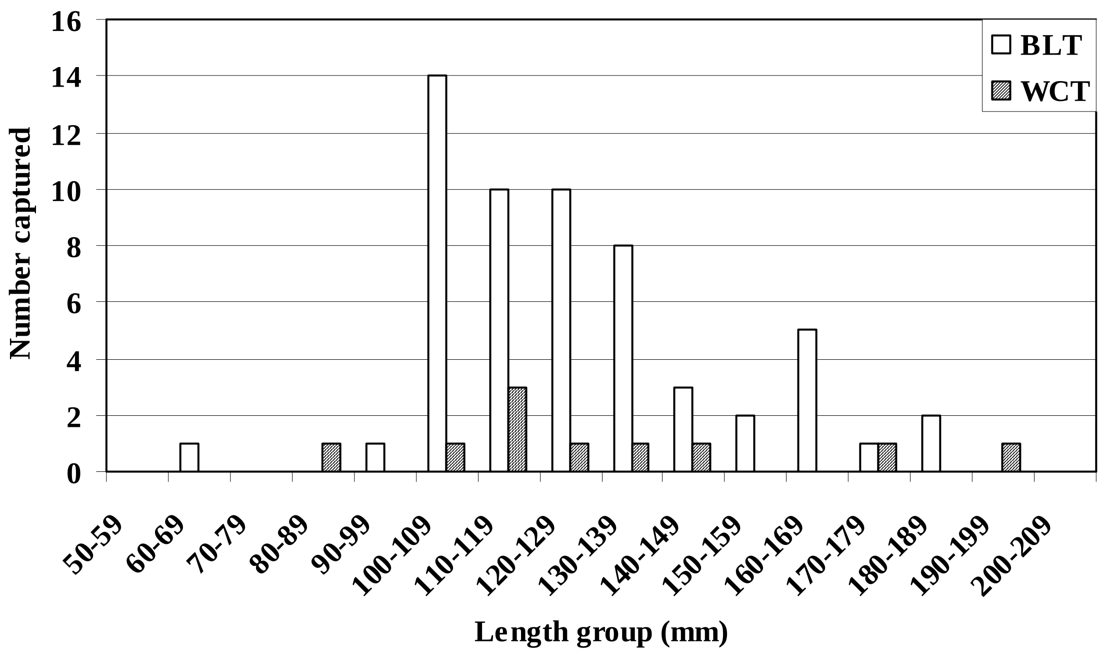

Figure 11. Length frequency histograms for all bull trout (n = 57) and westslope cutthroat trout (n = 10) captured in Section 2, Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Granite Creek

We captured bull and westslope cutthroat trout in Granite Creek on July 20, 21 and 22, 2005. In Section 1, bull trout had the highest density (6.38/100m^2), while the density for westslope cutthroat trout was 3.90/100m^2 (Table 6). In Section 2, the density for bull trout was 6.29/100m^2, while it was 3.21/100m^2 for westslope cutthroat trout (Table 6). In Section 3, the density for bull trout was the highest of all three sections, (11.16/100m^2), while the density for westslope cutthroat trout was the lowest (1.16/100m^2) (Table 6).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 112 mm for bull trout to 125 mm for westslope cutthroat trout (Table 7). Length-frequency histograms from Section 1 indicate multiple age-classes present for both bull and westslope cutthroat trout (Figure 12). In Section 2, average size of salmonids $\geq$ 75 mm ranged from 126 mm for westslope cutthroat trout to 149 mm for bull trout (Table 7). Length-frequency histograms from Section 2 indicate the presence of multiple age-classes for bull and westslope cutthroat trout (Figure 13). Average size of salmonids $\geq$ 75 mm in Section 3 ranged from 135 mm for bull trout to 164 mm for westslope cutthroat trout (Table 7). The length-frequency histograms from Section 3 indicate multiple age-classes present for bull and westslope cutthroat trout (Figure 14).

Table 6. Total number captured (all lengths) and population estimates for salmonid species ($\geq$ 75 mm; TL) captured in the three sections in Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/minute)**
Section 1	BLT	61	36 (36-36)	6.38	0.63
	WCT	22	22 (22-22)	3.90	0.33
Section 2	BLT	48	47 (47-47)	6.29	0.74
	WCT	25	24 (24-24)	3.21	0.43
Section 3	BLT	49	48 (46-50)	11.16	1.24
	WCT	5	5 (5-5)	1.16	0.14

Table 7. Mean lengths (TL; mm), mean weights (g), standard deviation (SD) and sample size (n) for individuals ≥ 75 mm, and length range for all individuals captured in the three sections in Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Location	**Species**	**Mean length (S.D.) (n)**	**Length range**	**Mean weight (S.D.) (n)**
Section 1	BLT	111.8 (35.0) (36)	55-185	16.3 (13.3) (36)
	WCT	124.9 (35.8) (22)	80-207	24.5 (25.8) (22)
Section 2	BLT	148.7 (22.9) (47)	61-223	29.3 (14.3) (47)
	WCT	125.5 (39.0) (24)	71-208	25.2 (22.3) (24)
Section 3	BLT	135.1 (19.3) (48)	52-174	21.6 (8.0) (48)
	WCT	163.8 (64.4) (5)	81-228	58.4 (49.9) (5)

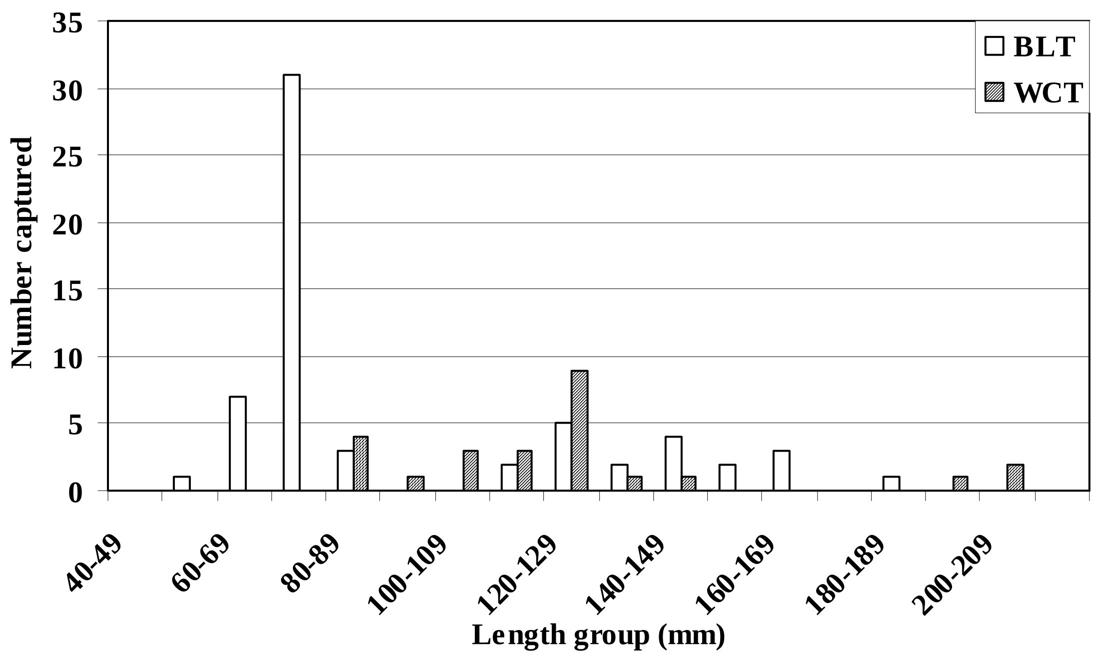

Figure 12. Length frequency histograms for all bull trout (n = 61) and westslope cutthroat trout (n = 22) captured in Section 1, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

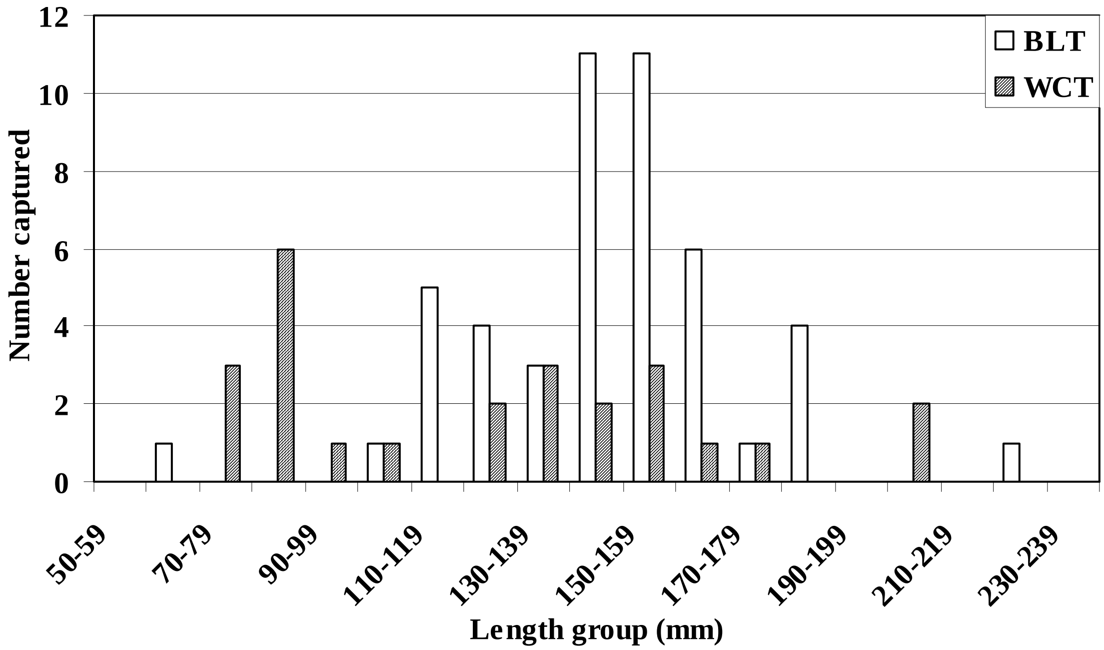

Figure 13. Length frequency histograms for all bull trout (n = 48) and westslope cutthroat trout (n = 25) captured in Section 2, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

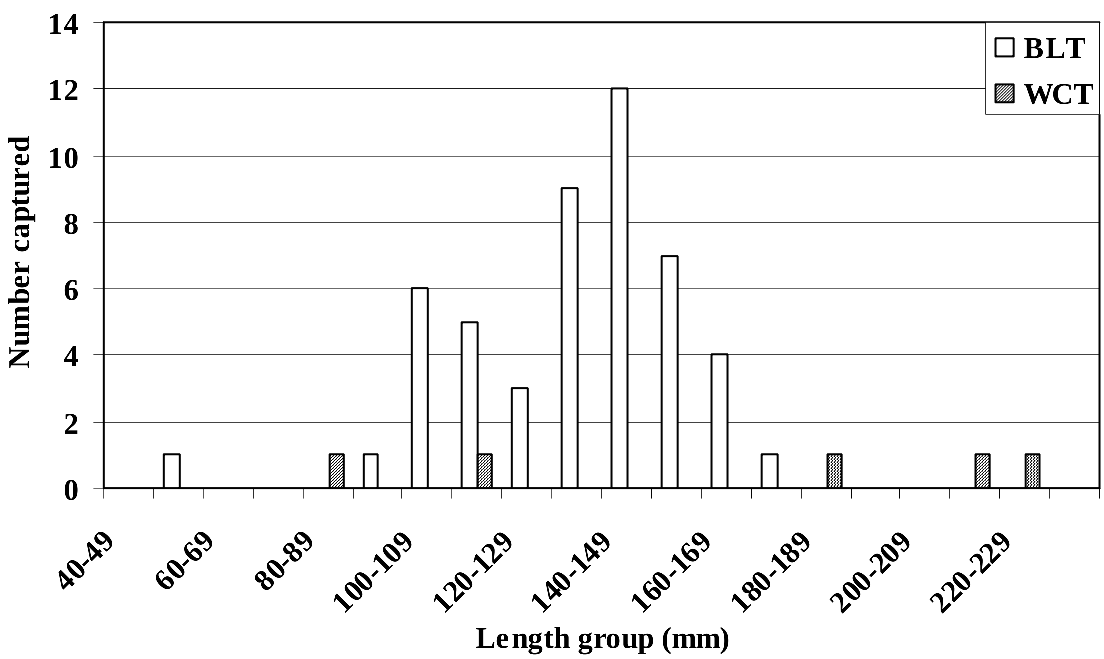

Figure 14. Length frequency histograms for all bull trout (n = 49) and westslope cutthroat trout (n = 5) captured in Section 3, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Rattle Creek

We captured bull, rainbow and westslope cutthroat trout in Rattle Creek on July 27 and 28, 2005. In Section 1, bull trout had the highest density ($3.43/100m^2$), while rainbow trout had the lowest ($3.05/100m^2$). No westslope cutthroat trout were captured in Section 1 (Table 8). In Section 2, bull trout had the highest density ($10.72/100m^2$) while the density for westslope cutthroat trout was $2.63/100m^2$. A single rainbow trout (155 mm) was also captured (Table 8).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 118 mm for bull trout to 126 mm for rainbow trout (Table 9). Length-frequency histograms from Section 1 indicate the presence of multiple age-classes for both bull and rainbow trout (Figure 15). In Section 2, average size of salmonids $\geq$ 75 mm ranged from 110 mm for bull trout to 155 mm for a single rainbow trout. The average length for westslope cutthroat trout was 151 mm (Table 9). Length-frequency histograms from Section 2 indicate the presence of multiple age-classes for bull and westslope cutthroat trout (Figure 16).

Table 8. Total number captured (all lengths) and population estimates for salmonid species ($\geq$ 75 mm; TL) captured in the two sections in Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2005.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**$N/100m^2$**	**CPUE (fish/minute)**
Section 1	BLT	18	18 (18-18)	3.43	0.33
	RBT	17	16 (16-16)	3.05	0.35
Section 2	BLT	57	57 (55-59)	10.72	0.84
	WCT	15	14 (13-15)	2.63	0.22
	RBT	1	N/A[a]	N/A	N/A

[a]No estimate possible. A single 155 mm rainbow trout was captured.

Table 9. Mean lengths (TL; mm), mean weights (g), standard deviation (SD) and sample size (n) for individuals ≥ 75 mm, and length range for all individuals captured in the two sections in Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2005.

Location	**Species**	**Mean length (S.D.) (n)**	**Length range**	**Mean weight (S.D.) (n)**
Section 1	BLT	117.9 (25.0) (18)	86-194	16.1 (12.3) (18)
	RBT	125.6 (48.9) (16)	70-230	31.1 (37.5) (16)
Section 2	BLT	110.0 (25.5) (57)	79-201	14.4 (10.7) (57)
	WCT	150.8 (51.6) (14)	65-227	45.1 (35.7) (14)
	RBT	155 (N/A) (1)	N/A	41.0 (N/A) (1)

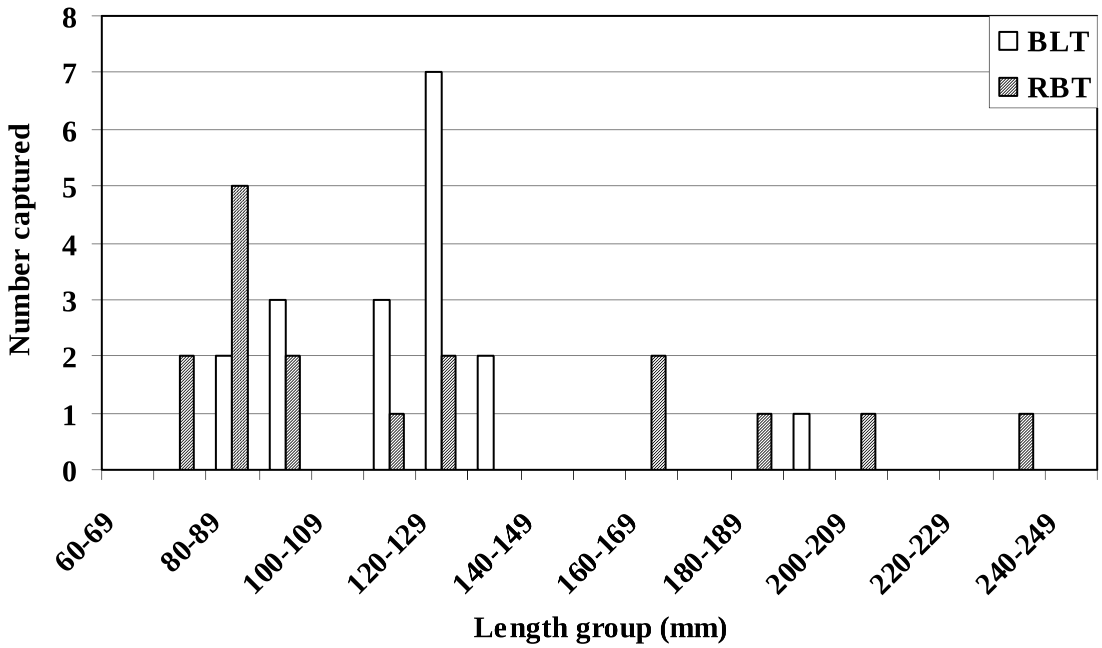

Figure 15. Length frequency histograms for all bull trout (n = 18) and rainbow trout (n = 17) captured in Section 1, Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2005.

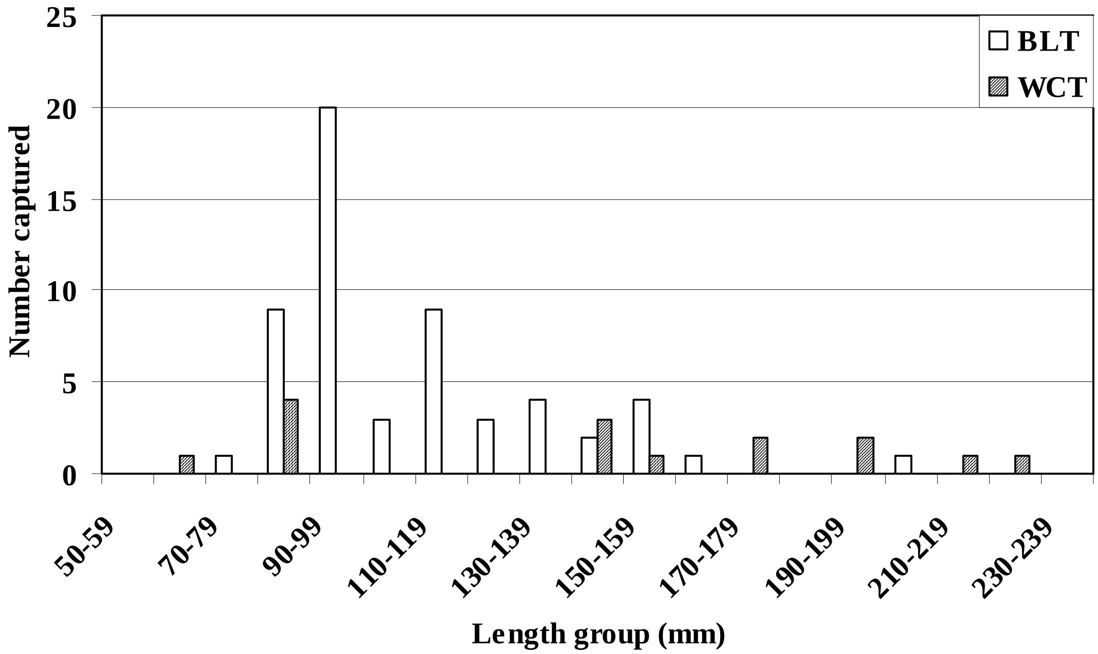

Figure 16. Length frequency histograms for all bull trout (n = 57) and westslope cutthroat trout (n = 15) captured in Section 2, Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2005.

Trestle Creek

We captured mountain whitefish, as well as bull and westslope cutthroat trout in Trestle Creek on August 5, 9 and 12, 2005. In Section 1, westslope cutthroat trout had the highest density ($6.71/100m^2$), while both bull trout and mountain whitefish shared the lowest ($1.00/100m^2$) (Table 10). In Section 2, the density for bull trout was $0.72/100m^2$. Although a total of 55 westslope cutthroat trout were captured in Section 2, an estimate was not possible due to a non-declining catch pattern (Table 10). In Section 3, bull trout had the highest density ($13.93/100m^2$), while the density for westslope cutthroat trout was $1.57/100m^2$ (Table 10).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 118 mm for westslope cutthroat trout to 183 mm for mountain whitefish. The average length for bull trout in Section 1 was 150 mm (Table 11). Length-frequency histograms from Section 1 for bull and westslope cutthroat trout as well as mountain whitefish indicate multiple age-classes present (Figures 17 and 18). In Section 2, average size of salmonids $\geq$ 75 mm ranged from 122 mm for westslope cutthroat trout, to 136 mm for bull trout (Table 11). Length-frequency histograms for bull and westslope cutthroat trout from Section 2 indicate multiple age-classes present (Figure 19). Average size of salmonids $\geq$ 75 mm in Section 3 ranged from 122 mm for bull trout to 166 mm for westslope cutthroat trout (Table 11). Length-frequency histograms from Section 3 indicate multiple age-classes present (Figure 20).

Table 10. Total number captured (all lengths) and population estimates for salmonid species (≥ 75 mm; TL) captured in the three sections in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**N/100m²**	**CPUE (fish/minute)**
Section 1	BLT	19	7 (7-7)	1.00	0.11
	MWF	7	7 (7-7)	1.00	0.07
	WCT	47	47 (47-47)	6.71	0.70
Section 2	BLT	4	4 (4-4)	0.72	0.08
	WCT	55	N/A[a]	N/A	0.38
Section 3	BLT	63	62 (62-62)	13.93	1.23
	WCT	7	7 (7-7)	1.57	0.12

[a]No estimate possible due to non-declining catch pattern.

Table 11. Mean lengths (TL; mm), mean weights (g), standard deviation (SD) and sample size (n) for individuals ≥ 75 mm, and length range for all individuals captured in the three sections in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

Location	**Species**	**Mean length (S.D.) (n)**	**Length range**	**Mean weight (S.D.) (n)**
Section 1	BLT	150.4 (32.3) (7)	54-215	34.9 (25.8) (7)
	MWF	182.7 (15.2) (7)	160-208	53.1 (13.9) (7)
	WCT	118.0 (36.9) (47)	78-272	22.0 (28.7) (47)
Section 2	BLT	136.0 (46.3) (4)	108-205	29.3 (30.6) (4)
	WCT	122.0 (43.5) (55)	75-255	27.3 (39.8) (55)
Section 3	BLT	121.9 (27.0) (62)	73-200	17.7 (12.8) (62)
	WCT	166.1 (41.2) (7)	90-213	52.3 (35.2) (7)

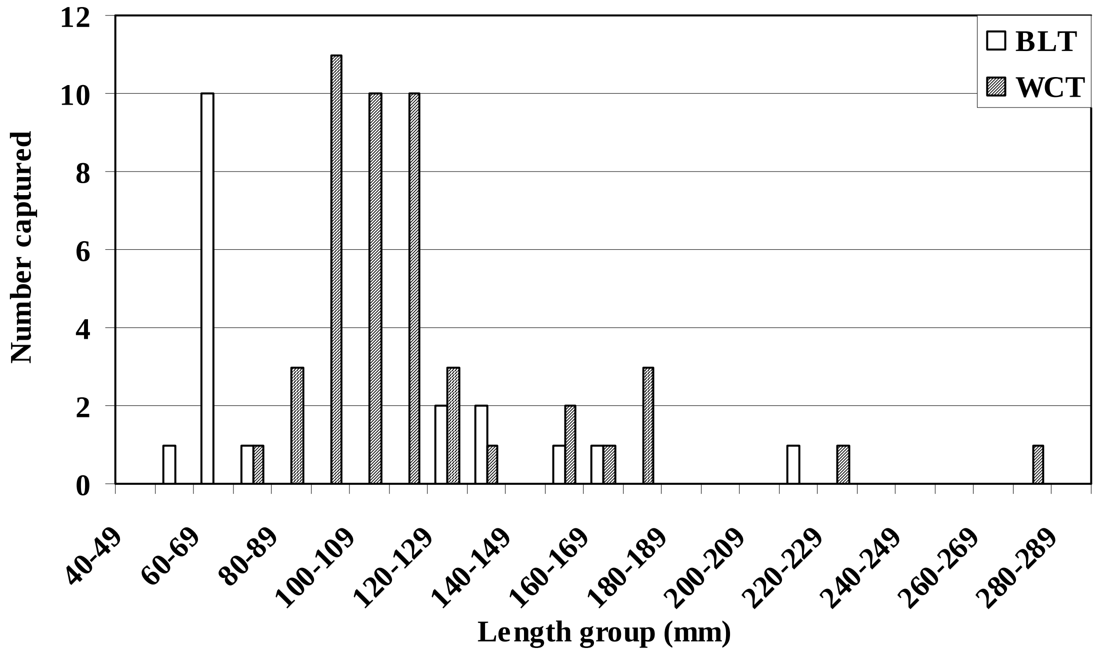

Figure 17. Length frequency histograms for all bull trout (n = 19) and westslope cutthroat trout (n = 47) captured in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

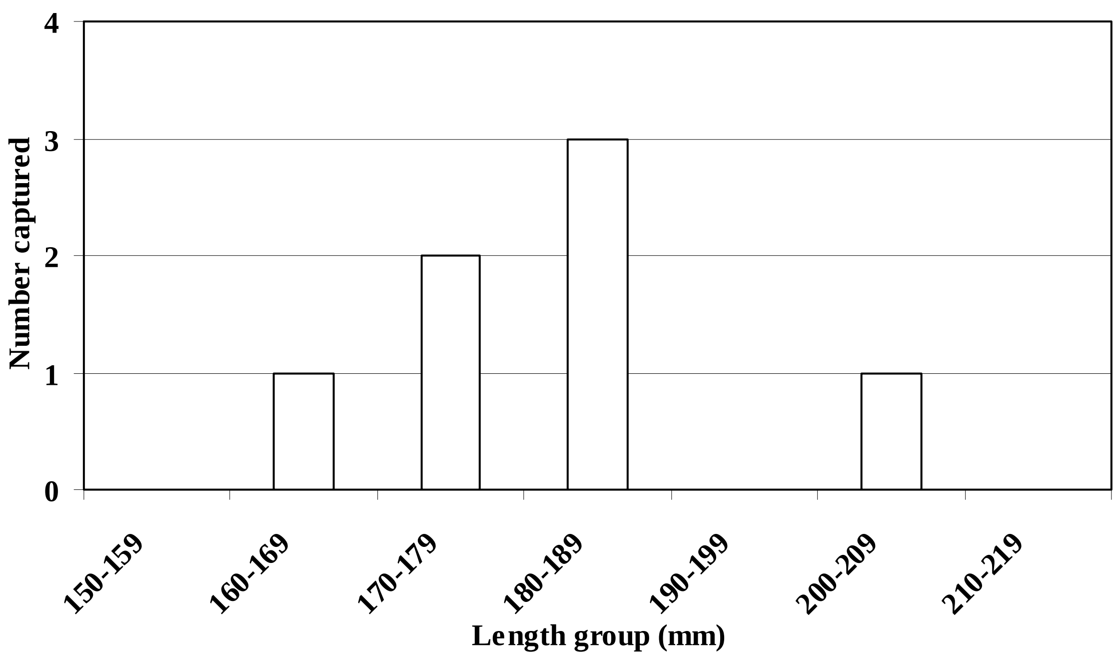

Figure 18. Length frequency histogram for all mountain whitefish (n = 7) captured in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

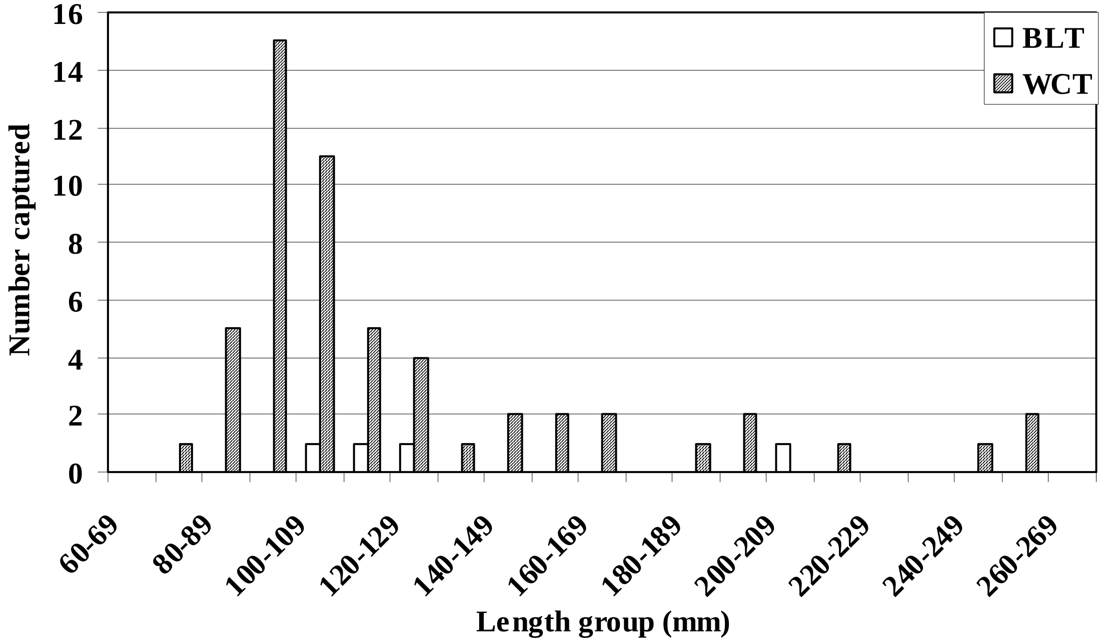

Figure 19. Length frequency histograms for all bull trout (n = 4) and westslope cutthroat trout (n = 55) captured in Section 2, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

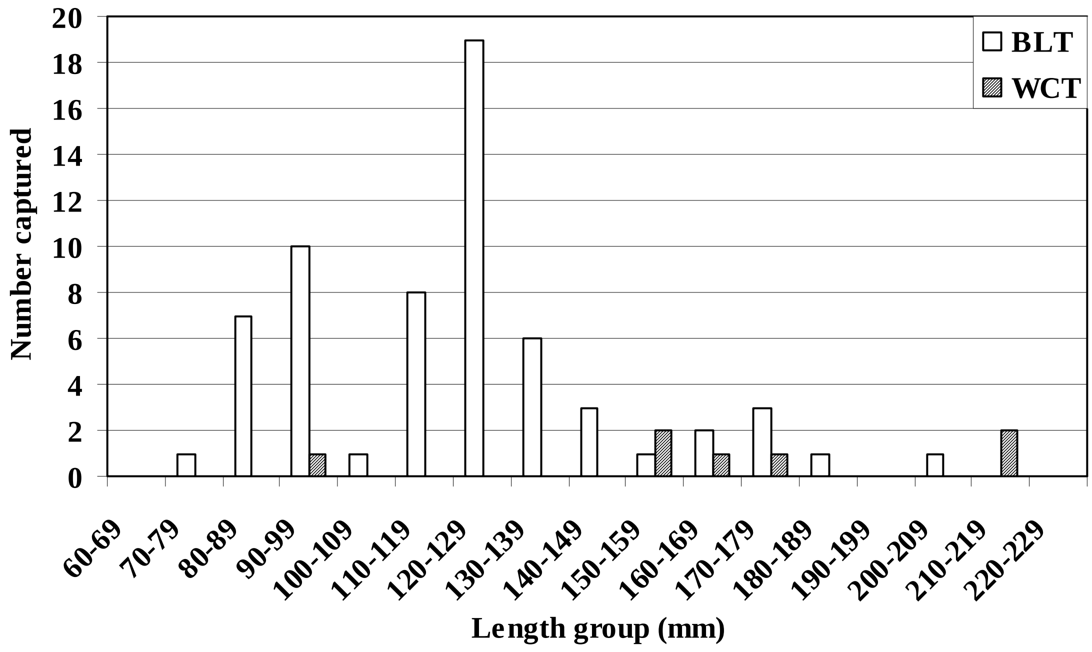

Figure 20. Length frequency histograms for all bull trout (n = 63) and westslope cutthroat trout (n = 7) captured in Section 3, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2005.

DISCUSSION

We successfully completed depletion population estimates for juvenile salmonids on 13 sections in 5 streams. These population estimates will serve to augment bull 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 bull 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 (bull and westslope cutthroat trout) were the only species captured in the upper-most sampling sites. The highest juvenile ($\geq$ 75 mm) bull trout densities observed were found in Gold creek (16.24/100m^2), but Granite, Trestle, and Rattle creeks all supported juvenile bull trout densities in excess of 10.72/100m^2. For comparison, Liermann et al. (2003) reported maximum densities for juvenile ($\geq$ 75 mm) bull trout in the E. Fk. Bull River, upper Prospect Creek, and Rock Creek (all lower Clark Fork River tributaries in Montana) at 4.1/100m^2, 6.1/100m^2, and 3.8/100m^2, respectively. Liermann (2003) reported maximum juvenile bull trout densities of 5.7/100m^2 and 9.7/100m^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 bull trout 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, the East Fork Lightning Creek supported the highest density observed for juvenile ($\geq$75 mm) westslope cutthroat trout (17.13/100m^2). This represents more than a two-fold increase in westslope cutthroat trout density in Section 3 (uppermost section) from 2004 (8.40/100m^2), to 2005. However, due to deposition of bed-load in this section during high flows between the 2004 and 2005 sampling period, 31 m within the sampling reach was dry when sampled in 2005. This could have inflated the density estimate. The stream channel within this reach is characterized by steep gradient and large substrate, with most, if not all fish, occurring in pools. As a result of part of the section being dry when sampled in 2005, fish likely were more concentrated and observed densities were greater. In 2005, as part of a telemetry study being conducted on westslope cutthroat trout in the lower Clark Fork River, a radio tagged fish (401 mm; TL), originally captured and tagged in the Clark Fork River downstream of Lightning Creek, was tracked as it migrated up Lightning Creek into the East Fork. It was detected and visually observed on June 9 in the East Fork, approximately 0.8 km downstream of the uppermost depletion section. This would suggest the presence of an adfluvial component to the westslope cutthroat trout population in the East Fork Lightning Creek.

In Trestle Creek, density estimates remained relatively low for juvenile bull trout in the lower and middle reaches of the stream channel, although the upper-most section did support high densities of juvenile bull trout. This indicates that the lower and middle reaches of Trestle Creek are not providing optimal habitat conditions for juvenile bull trout. Possible explanations for the low density of juvenile bull trout in the lower and middle reaches could be related to the impacts of residential development, timber harvest, and the adjacent county road in the lower and middle reaches of the stream. Sediment transport from the road, timber harvest and residential development to the stream is readily apparent when traveling along the stream and may be reducing over-winter habitat for juvenile bull trout. Over-winter habitat for juvenile bull trout has been defined as unembedded cobble substrate in Trestle Creek (Bonneau and Scarnecchia 1998), as well as in other Idaho stream systems (Thurow 1997). The substrate may be becoming increasingly imbedded, reducing the interstitial spaces that juvenile bull trout use for overwinter habitat. Significant differences existed among years for individual sample sites, but the only difference that appeared biologically significant was the decline in juvenile bull trout observed in Section 2 from 2004 to 2005. Estimated numbers dropped from 15 to $4/100m^2$. Continued monitoring will be needed to determine if the drop is part of a downward trend in juvenile abundance, or simply due to annual variation in numbers. Although an estimate and associated density was not possible for westslope cutthroat trout in the middle section of Trestle Creek due to a non-declining catch pattern, overall numbers appeared to remain strong within this section when compared with the 2004 data (50 total captured $\geq$ 75 mm in 2004; 55 total captured $\geq$ 75 mm in 2005). 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 and East Fork Lightning creeks are the only positively identified adfluvial westslope cutthroat trout spawning tributaries to Lake Pend Oreille. Others may exist, but have not been trapped/evaluated to determine the presence of migratory fish. Increasing numbers of outmigrating juvenile westslope cutthroat trout were captured in Granite Creek in 2003, 2004, and 2005 (5, 32, and 58 respectively), suggesting an adfluvial component may exist in this tributary as well (Downs and Jakubowski 2003).

Exotic species (primarily rainbow trout) were most abundant, when they were present, in the lower sampling sites. No exotic species were captured in Gold or Granite Creek. However, several bull X brook trout hybrids (genetically tested) were collected in Granite Creek indicating the presence of brook trout in the drainage. Rainbow trout densities were relatively high in the lower reaches of E. Fk. Lightning and Rattle creeks, while brook trout were rare in these streams. Only three individuals were captured in lower E. Fk. Lightning Creek and none in Rattle Creek. No exotic species were captured in Trestle Creek in 2005, although rainbow trout were captured in the lower section in 2004. A single brown *Salmo trutta* and brook trout were also captured in a screw trap on Trestle Creek in 2002 (Downs and Jakubowski 2003).

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2005 Lower Clark Fork River Westslope Cutthroat Trout Radio Telemetry and Genetic Study Progress Report

ABSTRACT

We evaluated genetic purity and movements of westslope cutthroat trout *Oncorhynchus clarki lewisi* (wct) in the Clark Fork River in Idaho during the spring of 2005. These results represent a progress report for the first year of a two-year radio telemetry project. The primary objectives of the study were to identify spawning areas for migratory wct in Idaho, evaluate genetic purity of wct in the Clark Fork River below Cabinet Gorge Dam, and to determine movement patterns in the Cabinet Gorge tailrace area as they may pertain to fish passage needs. We collected tissue samples from 57 individual fish visually identified as "pure" wct in the Clark Fork River and tested them for genetic purity. Fifty of fifty-seven did not show evidence of hybridization. We were able to correctly identify those individuals as "pure" that did not show molecular evidence of hybridization in 88% of the sample. We tracked the movements of 31 radio tagged wct from April into July in 2005. Forty-eight percent (15 of 31) of these individuals made movements up to the dam during the spring monitoring period. It appears genetically pure wct persist in the Clark Fork River and some of those are of upstream origin. Reconnecting these individuals to their natal streams through some type of experimental fish passage would allow them to fulfill their life-cycle and perpetuate a migratory form of wct in the lower Clark Fork River. We will begin tagging and tracking nine additional wct in April 2006 to complete the study.

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INTRODUCTION

The Native Salmonid Restoration Plan (NSRP) (Kleinshmidt and Pratt 1998) calls for conducting experimental upstream passage of native salmonids to evaluate the feasibility and need for larger-scale programs and permanent fish passage facilities. Successful experiments conducted from 2001 through 2004 included the transport of over 100 bull trout *Salvelinus confluentus* over Cabinet Gorge Dam. In addition to bull trout, upstream fish passage for westslope cutthroat trout *Oncorhynchus clarki lewisi* (wct) at Cabinet Gorge and Noxon Rapids dams is also a focus of the NSRP. To date, radio telemetry studies conducted over several years on wct populations upstream in Montana have demonstrated a migratory form still persists in some drainages. Individual adult and juvenile wct radio and PIT-tagged in the Bull River and the Rock Creek drainages have migrated downstream through Cabinet Gorge Dam to the Clark Fork River and Lake Pend Oreille in Idaho (Katzman and Hintz 2003, Lockard et al. 2004). It is likely that these fish (and those that have passed downstream over time from other streams) will try to ascend the river past Cabinet Gorge Dam to spawn in their natal streams, and that increased connectivity (fish passage) will strengthen the migratory component of the population, which is a focus of the NSRP. Westslope cutthroat trout fish passage studies conducted at dams further upstream in the Clark Fork River watershed have demonstrated the importance of providing for connectivity within river systems for this species (Schmetterling 2003). In a broader sense, other authors have recognized the importance of conserving diversity in life-history (Rieman and McIntyre 1993; Rieman and Allendorff 2001), or the importance of connectivity in maintaining that diversity in life-history of inland salmonids (Swanberg 1997a; Swanberg 1997b; Neraas and Spruell 2001; Morita and Yamamoto 2001; Nelson et al. 2002).

The first phase of this study is a genetic assessment of the existing wct population utilizing the Clark Fork River downstream of Cabinet Gorge Dam to evaluate if "pure" wct are still present in the river, and to evaluate the genetic risks to upstream populations from an upstream passage project. The second phase is a two-year radio telemetry study implemented concurrently with the genetic analysis to evaluate wct spawning movements in the Clark Fork River below Cabinet Gorge Dam.

GOAL

Restore population connectivity between upriver and downriver stocks, and enhance the abundance of the migratory component of wct populations utilizing Lake Pend Oreille and the Clark Fork River in Idaho and Montana.

OBJECTIVES

1. **Identify spawning areas for wct in the lower Clark Fork River in Idaho.**

2. **Assess the presence of genetically pure wct in the lower Clark Fork River in Idaho.**

3. Evaluate wct movement patterns in the Cabinet Gorge Dam tailrace as they pertain to fish passage needs.

STUDY AREA

The Clark Fork River is the largest tributary to Lake Pend Oreille, contributing an estimated 92% of the annual inflow (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. Cabinet Gorge Dam is located in Idaho, approximately 400 m on the Idaho side of the Idaho-Montana state border. The river flows approximately 16 km from Cabinet Gorge Dam to Lake Pend Oreille. At full summer pool level (controlled by Albenai Falls Dam on the Pend Oreille River), the river loses its lotic character approximately nine km downstream of Cabinet Gorge Dam due to back-water effects in the river. Cabinet Gorge Dam is operated as a "peaking" facility, with daily operations ranging from 141.5 cms (5,000 cfs) to approximately 1,010.3 cms (35,700 cfs).

METHODS

Genetics

Total genomic DNA was extracted from each of the fin clips using a standard salt-chloroform extraction protocol (Campbell 2000). DNA was re-suspended in 100 µl 1X TE. Seven diagnostic co-dominant nuclear DNA (nDNA) markers and one diagnostic mitochondrial DNA (mtDNA) marker were used to assess rainbow trout hybridization and introgression within these samples. This provides 95% confidence of detecting rainbow trout introgression present within the sample at a frequency of 20% or greater. Five of the Seven nDNA markers are simple sequence repeat (SSR) markers (Occ 35, Occ 36, Occ 38, Occ 42, OM55) and are diagnostic based on size differences in the Polymerase Chain Reaction (PCR) products between rainbow trout and cutthroat trout (Ostberg and Rodriquez 2002). The other two nDNA markers are Restriction Fragment Length Polymorphism (RFLP) markers: Rag 3' digested with the restriction enzyme *Dde-I*, and p53' digested with the restriction enzyme *Alu-I* yield species specific RFLP patterns or polymorphisms (Baker et al. 2002). Products of PCR (SSR markers) and digests (RFLP marker) were electrophoresed on 3% synergels gels and diagnostic alleles were visualized as band patterns when fluoresced under UV-light.

Radio telemetry

We utilized electrofishing from a 6 m-long jet boat as our primary means of fish capture. The electrofishing setup in each boat consisted of a Coffelt VVP-15 electroshocker powered by a 5000 watt 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 8 amps at 190-250 volts. Electrofishing began in early April and ended in mid-May (the last wct was tagged on May 12), and generally occurred twice per week. We stopped tagging fish in mid-May to avoid handling fish in spawning condition.

Sampling occurred from the general area of the USGS gage station cable located upstream of the Cabinet Gorge Fish Hatchery downstream to the log booms below Lightning Creek. We attempted to distribute our sampling effort over this reach of river to collect a representative sample of migrants, and increase the likelihood we would tag some fish that would migrate into tributaries downstream of the dam.

Fish were anesthetized, measured (TL; mm), and weighed (g). We used the shielded-needle technique (Ross and Kleiner 1982) to surgically implant the radio tags into the abdominal cavity of the fish. A Passive Integrated Transponder (PIT) tag was also placed in the abdominal cavity for future identification. Coded radio tags within the frequencies 149.420, 149.440, 149.460, 149.480 were utilized during this study. Use of these frequencies ensured consistency with ongoing Avista telemetry projects and maximized the use of existing equipment. We desired to track the trout through two spawning cycles, so we used an "on/off" duty cycle to increase tag life. The tag duty cycle is "on" for 122 days (turned on April 1, 2005), "off" for 228 days (August 1, 2005 through March 14, 2006), and then back "on" until the tag dies (at least 106 days - March 15 to June 30, 2006). We ordered 7 g tags from the manufacturer, and targeted those fish that weighed more than 350 g in an attempt to keep the transmitter to fish weight ratio below 2%. However, the weight of the tags upon delivery was actually almost 8 g, and as a result the tag:fish weight ratio went as high as 2.6%, but most remained below 2%. We selected for fish that looked like genetically pure wct for radio tagging. Incisions were closed with several sutures constructed with 3-0 polypropylene thread on a 24 mm cutting tip needle. In general, fish were released near the site of capture immediately following their full recovery from surgery. Those fish captured upstream of the Cabinet Gorge Hatchery were tagged and released at the boat ramp at the Cabinet Gorge Hatchery, approximately 1.6 km downstream of the dam.

Captured wct were visually assessed for genetic purity. Those fish that appeared hybridized were released back into the river. Key morphological characteristics used to identify "pure" wct were the presence of an orange slash under the jaw and the spotting pattern. If the spotting pattern grew more dense as you progressed from the nose to the tail of the fish, and the area contained within a half-moon shape extending from the pectoral fin up to the lateral line and then back down to the pelvic fin was largely absent of spots, the fish was classified as "pure". These characteristics have been shown to be indicative of "pure" wct (J. DuPont, Idaho Department of Fish and Game, personal communication).

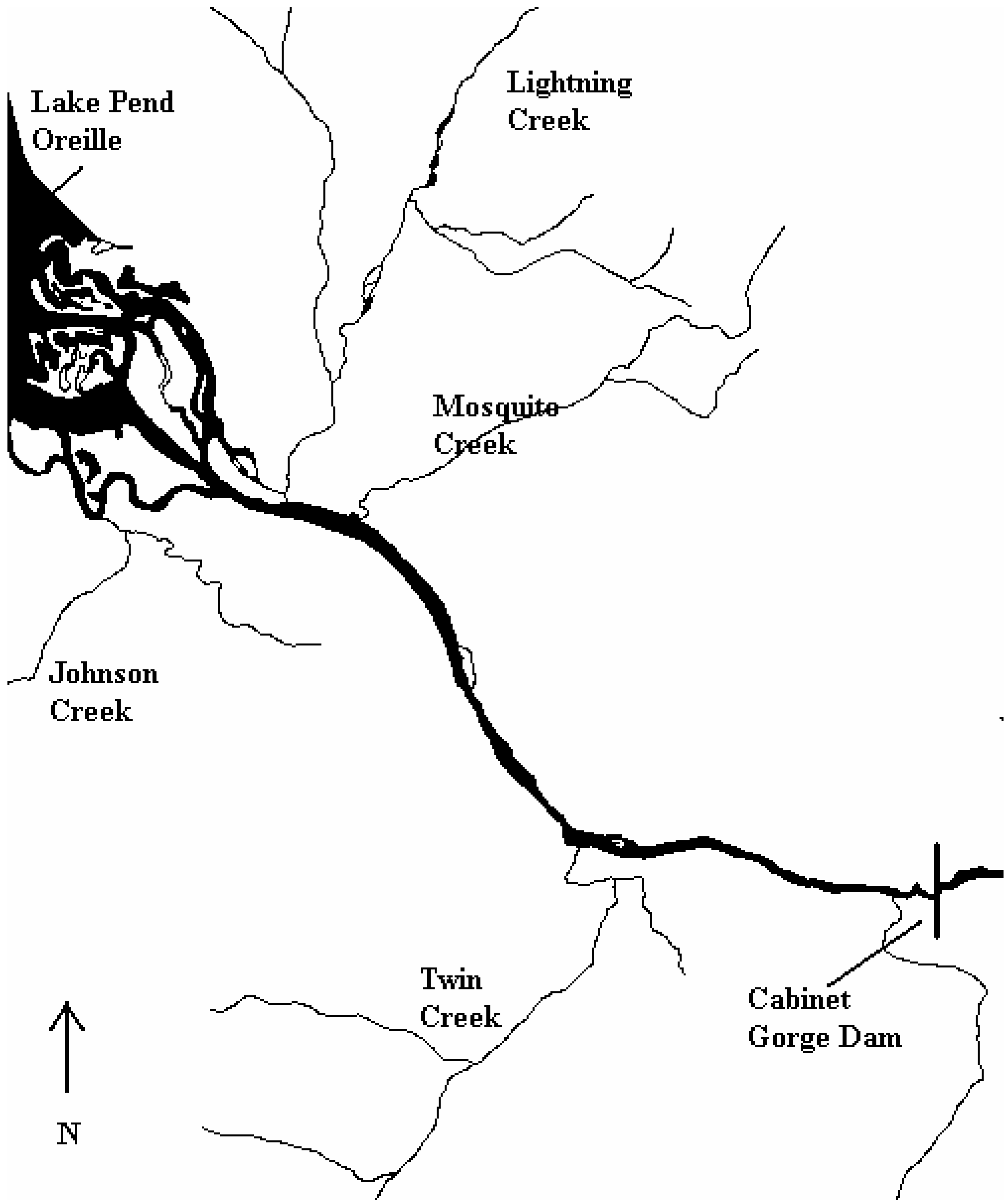

Figure 1. Westslope cutthroat trout radio telemetry and genetics study project area.

A fixed telemetry receiver array was deployed at Cabinet Gorge Dam to detect movements of wct up to and within the tailrace. Additional remote receiving stations were located at the Idaho Department of Fish and Game (IDFG) Cabinet Gorge Fish Hatchery, near the mouth of Mosquito Creek, and in Lightning Creek at the Highway 200 crossing (Figure 1). In addition to fixed-station monitoring, we also attempted to locate tagged fish twice per week in the river by boat. If we could not locate or account for a fish using the remote stations or boat, we searched Johnson, Twin, Mosquito, and Lightning creeks by foot, truck, and plane. We tracked individuals on a weekly basis and if we could not locate an individual within the river, we searched tributaries to the river by foot and fixed-wing aircraft. If we could not locate a fish in the river or in the tributaries, we assumed it moved downstream into the lake. Detection at the downstream-most remote antennae (near Mosquito Creek) was used to support this assumption.

RESULTS and DISCUSSION

Genetics

Genetic samples were collected from 57 individuals visually assessed as "pure" and analyzed by the IDFG Fish Genetics Laboratory. Fifty of fifty-seven individuals did not show evidence of hybridization, and the other seven were later generation (>F1) back-crosses to wct.

Other studies in northern Idaho have also shown similar results for wct. Spotting pattern was used as a key determinant in separating suspected hybrids from "pure" wct, as this has been shown to be one of the more reliable characteristics (J. DuPont, IDFG, personal communication). Increasing intensity of spotting toward the caudal fin and few spots below the lateral line anterior to the dorsal fin (typical half-moon crescent shaped area generally void of spots) were indicative of "pure" wct. In 2002, genetic samples were collected from 29 wct captured below Cabinet Gorge Dam and were analyzed (University of Montana) to determine the percent hybridization in the sample population. Of the 29 individual fish, three were determined to be of hybrid origin (the degree of hybridization was not determined) (Laura Katzman, Montana Fish, Wildlife and Parks, personal communication). This information supports the more recent genetic analysis from the ongoing study.

However, we could still make a type I error (call an individual pure when it is in fact a hybrid) if it has less than 20% rainbow trout *Oncorhynchus mykiss* (RBT) alleles within its genome. We would need 30 diagnostic nDNA loci to detect RBT introgression at the individual level at 5% or greater with 95% probability. Some of these fish may have come from a pure population (or populations) and in fact be pure (no RBT alleles), but some of these also could be multiple back-cross hybrids with low levels of RBT alleles within their genome.

Radio telemetry

We captured a total of 65 wct we evaluated for their suitability for radio tagging from April 1 through

May 12, 2005. We culled 13 from this group because they looked like hybrids and 21 because they were too small for tagging, resulting in a total of 31 transmitters deployed during the spring of 2005 sampling out of a target sample size of 40 (Table 1). The first fish was radio tagged on April 4 and the last was tagged on May 12, 2005. Fish were captured from approximately 0.7 km downstream of the dam to the log-booms near the confluence of Lightning Creek, approximately 13 km downstream of Cabinet Gorge Dam. Fish that were captured upstream of the Cabinet Gorge Fish Hatchery boat ramp (located approximately 1.6 km downstream of the dam), were tagged and released at the boat ramp. All others were released near their original capture sites. We did not observe any acute tagging mortality. We defined acute tagging mortality as mortality occurring before, or within 24 hours of, release back into the river.

We tracked individual wct from April 5 through July 21 in the Clark Fork River, Clark Fork River Delta, Johnson Creek, Twin Creek, and the Lightning Creek drainage. A total of 11 radio tagged fish were detected in the upper portion of the tailrace across from Units 1-4, and four others were detected in the lower tailrace only (near or immediately across from the diversion tunnels) (Table 1; Appendix A) in April through June. Of the 11 fish detected at specific fields in the upper tailrace, all were present at flows in excess of 934 cms (33,004 cfs). Three of these were detected at specific fields in the upper tailrace at flows greater than 1,274 cms (45,018 cfs). Two of these three were detected in specific fields in the upper tailrace at flows greater than 1,500 cms (53,004 cfs). Detailed information on fish movements within the tailrace will be provided under contract with Normandeau Associates after the 2006 field season is complete. Of the 15 fish that entered the tailrace area, only three were confirmed hybrids (Table 1).

The remaining 16 radio tagged individuals did not make movements indicative of attempting to pass upstream beyond Cabinet Gorge Dam (Table 1; Appendix A). One of these 16 individuals (frequency 464, code 7) tagged near the log-booms in the Clark Fork River on April 28 migrated upstream in the Lightning Creek watershed. This individual was 401 mm in length and weighed 600 g at the time of tagging and was detected by the remote station near the town of Clark Fork on May 16, moving upstream in Lightning Creek. It was tracked into the East Fork Lightning Creek where it was first detected on May 31. It continued to be detected in the upper reaches of East Fork Lightning Creek near the confluence of Thunder Creek until June 9. The individual was subsequently detected moving back downstream by the remote station on Lightning Creek near the town of Clark Fork on June 12. The results of genetic testing did not reveal any evidence of hybridization in this individual. Two others remained in the Clark Fork River into July (Frequency 443, code 9 and Frequency 423, code 88) indicating they may be exhibiting a fluvial rather than an adfluvial life-history. We are unable to confirm this however, because our tags turned off at the end of July. One of these individuals (code 9) was detected in lower Twin Creek in early June and it is possible it spawned in Twin Creek, although we did not detect it in upstream areas where we would expect spawning to occur. Most of the remaining individuals spent several weeks or longer in the river before moving back downstream and into the lake. However, two of these individuals moved rapidly (two days or less) into the lake following tagging and were not detected in the river again. Two of the 16 individuals that didn’t attempt to migrate past Cabinet Gorge Dam were confirmed hybrids (Table 1).

Table 1. Westslope cutthroat trout capture, tagging, genetic, and movement information in the Clark Fork River, Idaho, in 2005.

Length	**Weight**	**Tag Frequency**	**Tag Code**	**PIT Tag**	**Tag Date**	**Hybrid [a]**	**Dam [b]**
390	560	149.423	84	985120021554502	4/4/2005	N	Y
364	600	149.443	1	985120021552297	4/4/2005	Y	Y
422	775	149.464	1	985120021459280	4/4/2005	N	Y
338	390	149.464	2	985120021579080	4/4/2005	N	Y
403	580	149.483	109	985120017066511	4/4/2005	N	Y
324	350	149.483	100	985120017059350	4/5/2005	N	Y
414	660	149.443	10	985120021568071	4/7/2005	N	Y
360	390	149.423	81	985120017057455	4/12/2005	N	N
319	332	149.423	88	985120021555321	4/12/2005	N	N
310	297	149.443	7	985120021560505	4/12/2005	N	Y
328	367	149.464	5	985120021560388	4/12/2005	N	N
338	430	149.483	102	985120021604890	4/13/2005	N	N
317	300	149.464	6	985120021594313	4/18/2005	N	N
318	300	149.423	89	985120021572219	4/20/2005	N	N
350	445	149.443	8	985120021550472	4/20/2005	N	Y
394	570	149.464	10	985120021579265	4/20/2005	Y	Y
321	350	149.443	4	985120021563979	4/21/2005	N	Y
354	455	149.443	9	985120021588161	4/26/2005	N	N
304	310	149.483	106	985120021582750	4/26/2005	N	Y
401	600	149.464	7	985120021594010	4/28/2005	N	N
364	430	149.423	80	985120021462187	4/29/2005	N	N
378	565	149.443	5	985120017062362	4/29/2005	N	Y
308	290	149.483	103	985120021598804	4/29/2005	N	N
383	610	149.483	105	985120015937335	4/29/2005	Y	N
357	425	149.464	3	985120021549507	5/4/2005	N	N
314	310	149.483	107	985120021596724	5/5/2005	N	N
360	405	149.423	82	985120021596026	5/9/2005	N	N
365	410	149.443	3	985120021449149	5/9/2005	N	Y
397	570	149.464	8	985120021554581	5/10/2005	Y	N
376	445	149.423	85	985120021601624	5/12/2005	Y	Y
343	345	149.483	101	985120017061641	5/12/2005	N	N

[a] Genetically determined hybrid of westslope cutthroat X rainbow trout
[b] Detected in the Cabinet Gorge tailrace defined as the “meathole/point” remote station, upstream to the face of the spillgates

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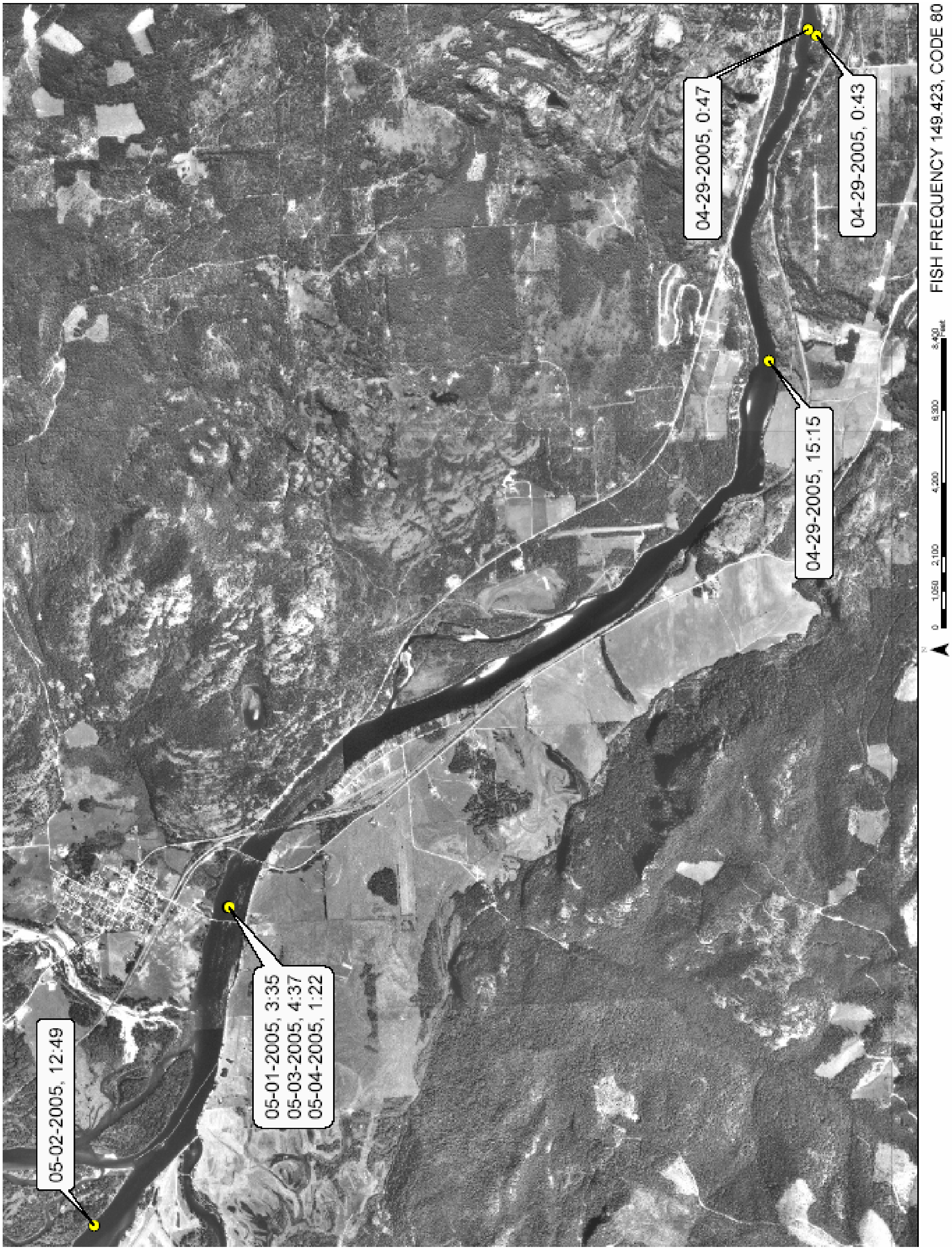
APPENDICES

Appendix A

Radio telemetry locations of westslope cutthroat trout in the Clark Fork River, Idaho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Feet
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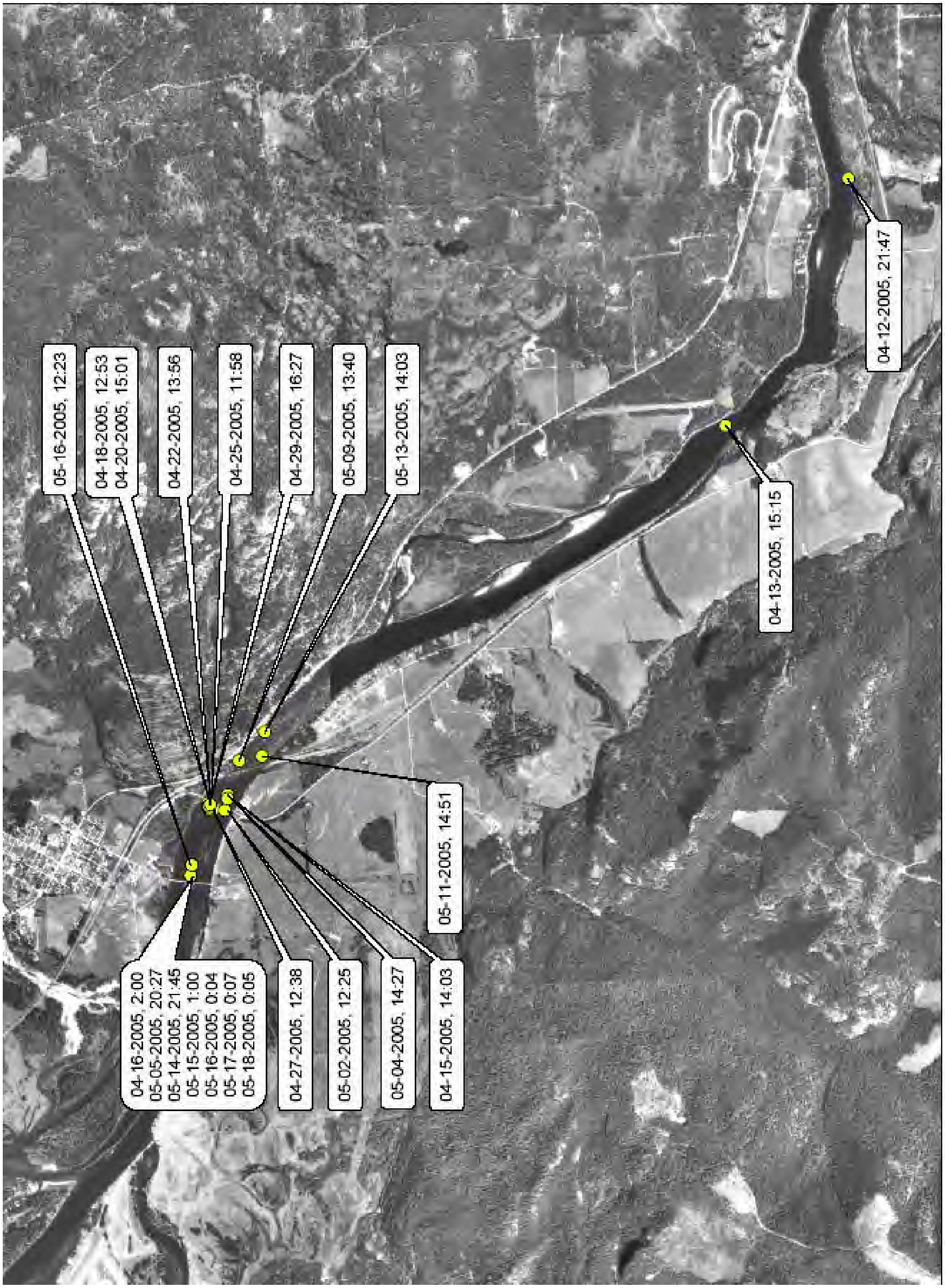

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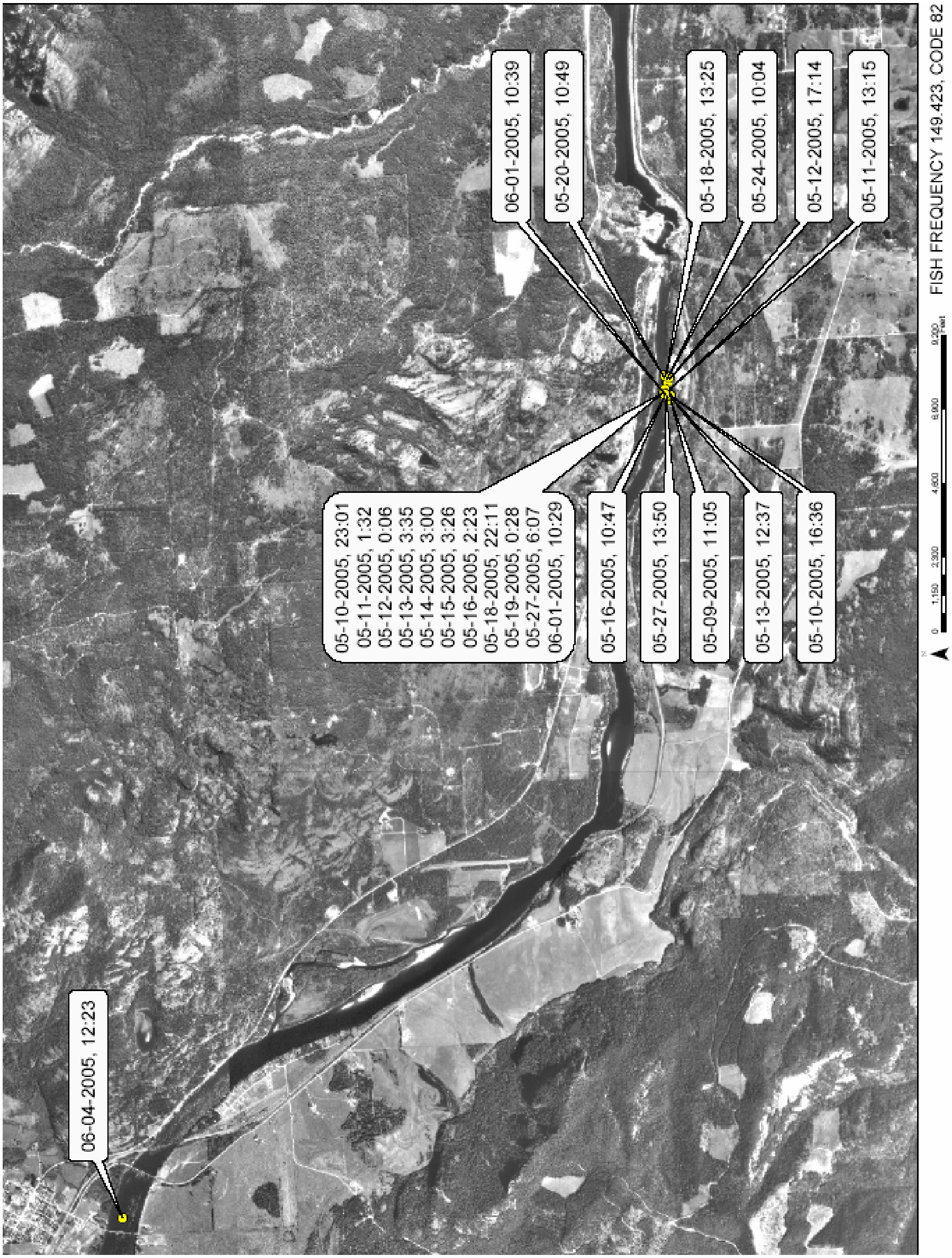

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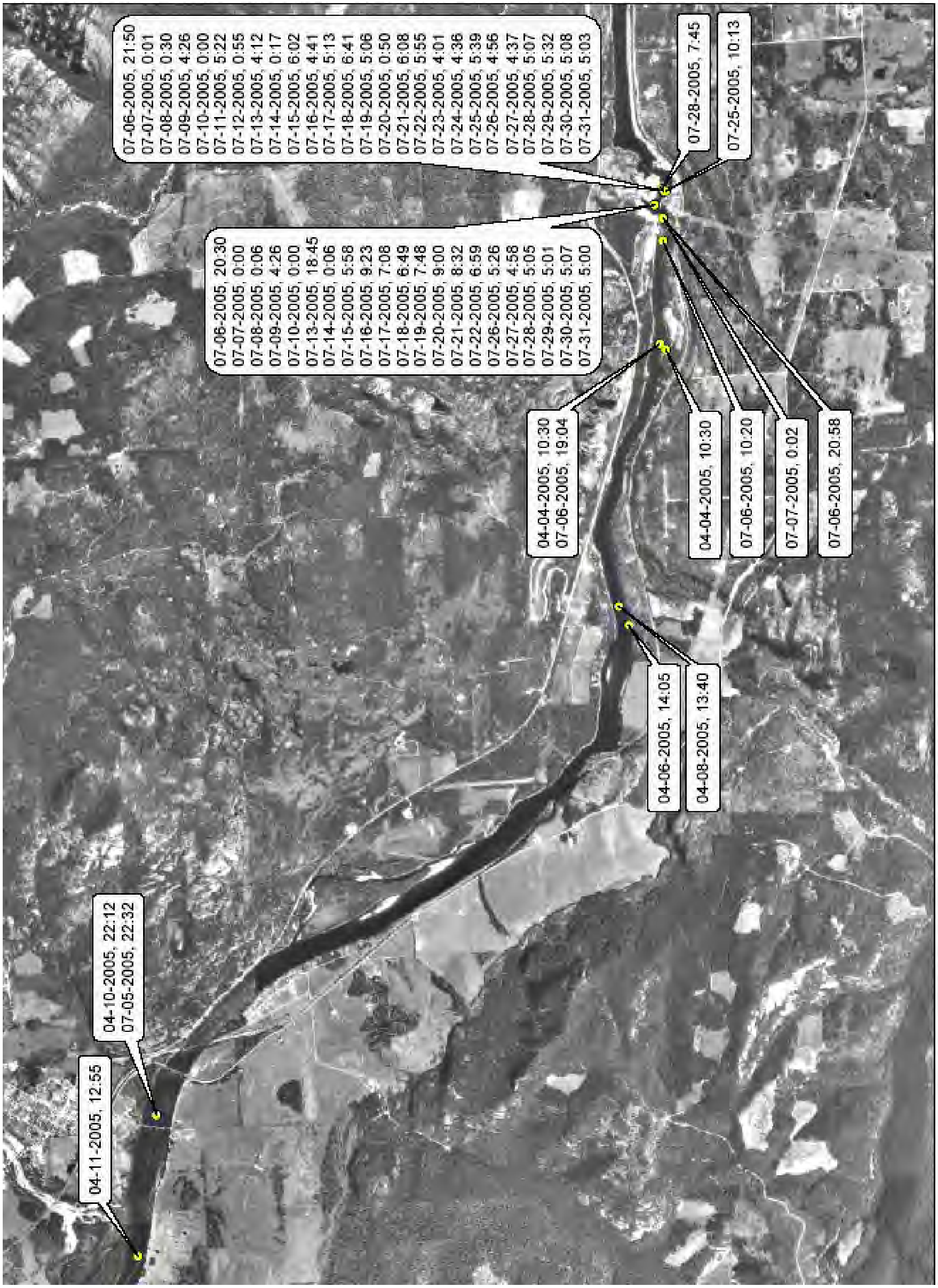

0 1,250 2,500 5,000 7,500 10,000 Feet

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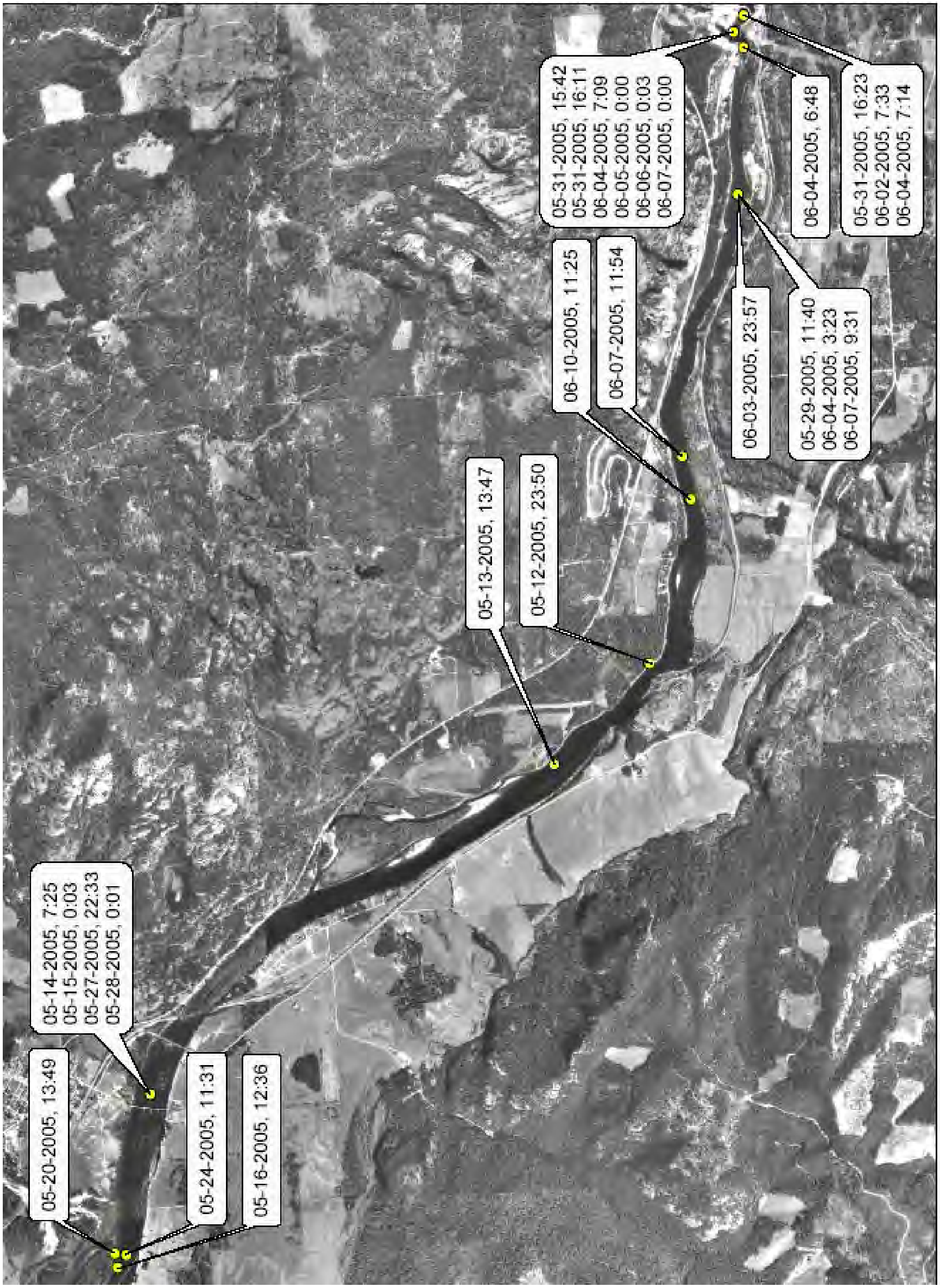

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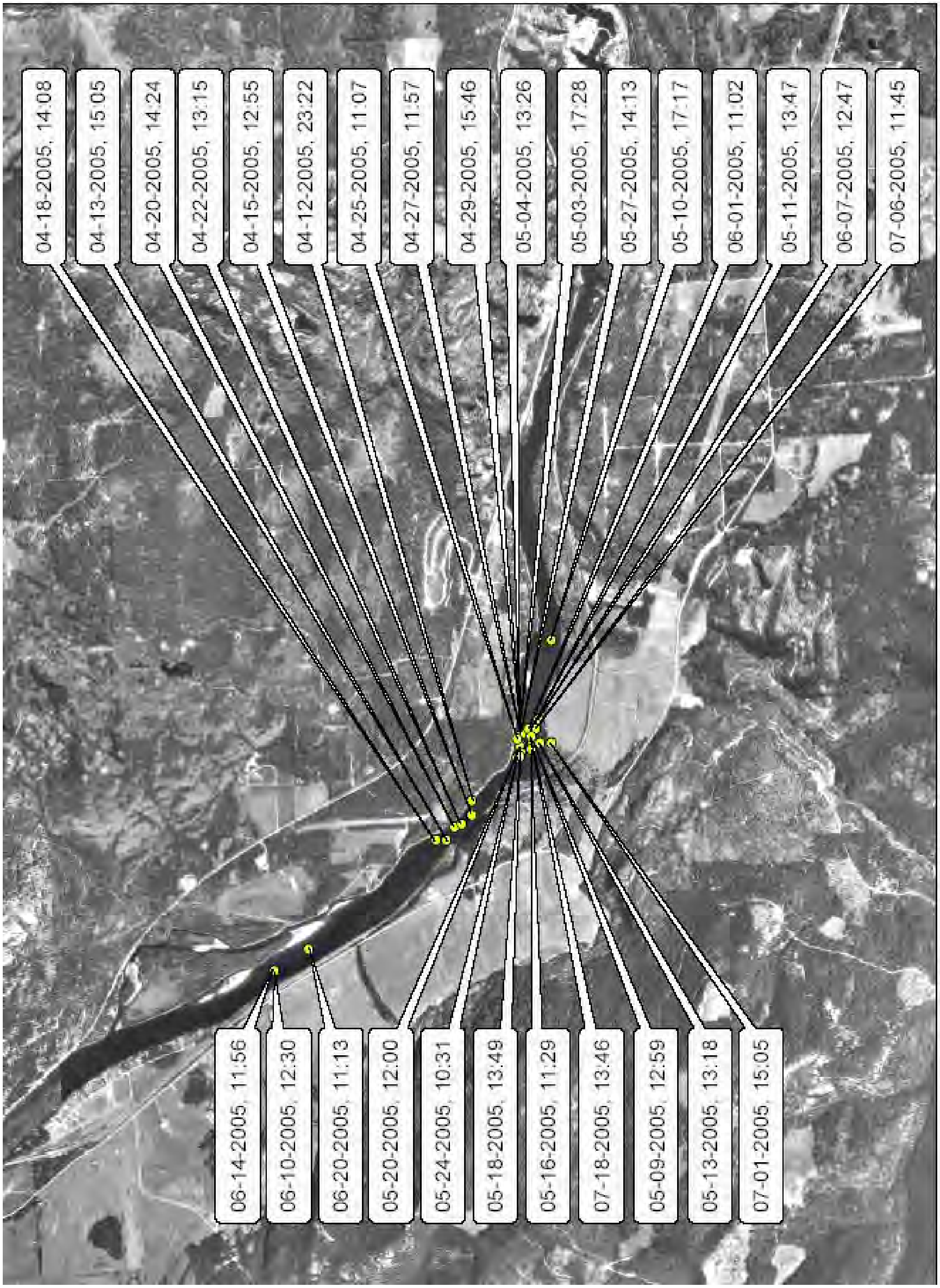

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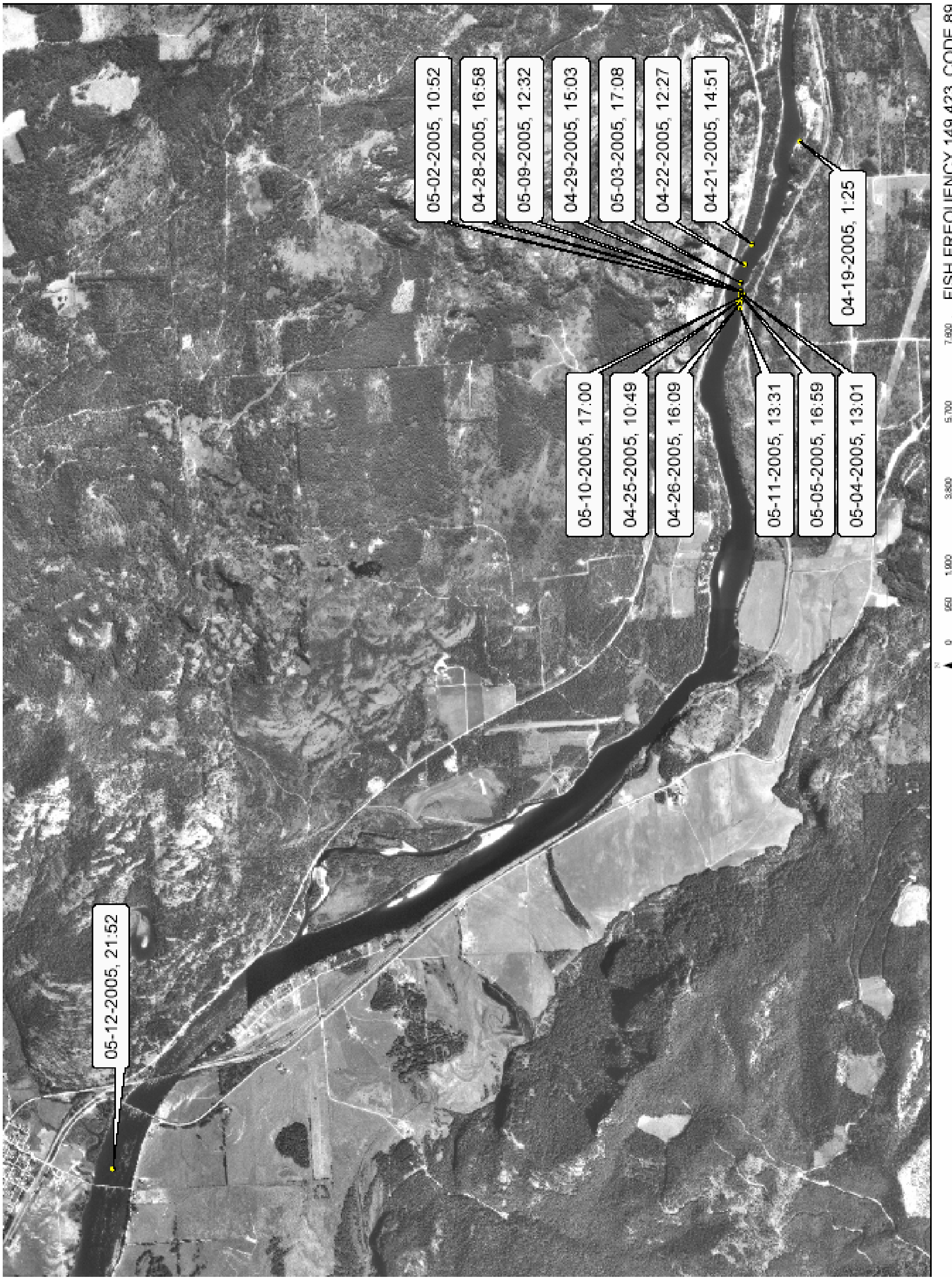
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04-25-2005, 10:49
04-26-2005, 16:09
05-11-2005, 13:31
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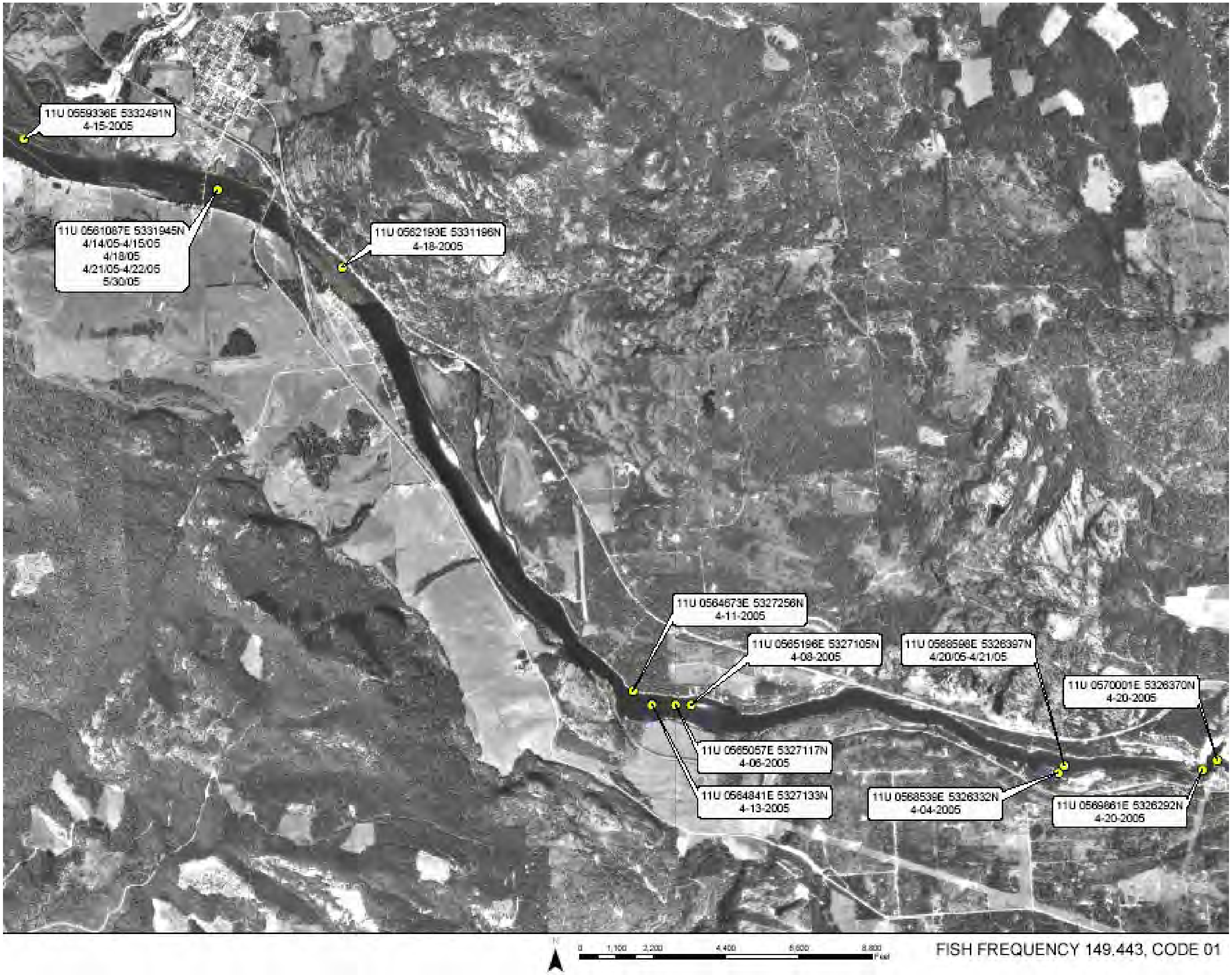
5,700
7,600
Feet



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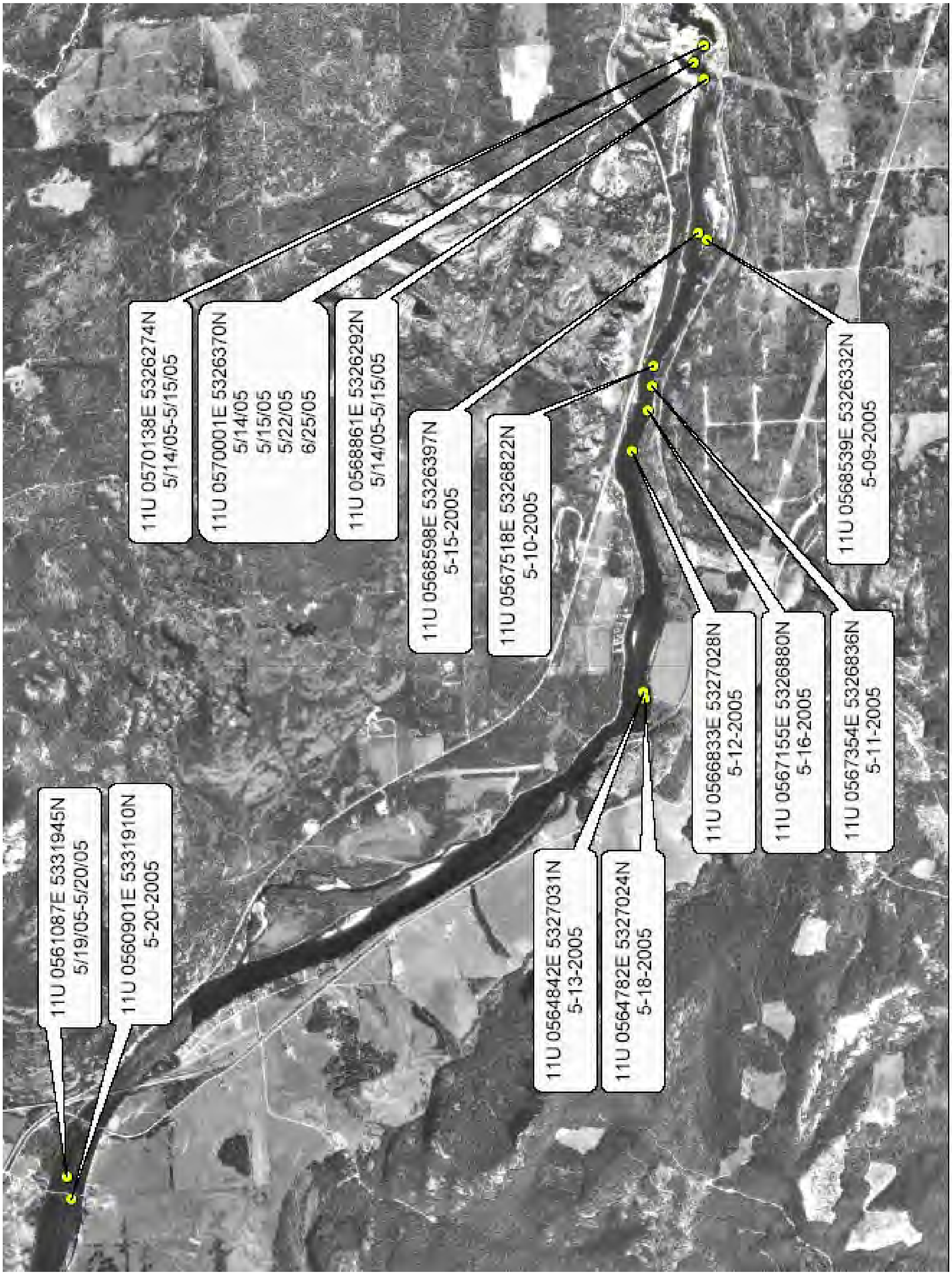

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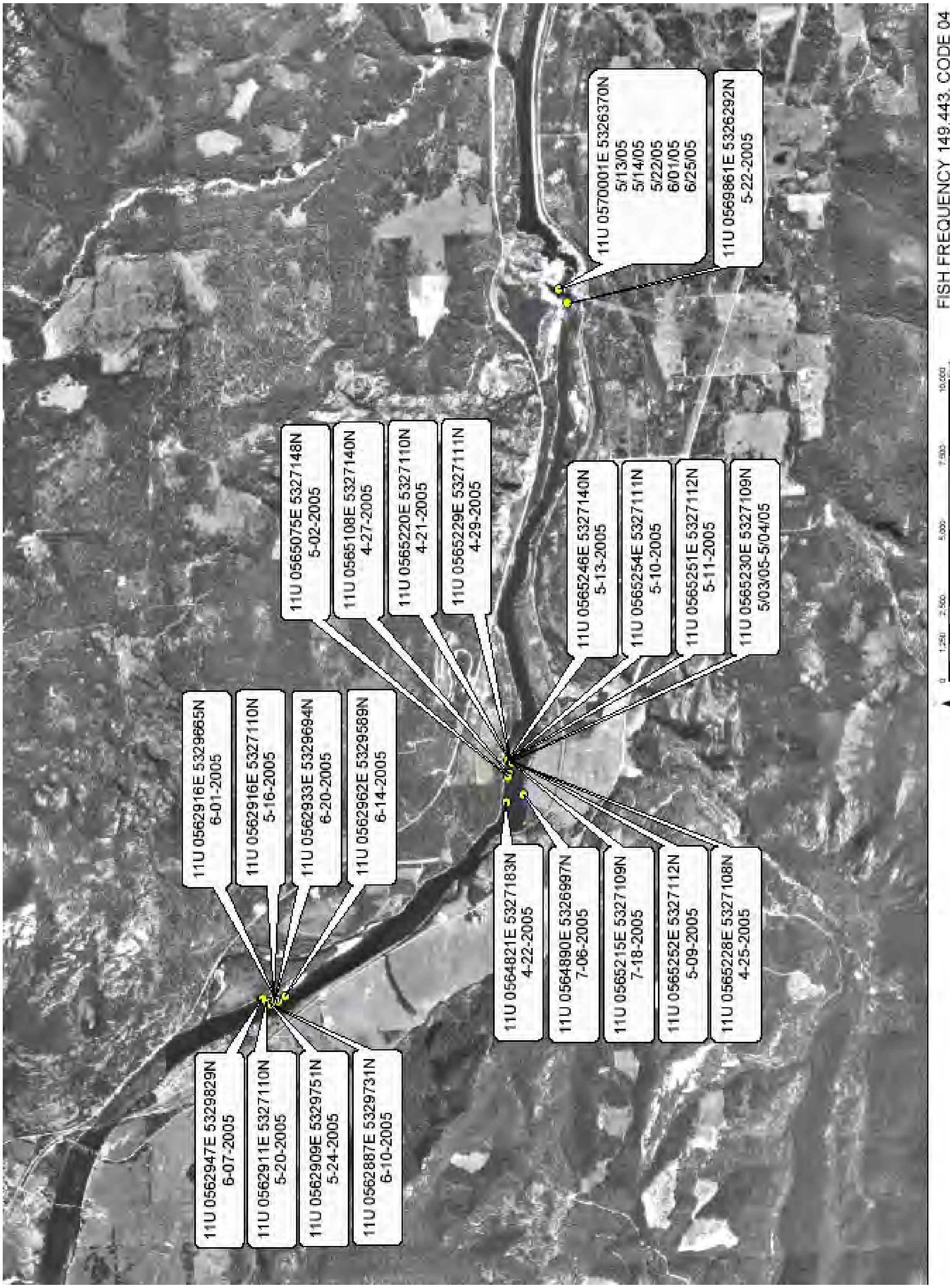
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11U 0564890E 5326997N
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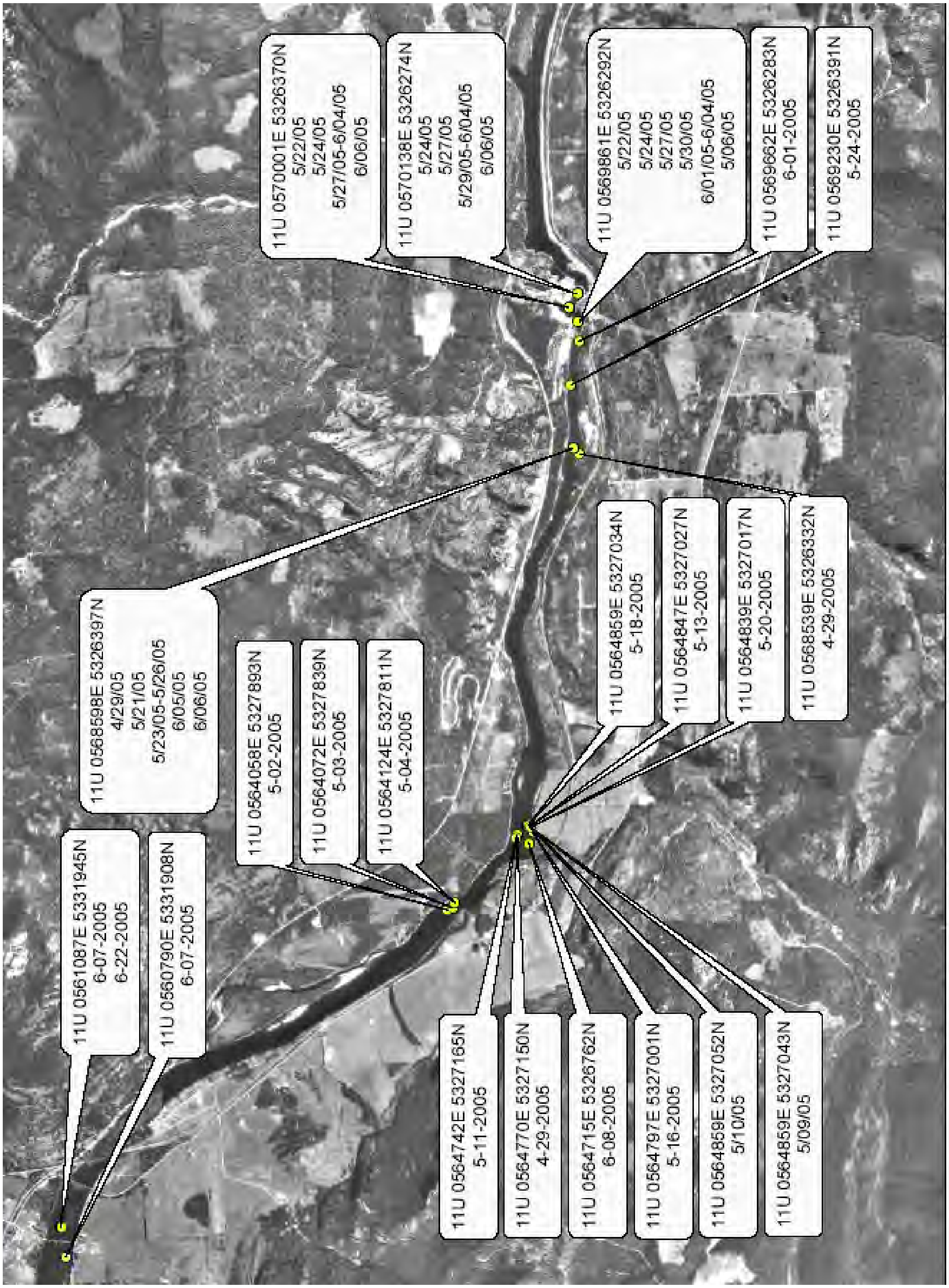
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6/06/05
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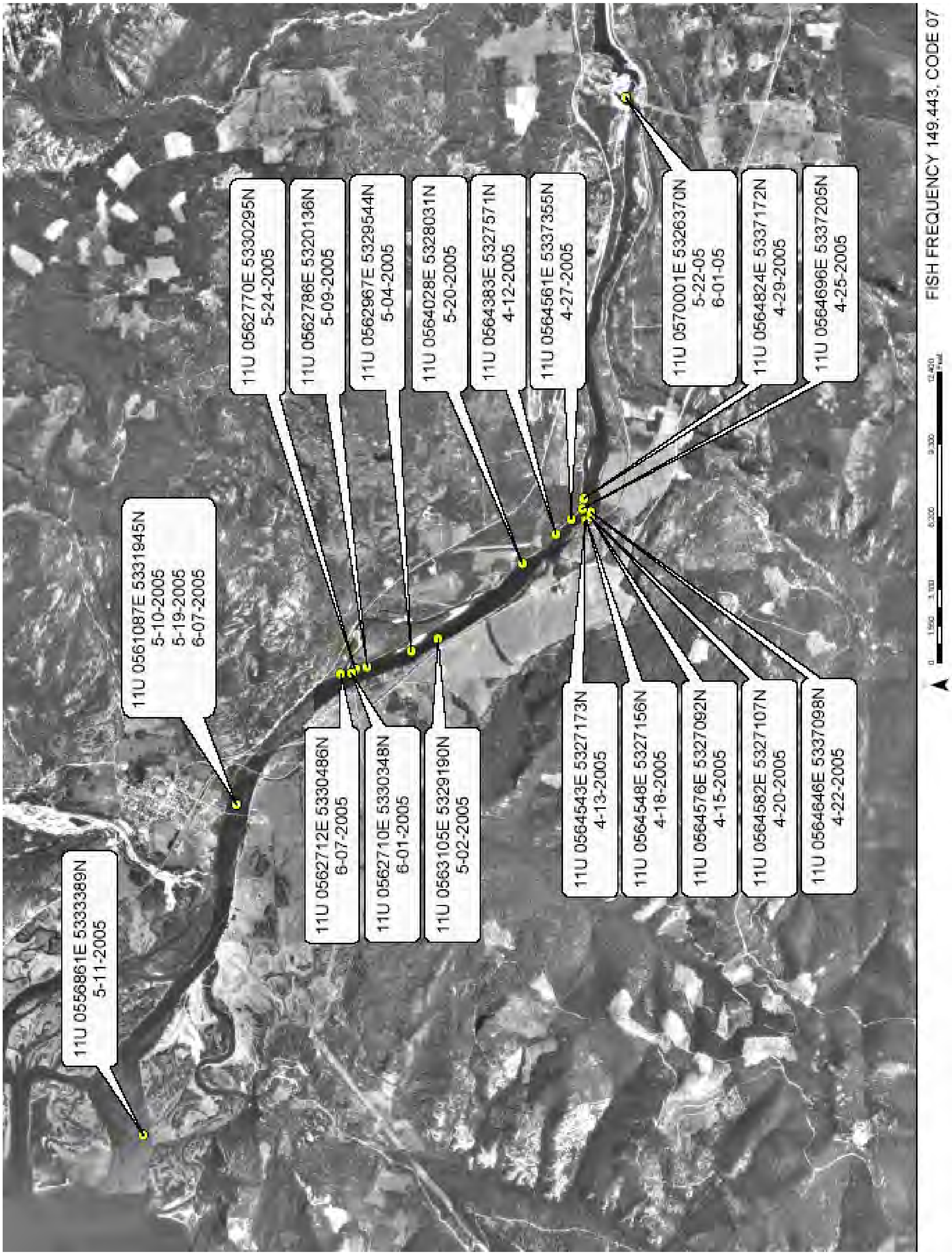

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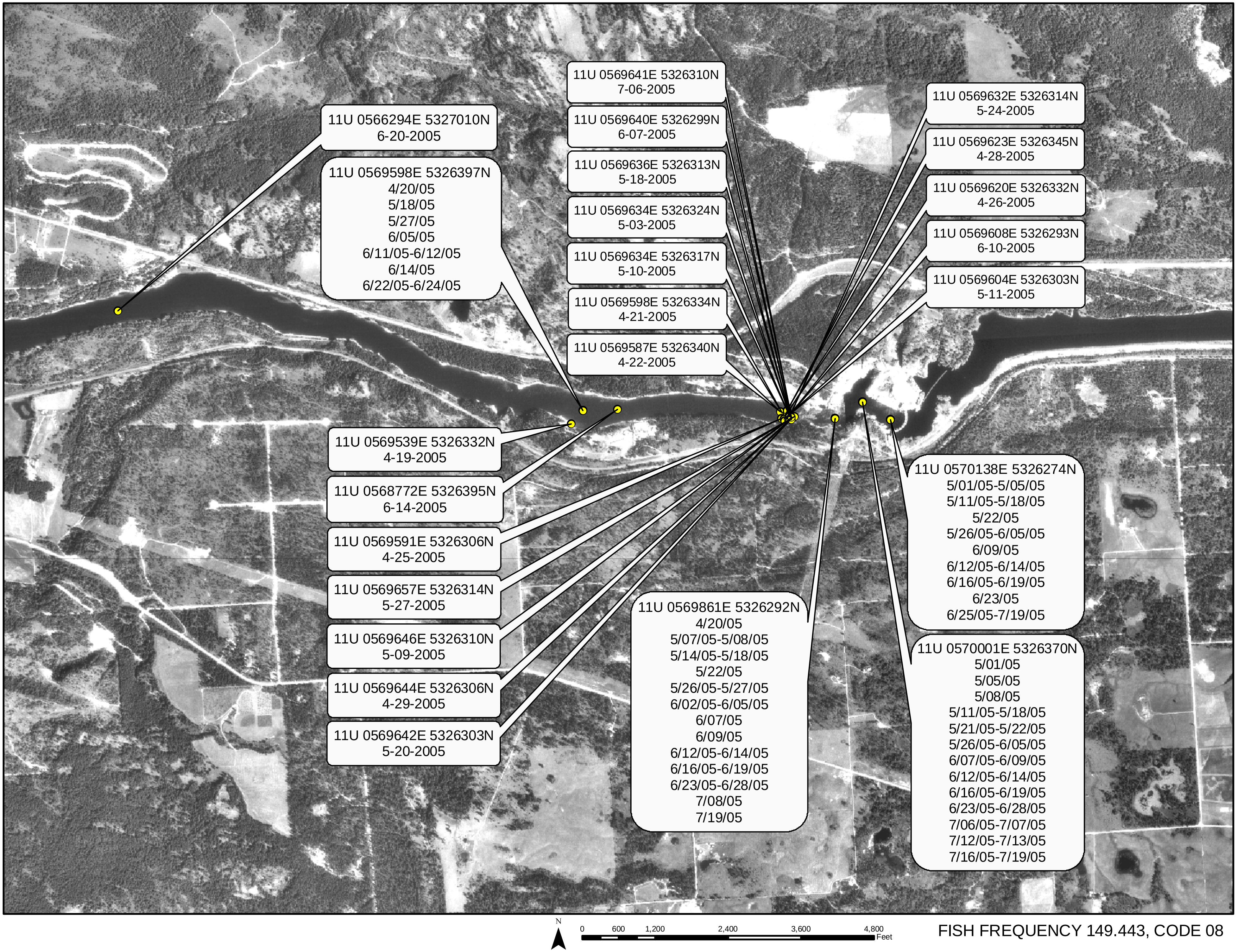

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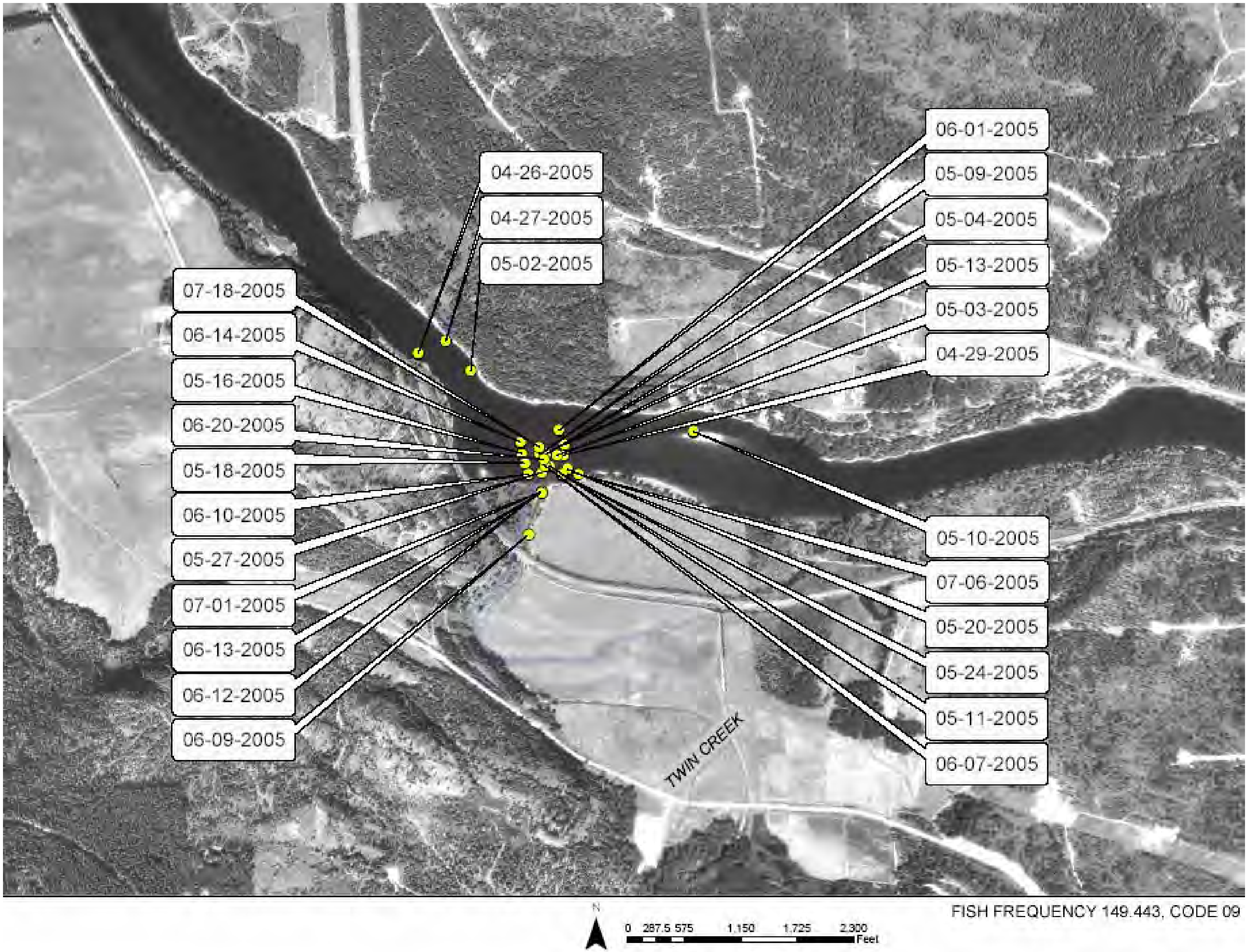

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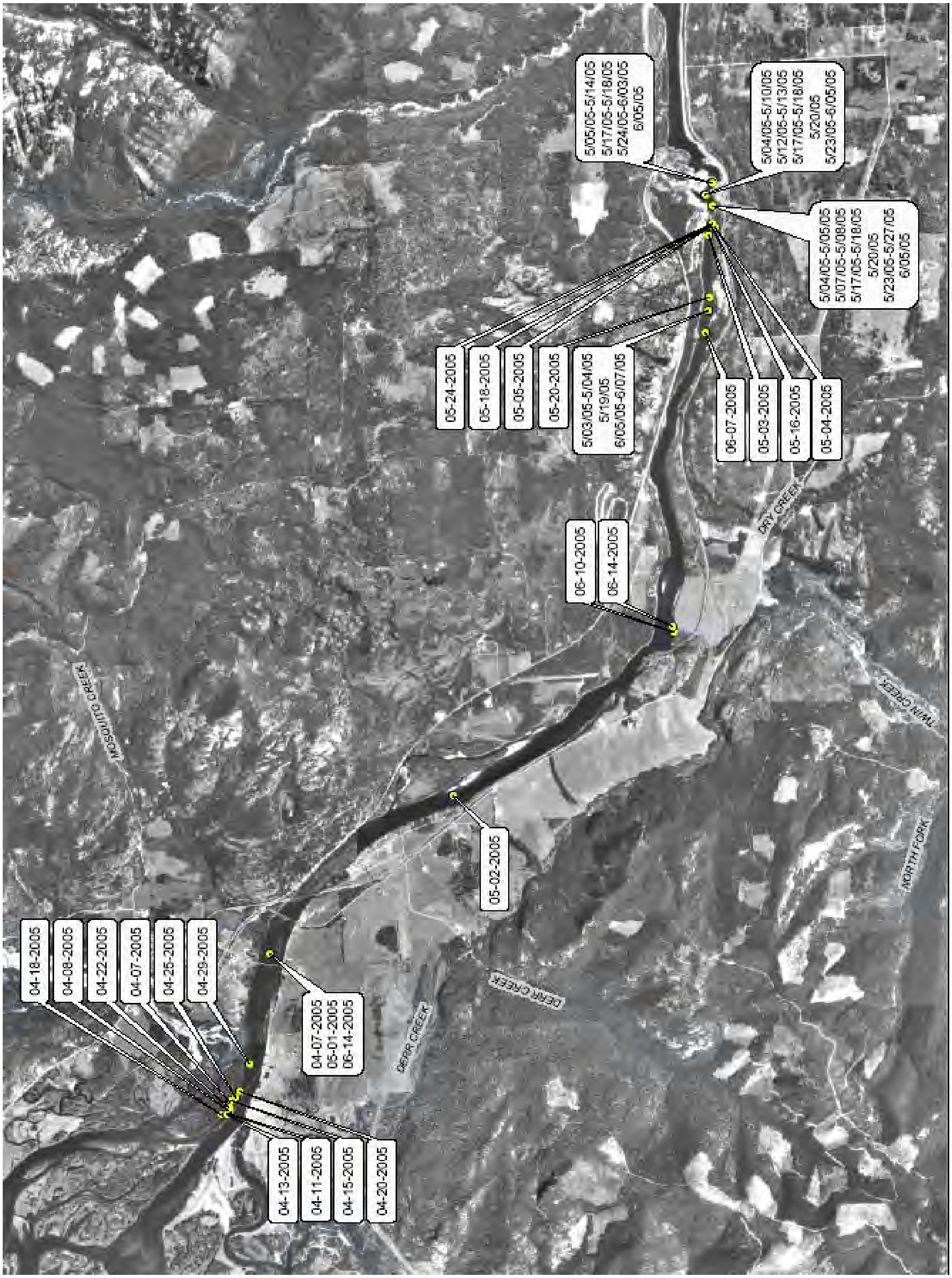

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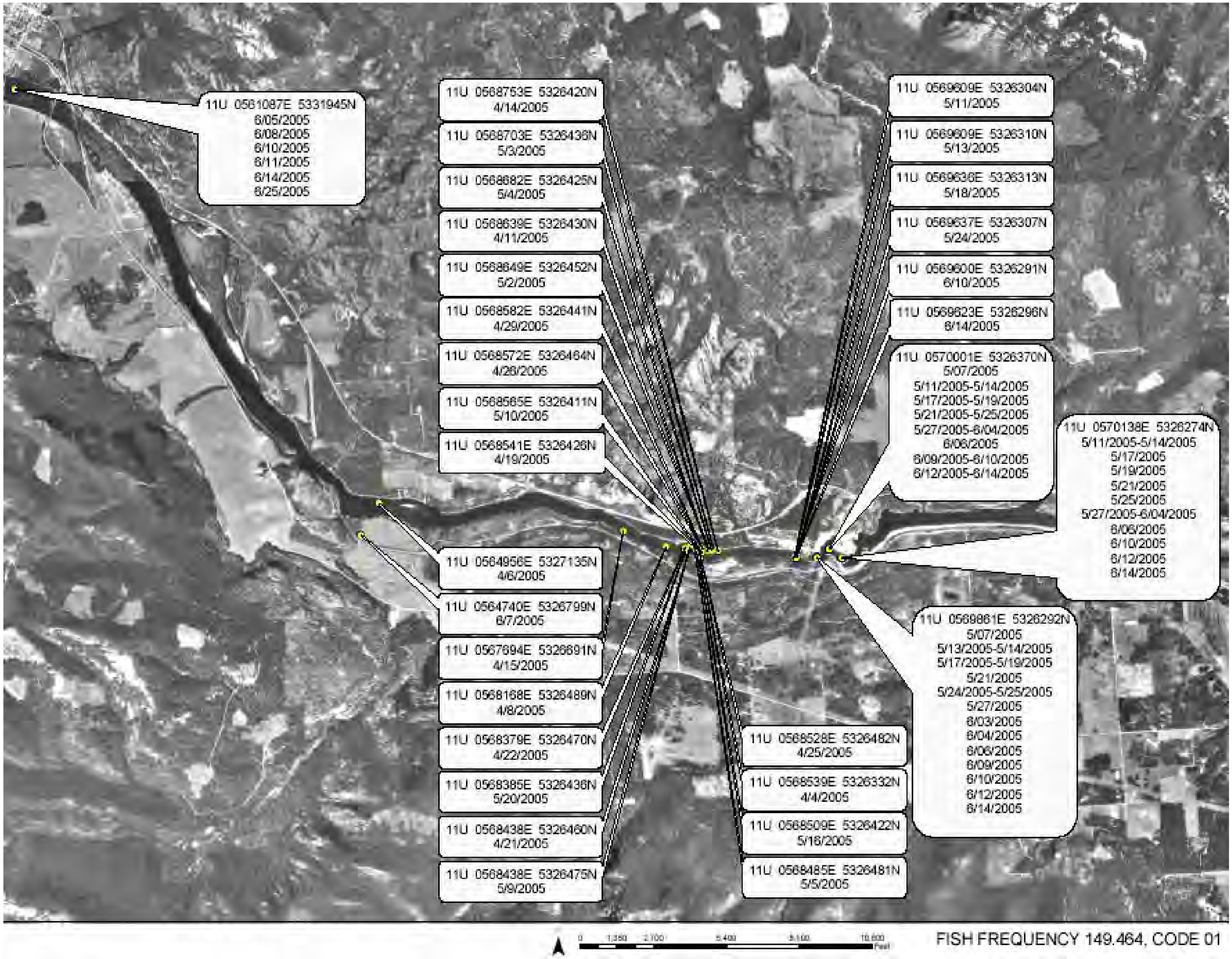

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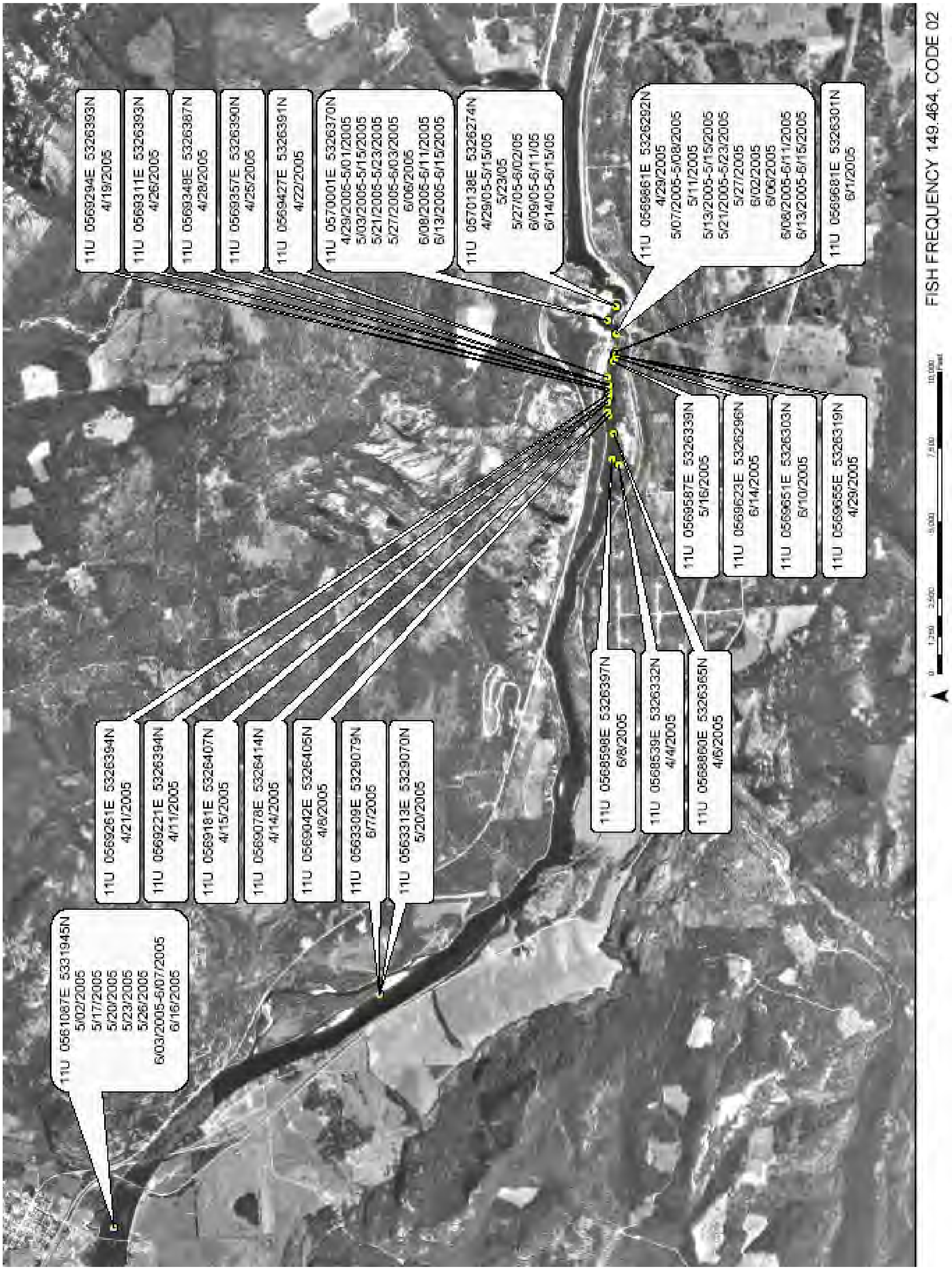

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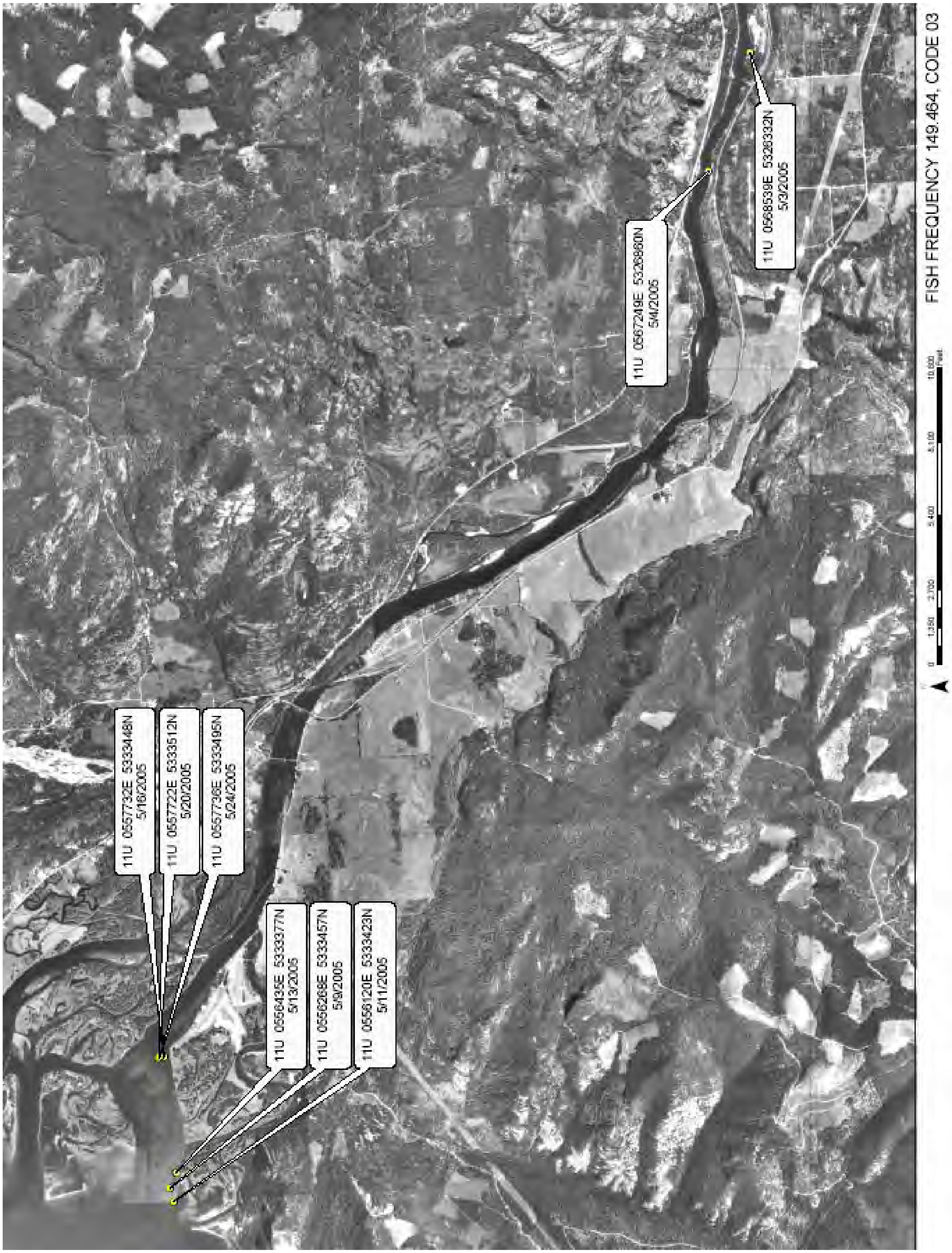

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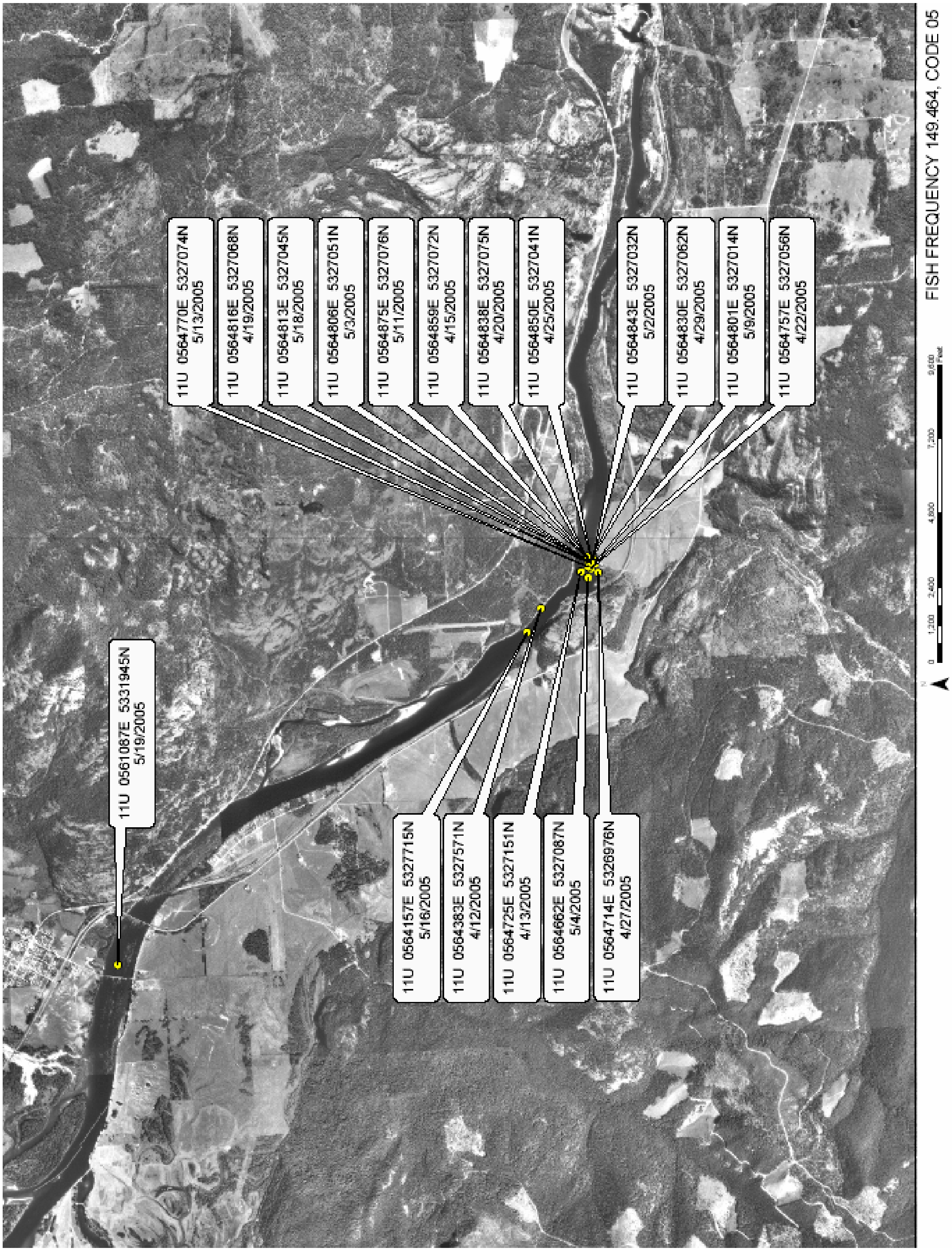

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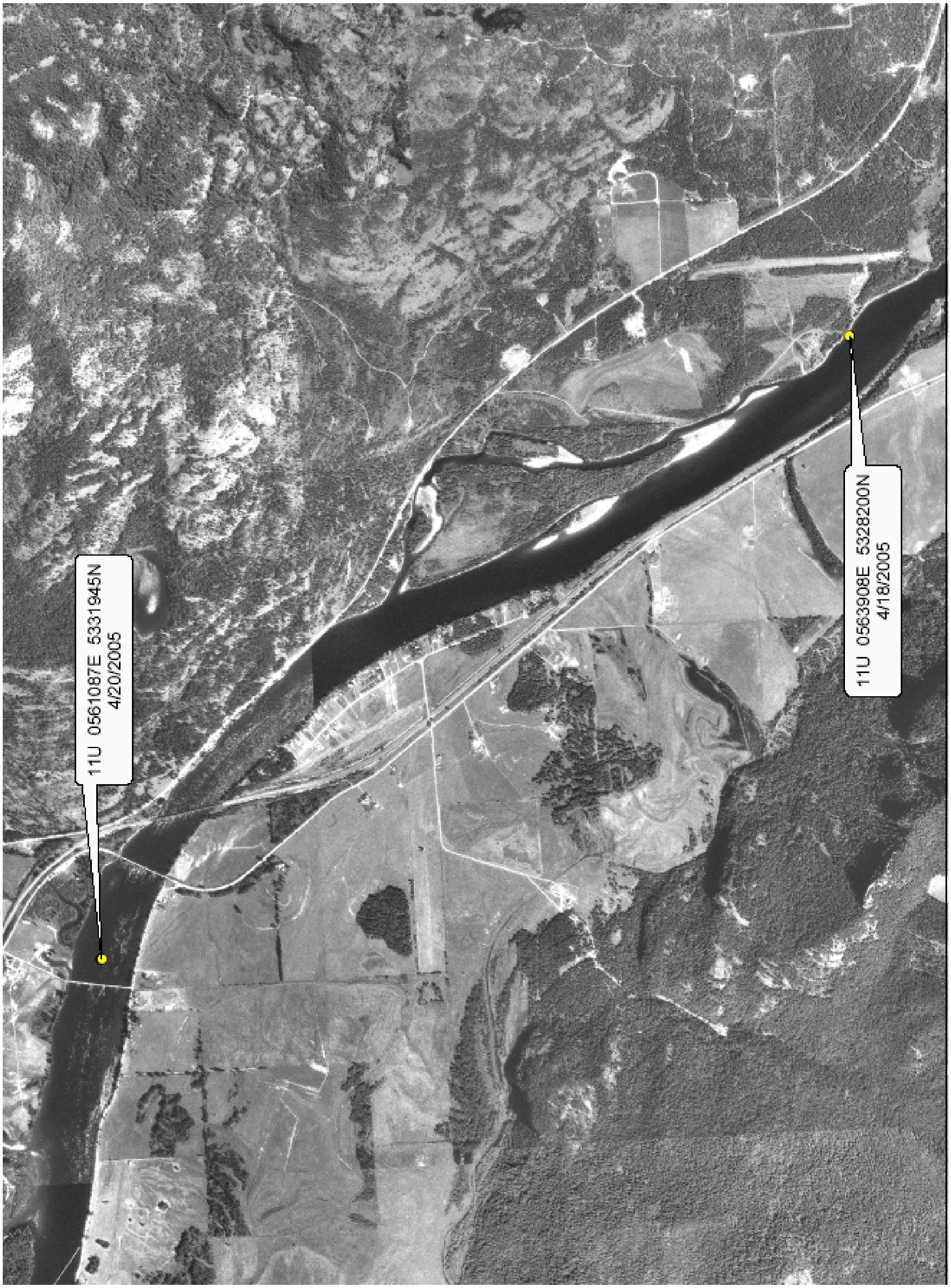

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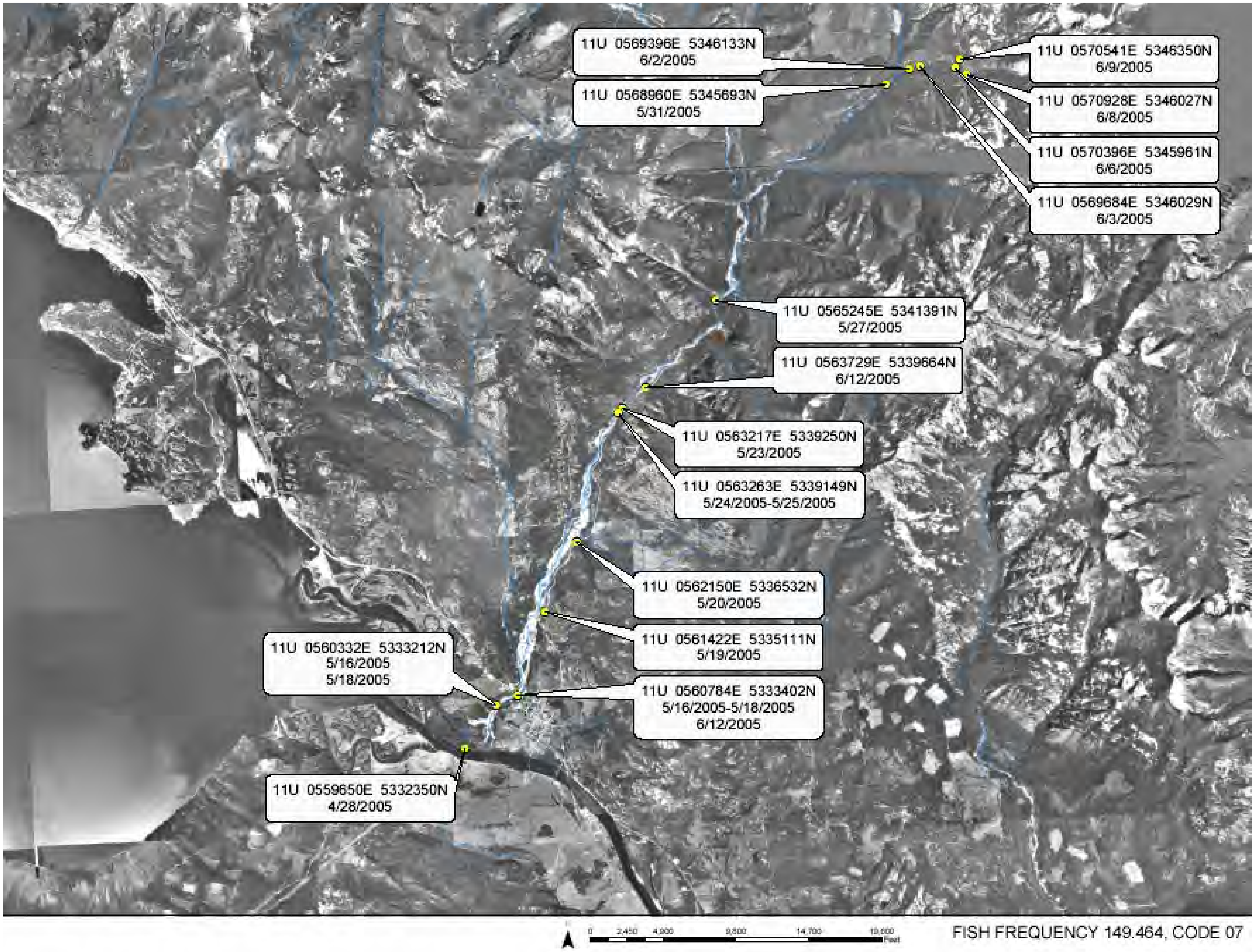

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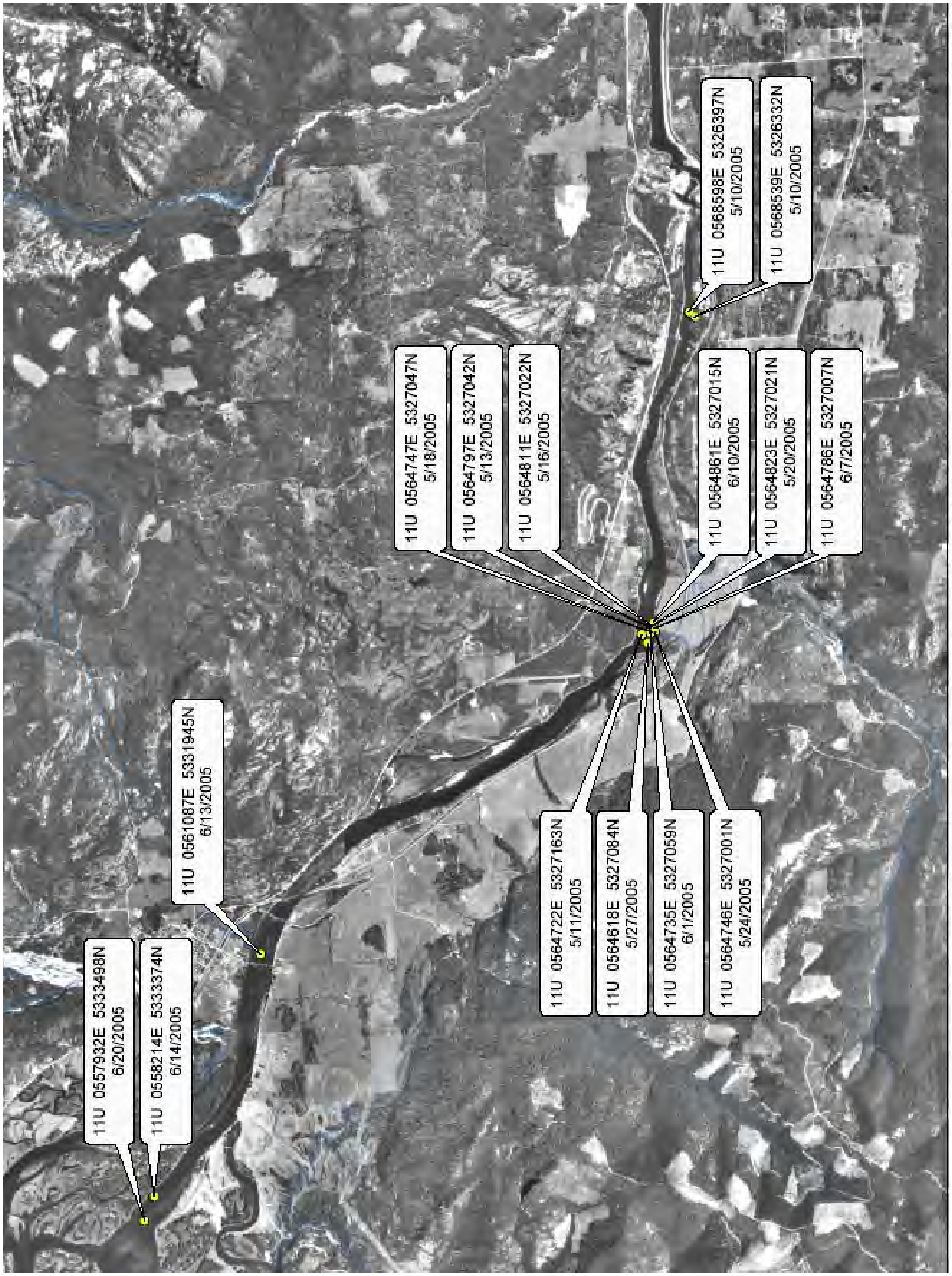

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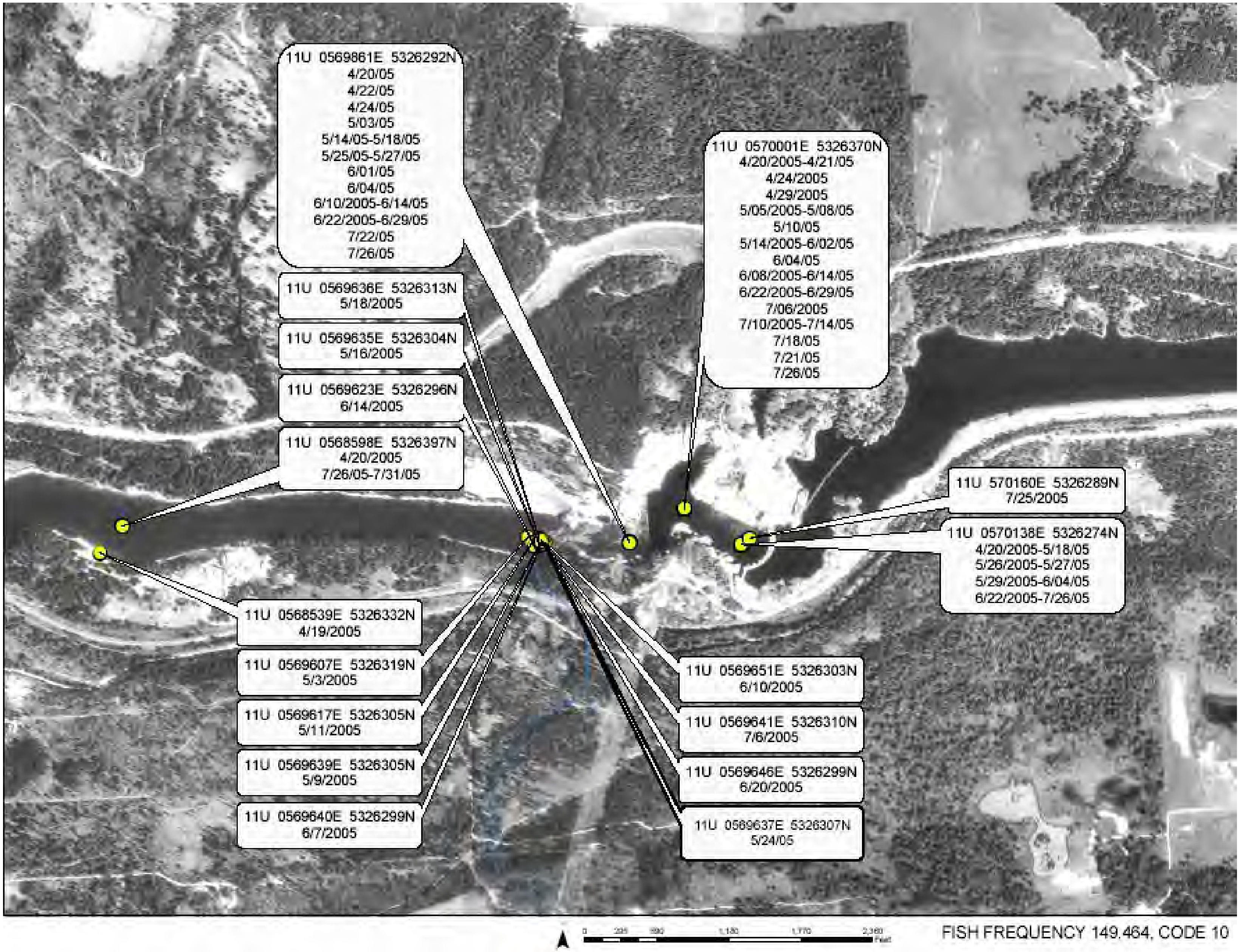

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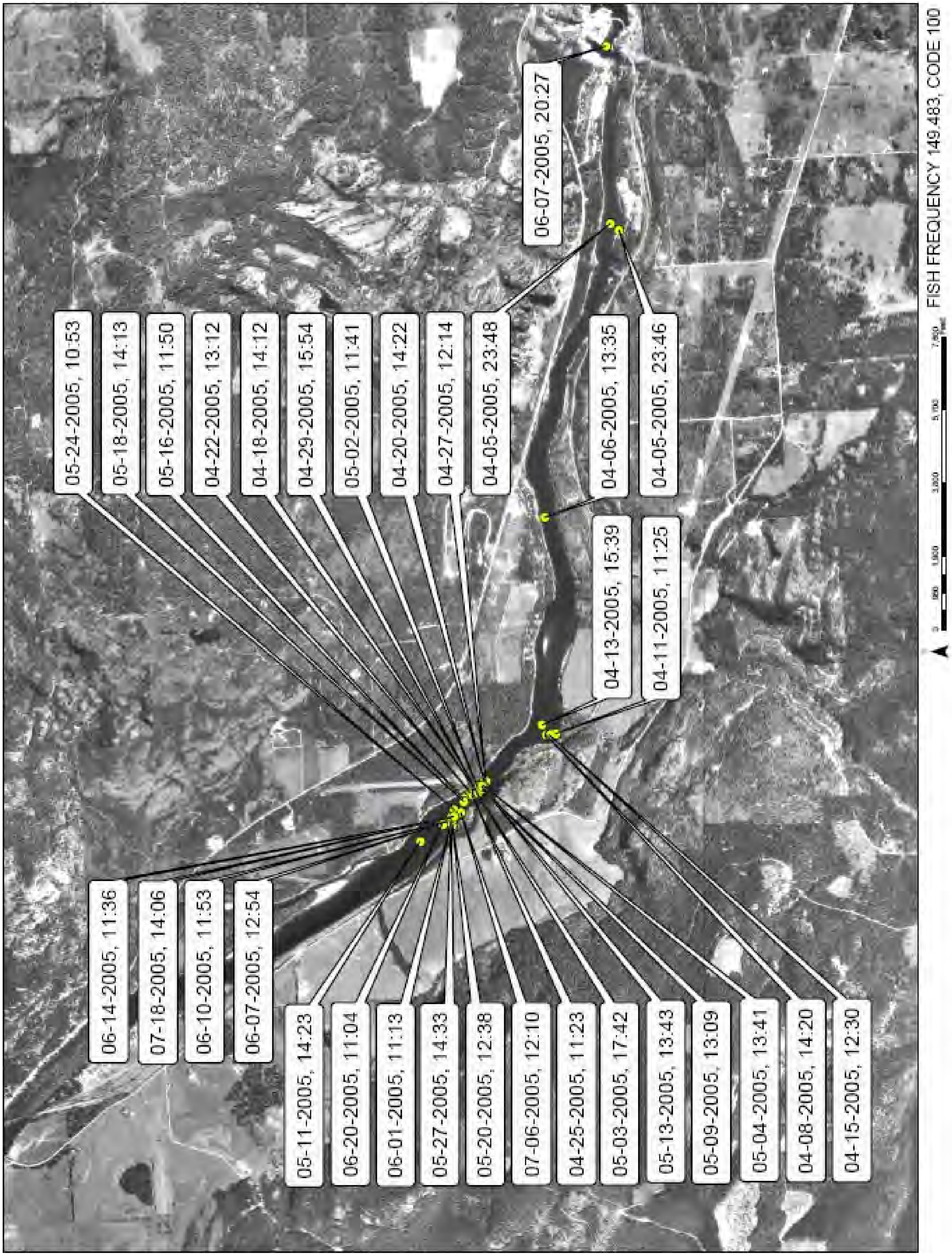

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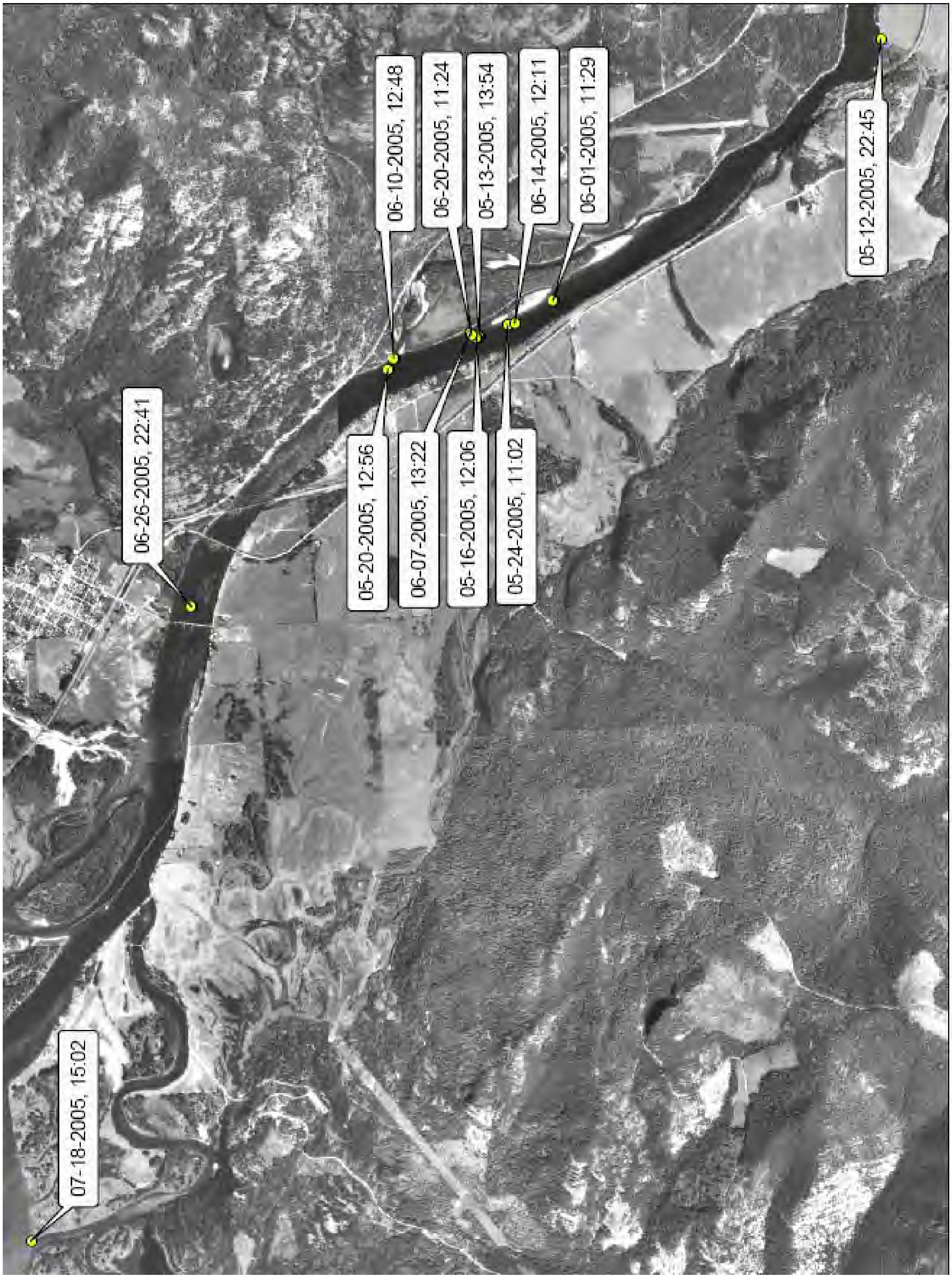

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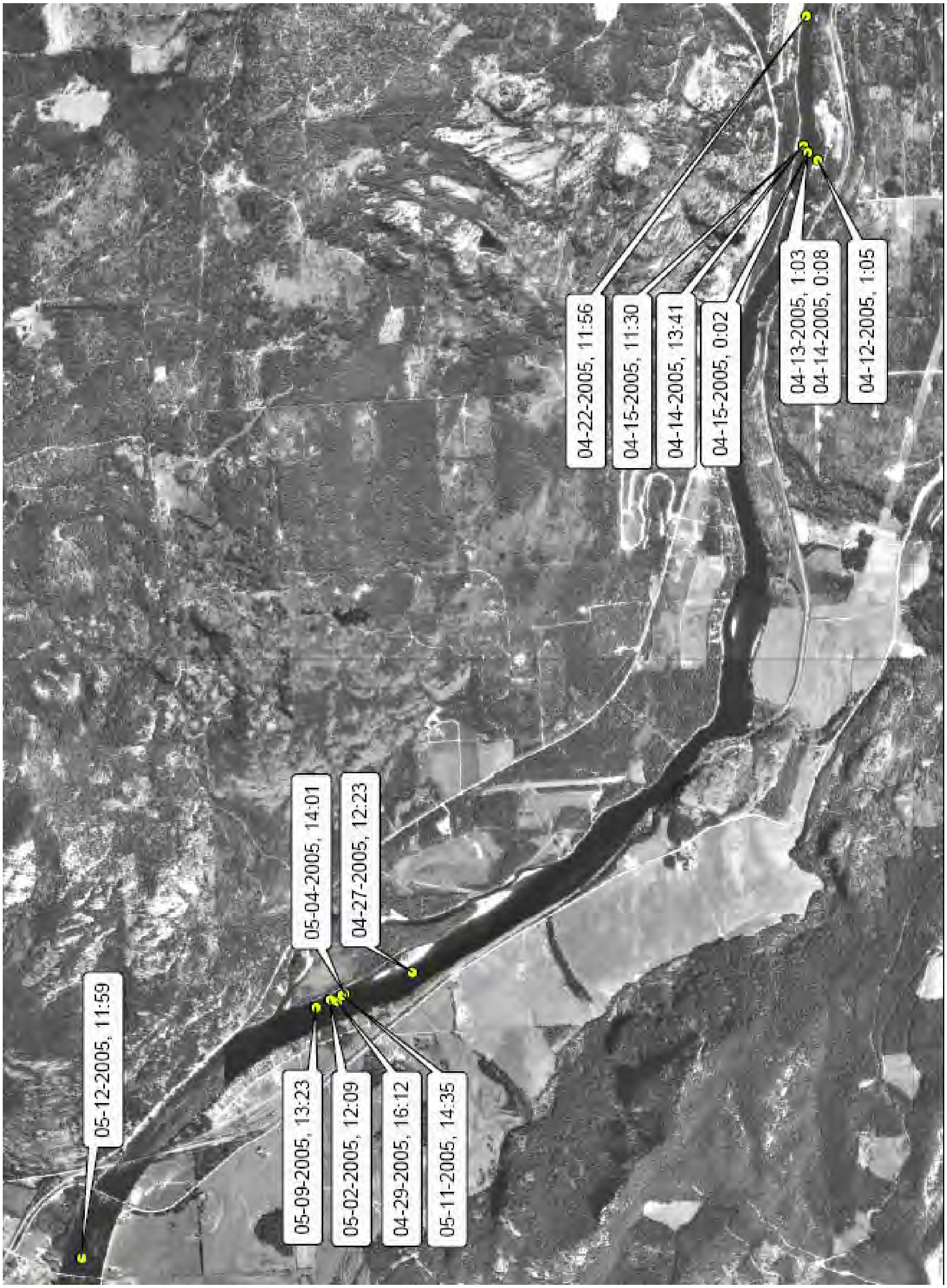

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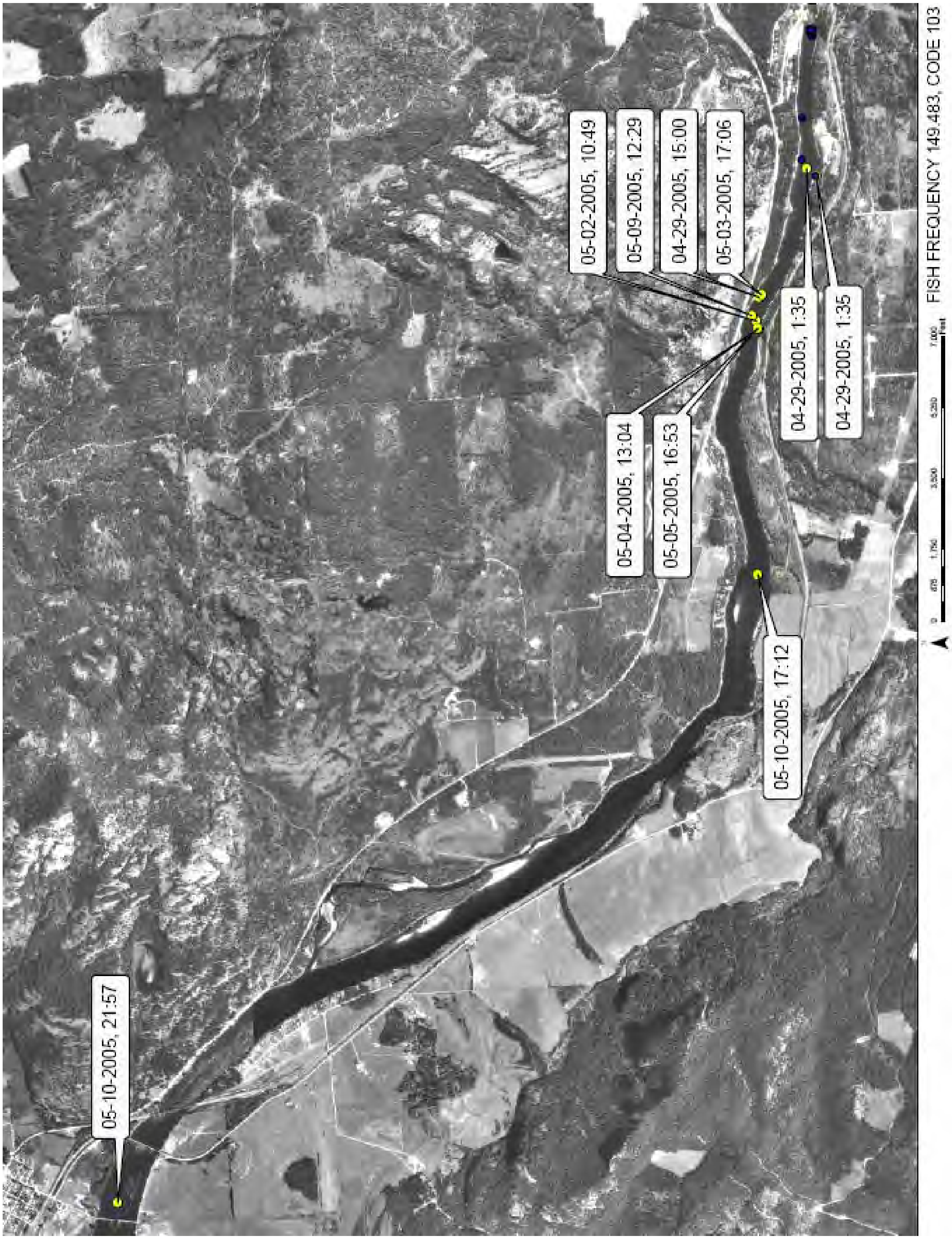

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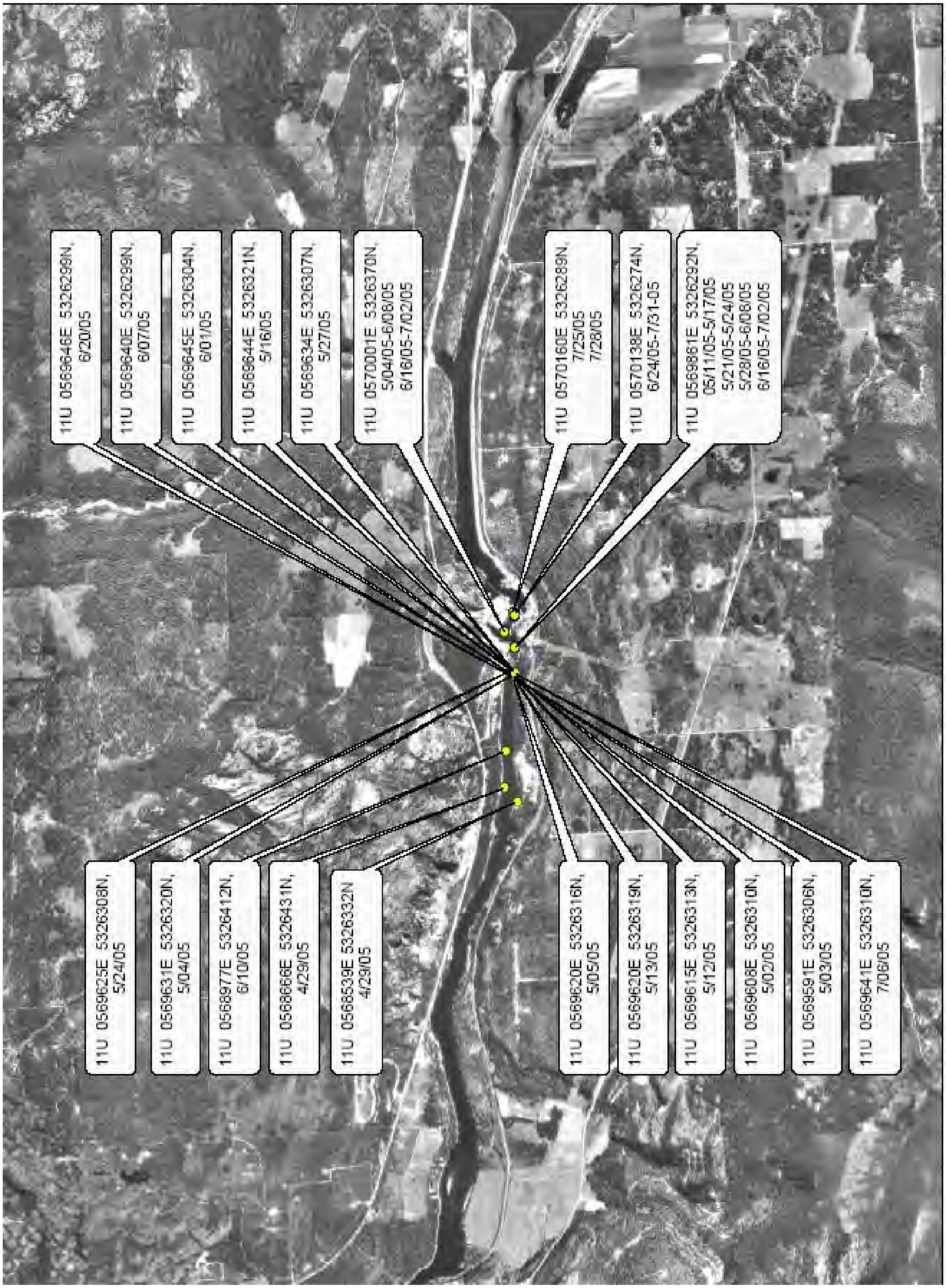

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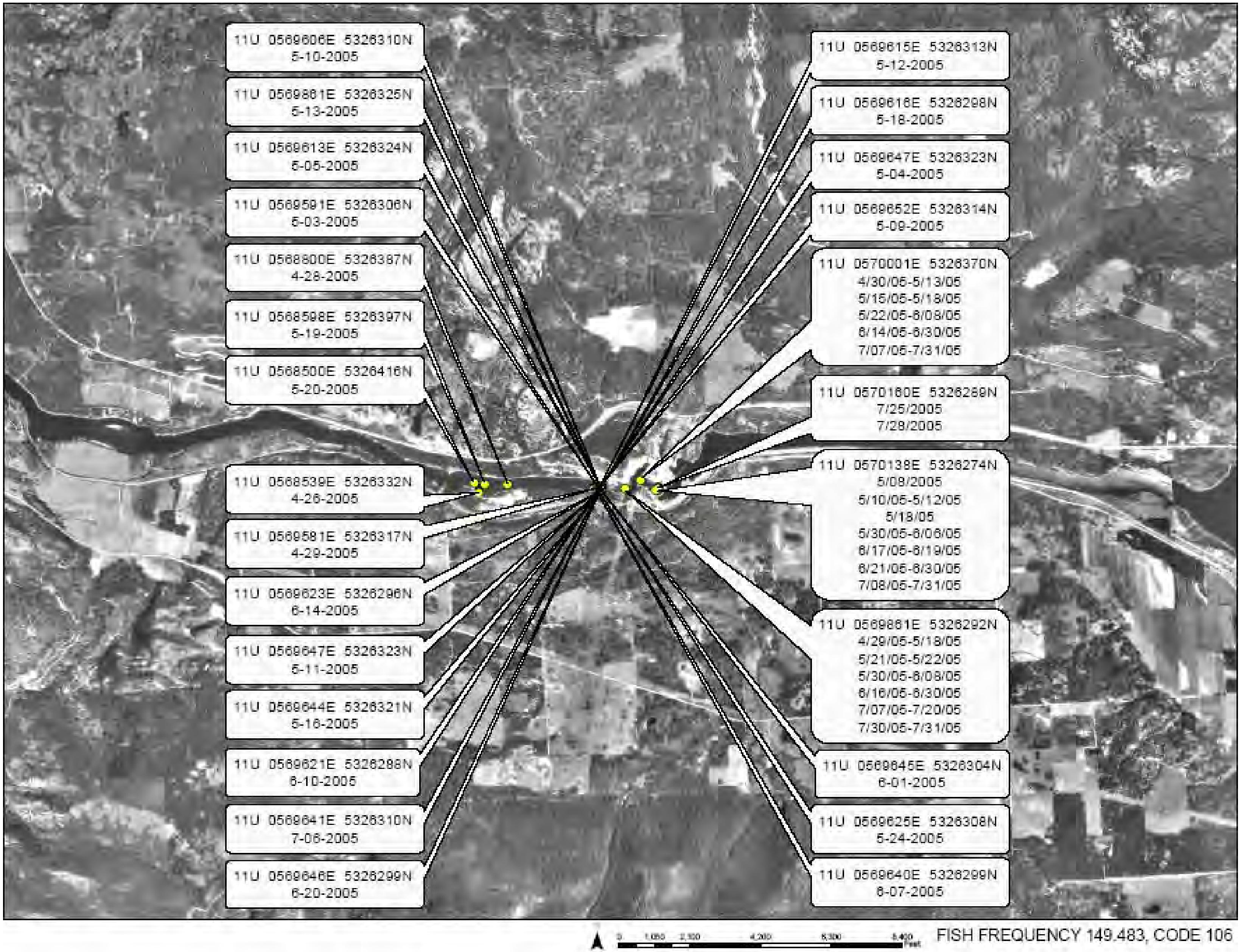

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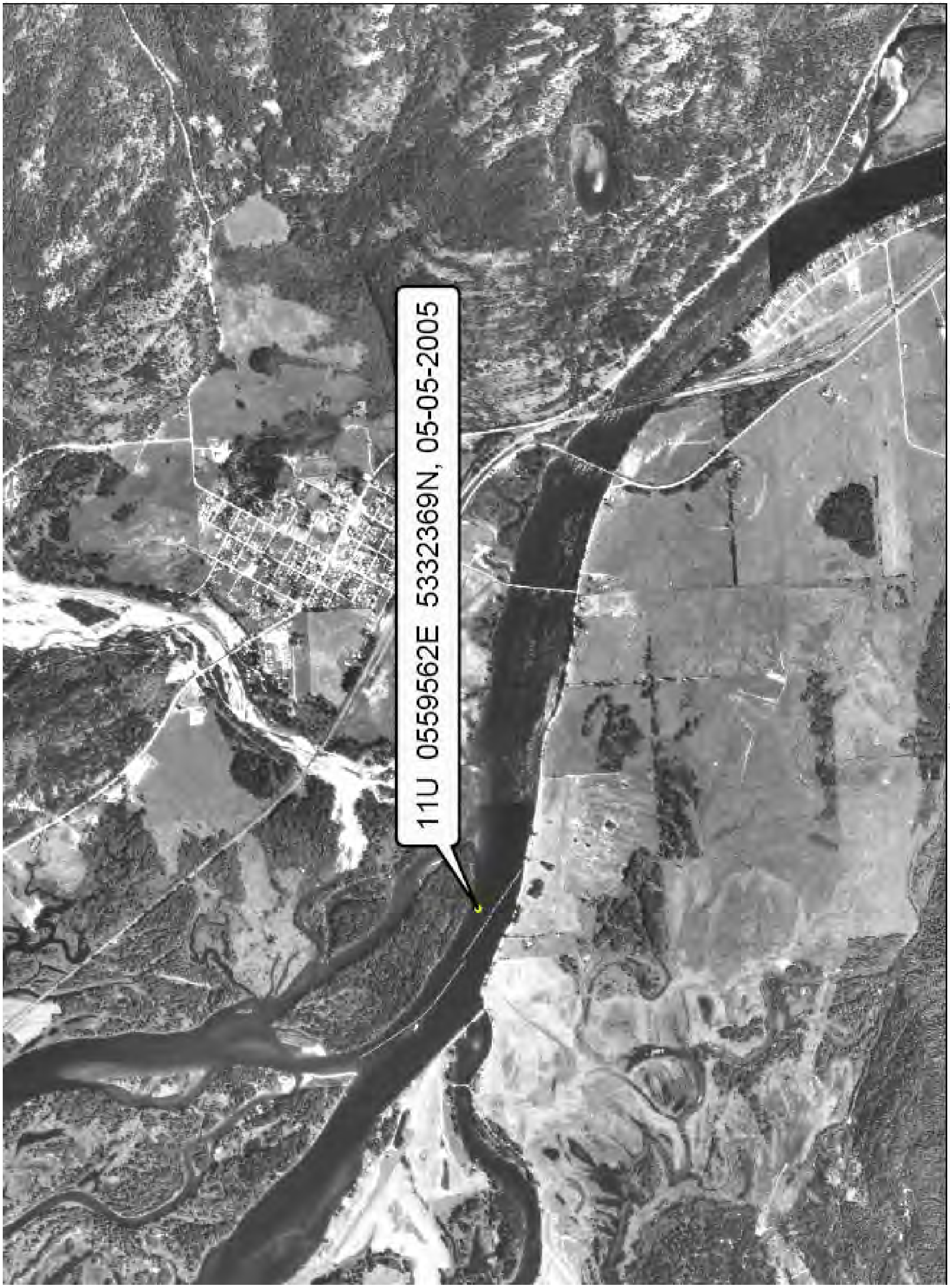

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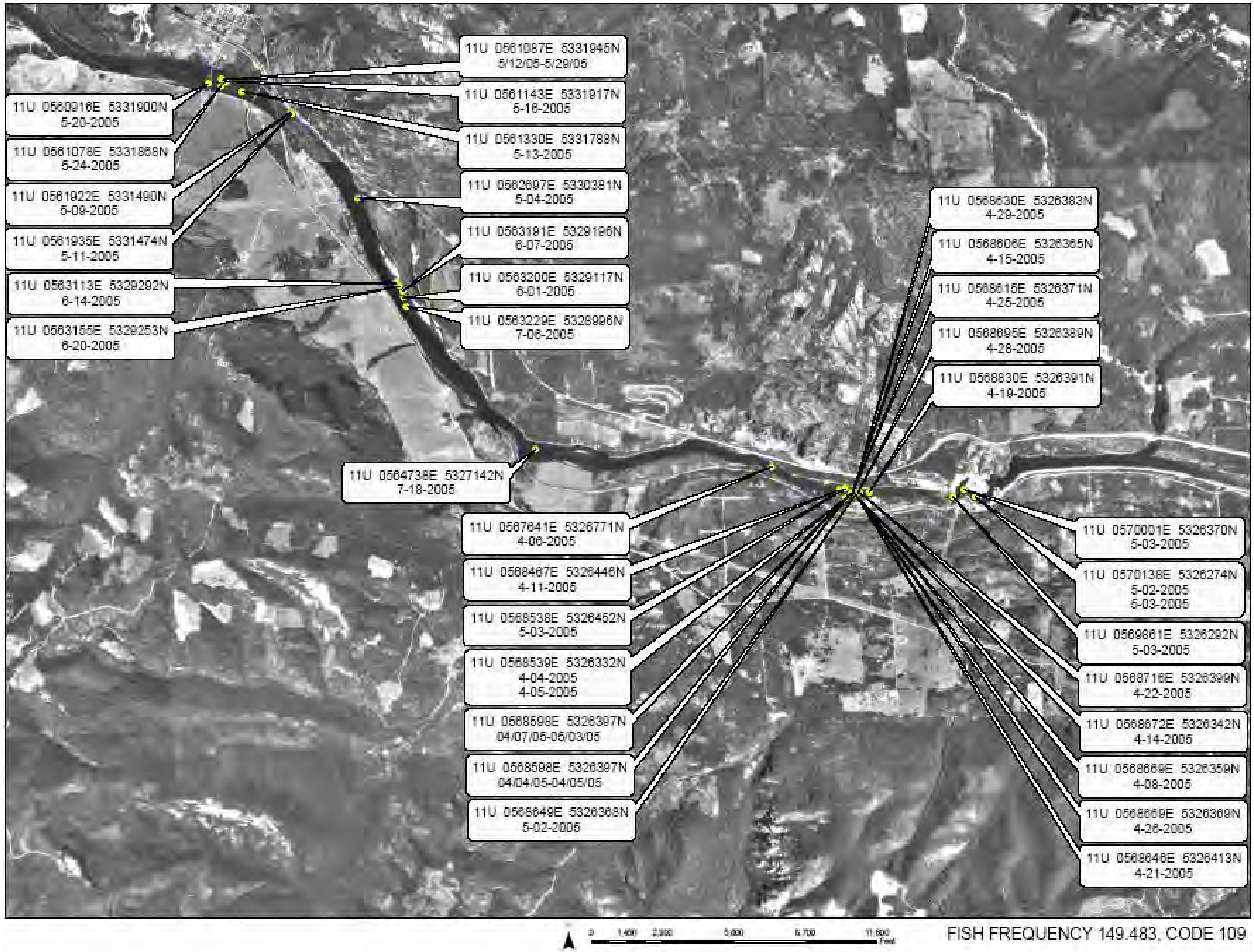

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Steve Yundt, Chief
Fisheries Bureau