LAKE PEND OREILLE/CLARK FORK RIVER FISHERY RESEARCH AND MONITORING

2006 PROGRESS REPORT

2006 LAKE PEND OREILLE BULL TROUT REDD COUNTS

2006 CLARK FORK RIVER FISHERY ASSESSMENT PROGRESS REPORT

2006 TRESTLE AND TWIN CREEKS BULL TROUT OUTMIGRATION AND LAKE PEND OREILLE SURVIVAL STUDY PROGRESS REPORT

2006 TWIN CREEK RESTORATION MONITORING PROGRESS REPORT

2006 TRIBUTARY FISH POPULATION MONITORING PROGRESS REPORT

2006 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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IDFG 07-45

Lake Pend Oreille/Clark Fork River Fishery Research and Monitoring

Progress Report 2006

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2006 Lake Pend Oreille Bull Trout Redd Counts Progress Report

ABSTRACT

Bull trout *Salvelinus confluentus* redd counts were conducted in 18 tributaries to Lake Pend Oreille and the Clark Fork River, as well as the Clark Fork River spawning channel in 2006. The Middle and the North Fk. 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 2006 was 1,256. Six of these tributaries (six index streams; Johnson, East Fk. Lightning, Trestle, Grouse, North Gold, and Gold creeks) have been surveyed consistently on an annual basis since 1983, and the 2006 redd count for these six streams combined (794) was considerably higher than the long-term average of 520 redds. A higher count of 395 redds in Trestle Creek in 2006, compared to 174 in 2005, as well as an increase in Gold Creek, were partially responsible for the overall higher redd count totals. We identified two statistically significant correlations in the 2006 redd count data. Statistically significant correlations between year and redd counts for Granite Creek (tau-b = 0.45; p = 0.01) and Gold Creek (tau-b = 0.42; p = 0.01), 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 seven 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. A redd count was also conducted in West Gold Creek, a tributary to Gold Creek located at the southern end of the lake, in 2006. Additionally, the Middle Fk. 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 Fk. 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, 2006. 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 18 tributaries to LPO, as well as the Clark Fork River, between October 9 and October 17, 2006 (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 Fk. 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 Fk. East River to spawn (J. DuPont, IDFG, personal communication).

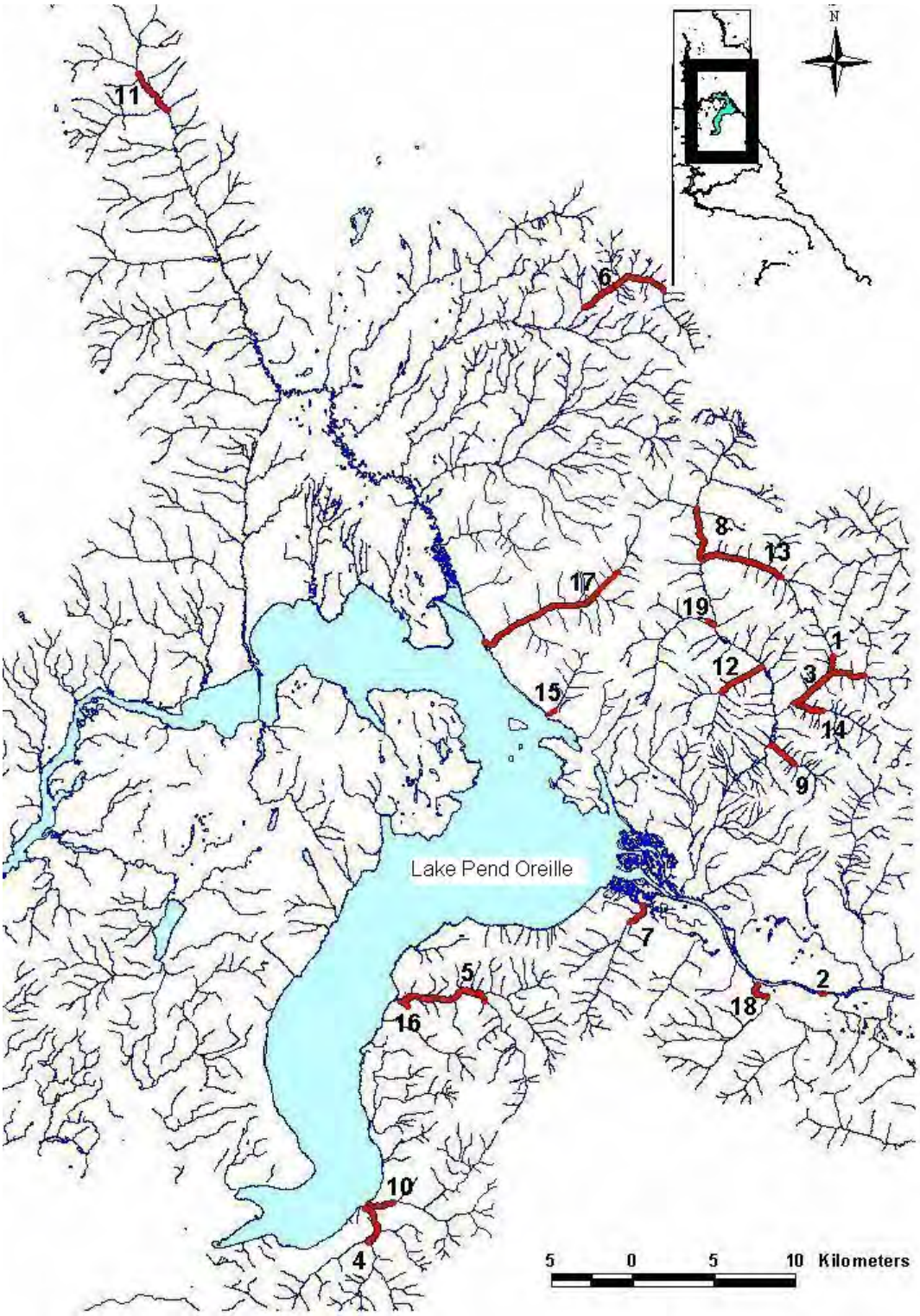

Figure 1 Bull trout redd count sections (with shading) in tributaries of Lake Pend Oreille, Idaho. Numbers denote stream name in Table 1.

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, 1992-2006
Clark Fork River	2	Spawning channel (N/A)	1992-2006
E. Fk. Lightning Cr[a]	3	Savage to Thunder Creek (5.0)	1983-2006
Gold Cr[a]	4	Mouth to 0.2 km upstream of W. Gold confluence (2.4)	1983-2006
Granite Cr	5	Mouth to road 278 crossing (6.4)	1983-1987, 1992-2006
Grouse Cr[a]	6	Flume Creek to end of road 280 (2.4 km beyond gate) (6.5)	1983-2006
Johnson Cr[a]	7	Mouth to falls (1.5)	1983-2006
Lightning Cr	8	Rattle to Quartz (3.2)	1983-1987, 1992-2006
Morris Cr	9	Mouth to trail 132 crossing (N/A)	1999-2006
N. Gold Cr[a]	10	Mouth to falls (1.2)	1983-2006
Pack R	11	Road 231 bridge near McCormick Cr to Falls located 0.4 km downstream of W. Branch (2.8)	1983-1987, 1992-2006
Porcupine Cr	12	Mouth to S.Fk. (3.2)	1983-1987, 1992-2006
Rattle Cr	13	Mouth to falls by upper bridge (5.7)	1983-1987, 1992-2006
Savage Cr	14	Mouth to trail 61 crossing (2.0)	1983-1985, 1987, 1992-2006
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, 1992-2006
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)	1983-2006
Twin Cr	18	Mouth to River Road (1.5)	1983-1987, 1992-2006
Wellington Cr	19	Mouth to falls (0.5)	1983-1987, 1992-2006

[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).

The U.S. Fish and Wildlife Service (USFWS) Bull Trout Draft Recovery Plan criteria (Plan) for LPO (USFWS 2002) has some similarities to the Lake Pend Oreille Bull Trout Conservation Plan. The Plan calls for six populations consisting of greater than 100 individuals, a total abundance of 2,500 adults, and an increasing trend in abundance.

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 affected 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 East Fk. Lightning creeks because some segments of these streams that may have contained relatively substantial numbers of redds were not counted. To test for long-term trends, we ran correlations between year and redd count using the full data set (1983-present). In addition, we tested for short-term trends using data collected since 1997. We used 1997 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.

RESULTS

We successfully completed bull trout redd counts in 18 tributaries to LPO, as well as the Clark Fork River spawning channel in 2006. 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 Fk. East River, to a high of 395 redds in Trestle Creek (Appendix A). The 2006 bull trout redd count was the highest ever recorded (1,256 redds).

The long-term correlation analysis revealed two statistically significant correlations between year and redd count. Correlations for Granite Creek (tau-b = 0.45; $p < 0.01$) and Gold Creek (tau-b = 0.42; $p < 0.01$) indicated long-term increases in both populations (Table 2). The majority (69%) of correlation coefficients for the long-term analysis were positive, suggesting improving spawning escapement in a high proportion of the tributaries monitored.

Table 2. Correlations between year and redd count (trends) for bull trout populations monitored from 1983 through 2006 in tributaries to Lake Pend Oreille, Idaho.

Stream	Number of years	Tau-b correlation	P-value
Char Cr.	19	0.14	0.42
E. Fk. Lightning Cr.	21	-0.06	0.72
Gold Cr.	24	0.42	<0.01[a]
Granite Cr.	19	0.45	<0.01[a]
Grouse Cr.	22	<0.01	0.98
Johnson Cr.	23	0.10	0.49
Lightning Cr.	19	-0.01	0.94
N. Gold Cr.	24	-0.14	0.35
Pack R.	19	0.00	1.00
Porcupine Cr.	19	-0.18	0.29
Rattle Cr.	18	0.12	0.49
Savage Cr.	18	0.12	0.51
Sullivan Springs	19	0.24	0.14
Trestle Cr.	23	0.22	0.14
Twin Cr.	19	0.01	0.94
Wellington Cr.	19	-0.12	0.47

[a] Denotes statistical significance at the 0.05 level

Examining only the data from 1997 to present to obtain a view of the short-term trends in populations (10 years), we find that all but two tributary populations evaluated exhibited positive correlation values (Table 3). Of these, five were statistically significant while two others bordered on statistical significance. This may suggest that adult escapement is generally increasing across the majority of tributaries in recent years.

Table 3. Correlations between year and redd count (trends) for bull trout populations monitored from 1996 to 2006 in tributaries to Lake Pend Oreille, Idaho.

Stream	Tau-b correlation	P-value
Char Cr.	0.22	0.35
E. Fk. Lightning Cr.	0.20	0.39
Gold Cr.	0.64	<0.01[a]
Granite Cr.	0.46	0.05
Grouse Cr.	0.20	0.38
Johnson Cr.	0.29	0.21
Lightning Cr.	0.61	<0.01[a]
N. Gold Cr.	0.24	0.30
Pack R.	0.71	<0.01[a]
Porcupine Cr.	0.65	<0.01[a]
Rattle Cr.	0.44	0.06
Savage Cr.	0.79	<0.01[a]
Sullivan Springs	-0.04	0.87
Trestle Cr.	0.27	0.24
Twin Cr.	-0.17	0.48
Wellington Cr.	0.28	0.23

[a] Denotes statistical significance

DISCUSSION

Six tributaries (index streams; Johnson, East Fk. Lightning, Trestle, Grouse, North Gold, and Gold creeks) have been surveyed consistently on an annual basis since 1983, and the 2006 redd count for these six streams combined (794) represents a record count, and is considerably higher than the long-term average of 520 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 total redd count in 2006 of 1,256 redds was almost twice as large as the long-term average of 680 redds. The 2006 redd count does include 82 redds from streams not sampled in all earlier years, but even considering this, the count far exceeds any earlier counts.

Trestle and Gold creeks have a large influence on the total number of redds counted in the entire LPO system. From 1983 to 2006, Trestle and Gold creeks together accounted on average for the majority (74%) of the total number of redds counted in the six index streams annually. Any 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. Although it is clear that many populations had undergone fairly dramatic reductions in abundance, it appears that many have recovered and are now on a positive trajectory. It is likely that if lake trout *Salvelinus namaycush* abundance is successfully suppressed, bull trout should benefit through reduced competition and predation in the lake environment.

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; six in 2006), and exceeded the threshold population size established in the Plan of 2,500 adults (estimated at 4,019 in 2006). 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 (Downs and Jakubowski 2006). A third criteria in the Plan is an increasing trend in abundance. Both the long and the short-term abundance trend evaluations suggest the majority of tributaries are increasing in adult escapement. The shorter-term evaluation (10 year) shows this more dramatically than the longer-term analysis.

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. 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.

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 2006) 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 and 2006, 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 was highly successful and in 2006, bull trout were able to migrate without the aid of the trap and transport program, or being adversely impacted by channel intermittency since 1996. The population responded to the unimpeded access to the spawning area with a record high redd count.

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, East 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.

An early winter rain-on-snow event occurred in the LPO area in November 2006. This event caused severe flooding, as well as debris and bedload movement in tributaries, most notably in Lightning Creek. Habitat restoration priorities identified in the watershed assessment may need to be reassessed once the full magnitude of the storm damage is known. This event will likely have adverse impacts not only on the 2006 spawn class because eggs were incubating in the gravel, but also on the previous few years age-classes of juveniles due to bed scour and movement. Many of these juveniles were likely already in their overwinter habitats located in interstitial spaces of larger cobble and rock and would have been at risk of injury as the bedload became mobile as flows rose rapidly.

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APPENDICES

Appendix A. Annual bull trout redd counts (1983-2006) for tributaries to Lake Pend Oreille, Idaho.

Table A.1. Bull trout redd counts for Lake Pend Oreille, Idaho, basin tributaries, 1983-2006.

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
W. Gold Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--
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	2006
Clark Fork R.	3	7	8	5	5	6	7	8	1	0	3
Lightning Cr.	6	0	3	16	4	7	8	8	9	22	9
E. Fk. Light. Cr.	49	22	64	44	54	36	58	38	77	50	51
Savage Cr.	0	0	0	4	2	4	15	7	15	7	25
Char Cr.	14	1	16	17	11	2	8	7	14	15	20
Porcupine Cr.	0	0	0	4	4	0	0	5	10	14	8
Wellington Cr.	5	2	1	22	8	7	7	8	7	6	29
Rattle Cr.	10	2	15	13	12	67	33	37	34	34	21
Johnson Cr.	5	27	17	31	4[c]	34	31	0	32	45	28
Twin Cr.	16	6	10	19	10	1	8	3	6	7	11
Morris Cr.	--	--	--	1	1	0	7	1	1	3	16
North Shore											
Trestle Cr.	243	221	330	253	301	335[e]	333[e]	361	102[b]	174	395
Pack River	6	4	17	0	8	28	22	24	31	53	44
Grouse Cr.	50	8	44	50	77	18	42	45	28	77	55
Strong Cr.	2	--	--	--	--	--	0	--	0	--	--
East Shore											
Granite Cr.	47	90[f]	49	41	25	7	57	101	149	132	166
Sullivan Springs	15	42	10	22	19	8	15	12	14	15	28
North Gold Cr.	39	19	22	16	19	16	24	21	56	34	30
Gold Cr.	100	76	120	147	168	127	203	126	167	200	235
W. Gold Cr.	--	--	--	--	--	--	--	--	--	--	4
Lower Priest R.											
M.F. East River	--	--	--	--	--	4[k]	8[k]	21	20	48	71
N.F. East River	--	--	--	--	--	--	--	--	1	0	0
Uleda Cr.	--	--	--	--	--	3[k]	4[k]	3	7	4	7
6 index streams[d]	486	373	597	541	623	566	691	591	462	580	794
Total of all streams	610	527	726	705	732	710	890	836	781	940	1,256

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.

2006 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 (cfs)) to 141.5 cms (5,000 cfs) in the Clark Fork River, Idaho. Mark-recapture population estimates were conducted in the spring of 2006 to estimate the abundance of brown trout *Salmo trutta* and mountain whitefish *Prosopium williamsoni*. We estimated 148 brown trout and 8,449 mountain whitefish greater than 200 mm total length in the study reach during the spring sampling period. In general, based on population estimates and catch-per-unit-effort (CPUE), mountain whitefish are the most abundant salmonid species in the 6.6 km study reach of 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 brown trout and mountain whitefish in the spring of 2006 of 83 and 87, respectively. This indicates a low-density, high quality trout fishery. The short-term nature of the data set, variability in the fish population parameter estimates, and the lack of fish population 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. Additional sampling to increase sample size for trends analysis is recommended. We sampled Foster Bar side-channel in 2006 with backpack electrofishing equipment, in response to a habitat enhancement project to restore perennial flow to the side-channel. The only salmonid species captured in the side-channel with backpack electrofishing equipment in 2006 were six juvenile brown trout. We also captured five non-salmonid species of fish (northern pikeminnow *Ptychocheilus oregonensis*, redside shiner *Richardsonius balteatus*, largescale sucker *Catostomus macrocheilus*, longnose sucker *Catostomus catostomus*, and a single fathead minnow *Pimephales promelas)*, plus unidentified juvenile suckers *Catostomus sp*. The fathead minnow had never previously been documented in northern Idaho.

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INTRODUCTION

Avista Corporation (Avista; formerly Washington Water Power (WWP)) 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 was also 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. clarkii lewisi*. In addition, catch-per-unit-effort (CPUE) information was 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.

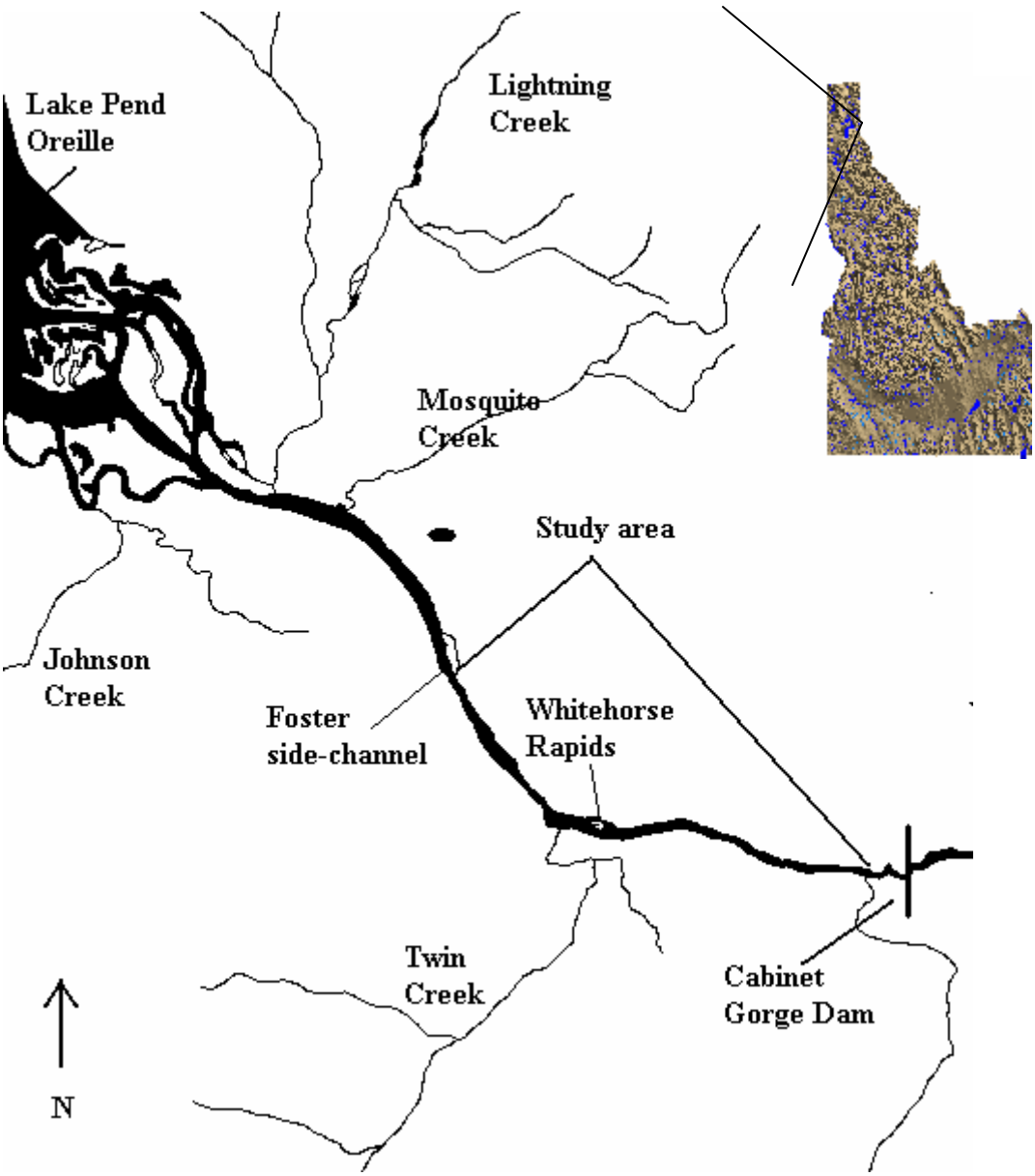

Figure 1. Fishery evaluation study area on the Clark Fork River, a tributary to Lake Pend Oreille, Idaho.

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 spring of 2006 for brown trout and mountain whitefish (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 2006, we conducted our marking runs from March 27 through March 29, and our recapture runs from April 3 through April 5.

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 three-night period in the first week of sampling, and the "recapture" period was conducted over a three-night period the following week. We continued with recapture runs until we captured at least three previously marked fish of each target species to reduce probability of statistical bias in our estimates (Ricker 1975).

Stunned fish were netted out of the electrofishing field and placed into a livewell for recovery. We attempted to net all salmonids stunned by electrofishing during the spring sampling. We used these data to conduct the mark-recapture population estimates for brown trout and mountain whitefish, and also to estimate CPUE for all salmonids encountered on the first night of spring sampling. However, only data from the right bank was used to estimate CPUE, due to one of the boats being unable to complete the final section after it became stranded by rapidly decreasing flows. Captured fish were anesthetized 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. In addition, any large rainbow trout identified as "kamloops", migrating from Lake Pend Oreille, Idaho, were PIT tagged to assist with a predator study being conducted on the lake.

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).

Catch-per-unit-effort (CPUE) was estimated as fish captured per minute of electrofishing. We compared CPUE for target species measured on the first night of the marking run for trend analysis. We plotted the population estimate data with 95% confidence intervals (CI's) and then examined the CI's for significant differences. We used linear regression to evaluate trends in the CPUE data.

Population Size Structure and Condition

Relative weight (*Wr*) (Anderson and Neumann 1996) was calculated to assess trends in salmonid condition. We used linear regression to evaluate trends in the *Wr* data, and evaluated significance through comparison of 95% confidence intervals for mean *Wr*. We used linear regression to evaluate changes in growth over the course of the study by comparing the slopes of the log10 transformed length and weight data. 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). Trends in PSD were evaluated using linear regression.

We evaluated changes in growth rates for mountain whitefish using ages estimated from scales. Mountain whitefish are a good species to use as an indicator of changes in growth rates of resident salmonids in the Clark Fork River because they likely spend most of their lives in the lower Clark Fork River itself. Other target salmonid species inhabiting the lower Clark Fork River study area migrate at varying ages from multiple tributaries, and some likely move back and forth between the lake and river environment. This has the potential to bias any conclusions regarding changing growth conditions in the lower Clark Fork River.

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 10 and 11, 2006. Flows during this time were 13,580 and 12,950 cfs, respectively. We sampled six sections located along the longitudinal gradient of the stream channel (Figure 2). Electrofishing was conducted walking upstream netting stunned fish as they were captured in the electrofishing field. Pulsed DC current was employed to capture fish with a typical setting of 400 volts 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.

RESULTS

Population Estimates and Catch-Per-Unit-Effort

We estimated 148 brown trout and 8,449 mountain whitefish greater than 200 mm total length occupied the study reach during the spring sampling period in 2006 (Table 1). CPUE for all salmonids, from the right bank only, captured during the first night of the marking run, reflected a dominance by mountain whitefish (Table 2). Lake whitefish *Coregonus clupeaformis* were the rarest salmonid in our catch based on CPUE.

We captured eight species of salmonids during the spring 2006 sampling period (Table 3). We also captured a total of 10 fish visually identified as westslope cutthroat X rainbow trout hybrids (mean TL; mm = 342.5; range = 305-423; S.D. = 37.3) over the entire study period. A single smallmouth bass *Micropterus dolomieui*, 283 mm total length, was also captured.

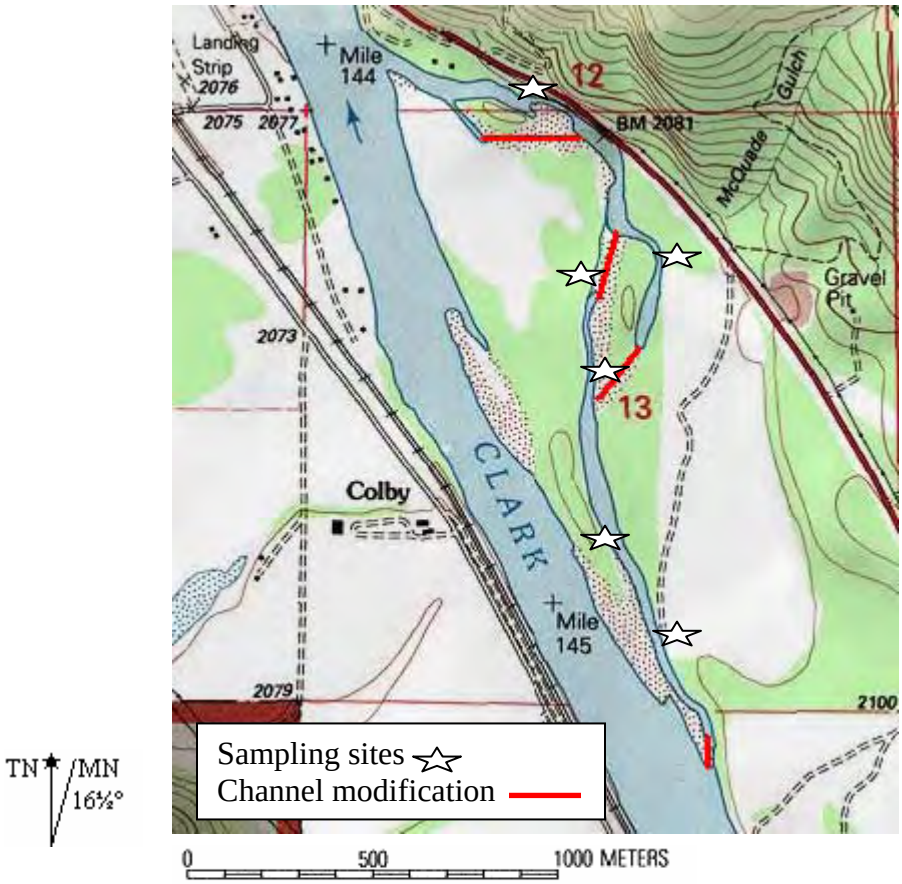

Figure 2. Locations of the six backpack sampling sections in Foster Bar side-channel as well as areas of channel modification to achieve perennial flow through the side-channel over the operational discharges from Cabinet Gorge Dam.

Table 1. Population estimate statistics for brown trout and mountain whitefish >200 mm captured in the 6.6 km study reach of the Clark Fork River, Idaho, below Cabinet Gorge Dam, during the last week of March and first week of April, 2006.

Species	**M**	**C**	**R**	**Population estimate**	**Lower 95% CI**	**Upper 95% CI**
Brown trout	75	44	22	148	113	222
Mountain whitefish	653	322	24	8,449	5,984	13,588

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

Table 2. Electrofishing catch-per-unit-effort (CPUE) (fish/minute and fish/1000 m) for salmonid species captured along the right bank only in the 6.6 km study reach of the Clark Fork River, Idaho, during the first night of marking in March 2006.

Species	**Number captured**	**Time electrofished (minutes)**	**CPUE (fish/minute)**	**CPUE (fish/1000 m)**
Brown trout	33	186.03	0.18	5.00
Lake whitefish	1	186.03	<0.01	0.15
Mountain whitefish	173	186.03	0.93	26.21
Rainbow trout	12	186.03	0.06	1.82
Westslope cutthroat trout	7	186.03	0.04	1.06

Population Size Structure and Condition

During the report period, average length-at-capture across all salmonid species ranged from 216 mm for a single brook trout *Salvelinus fontinalis* to 399.5 mm for lake whitefish (Table 3; Figures 3 through 7). PSD's (proportion of catch > 305 mm) for the target salmonid species ranged from 65% for rainbow trout to 87% for mountain whitefish. QSD's (proportion of the catch > 406 mm) ranged from 1% for mountain whitefish to 36% for brown trout across the target salmonid species (Table 4). Estimated mean relative weight (*Wr)* for mountain whitefish and brown trout was 84.7 (S.D. = 10.4, n = 358) and 73.9 (S.D. = 10.4, n = 95), respectively. Growth rate in 2006, as expressed by the slope of the length-weight relationship, was similar to 2004 (slope = 2.66). The average age of mountain whitefish captured in 2006 was 4.75 years (S.D. = 1.4, n = 104). Mean length of mountain whitefish at age-4 was 310.4 mm (S.D. = 22.7, n = 84), and the average growth increment from age-3 to age-4 was 48.1 mm (S.D. = 21.8, n = 84).

Table 3. 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 spring, 2006.

Species	Mean length (mm) (SD) (n)	Length range	Mean weight (g) (SD) (n)
Bull trout	310.0 (N/A) (1)	N/A	320.0 (N/A) (1)
Brook trout	216.0 (N/A) (1)	N/A	91.0 (N/A) (1)
Brown trout	383.8 (97.3) (100)	109-780	535.4 (577.0) (98)
Kokanee[a]	271.3 (100.7) (3)	190-384	286.7 (191.4) (3)
Lake whitefish	399.5 (35.6) (25)	294-487	558.3 (137.9) (6)
Mountain whitefish	340.3 (39.0) (907)	157-454	357.0 (105.2) (367)
Rainbow trout	364.2 (132.9) (112)	141-870	726.2 (1253.6) (110)
Westslope cutthroat trout	329.6 (43.8) (41)	230-440	360.9 (143.1) (41)

[a]Kokanee *Oncorhynchus nerka*

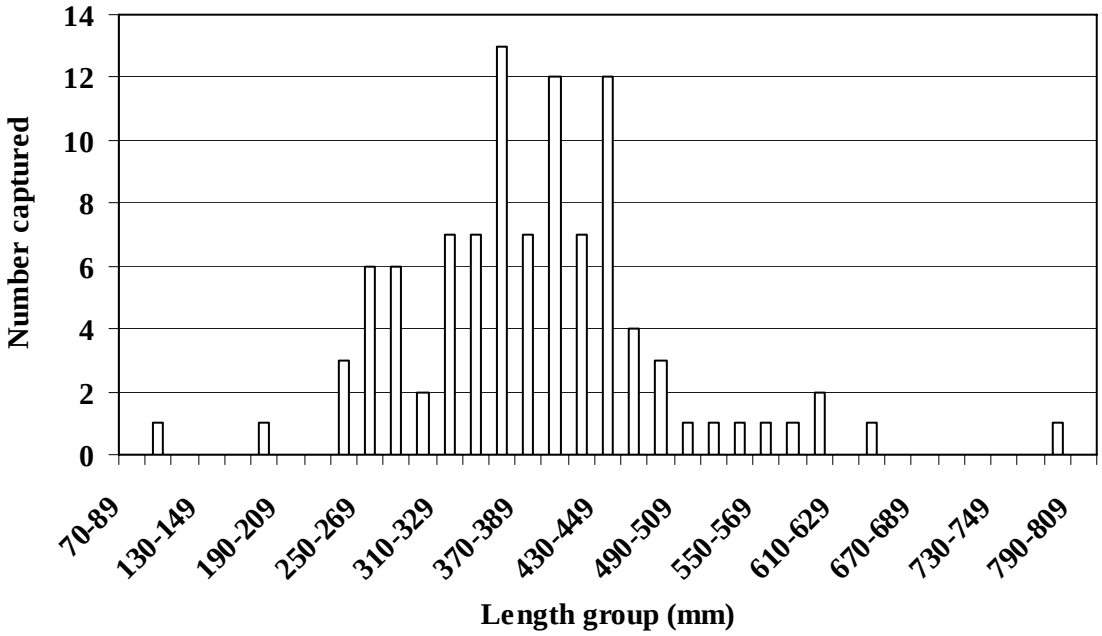

Figure 3. Length frequency histogram for brown trout (n = 100) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in spring, 2006.

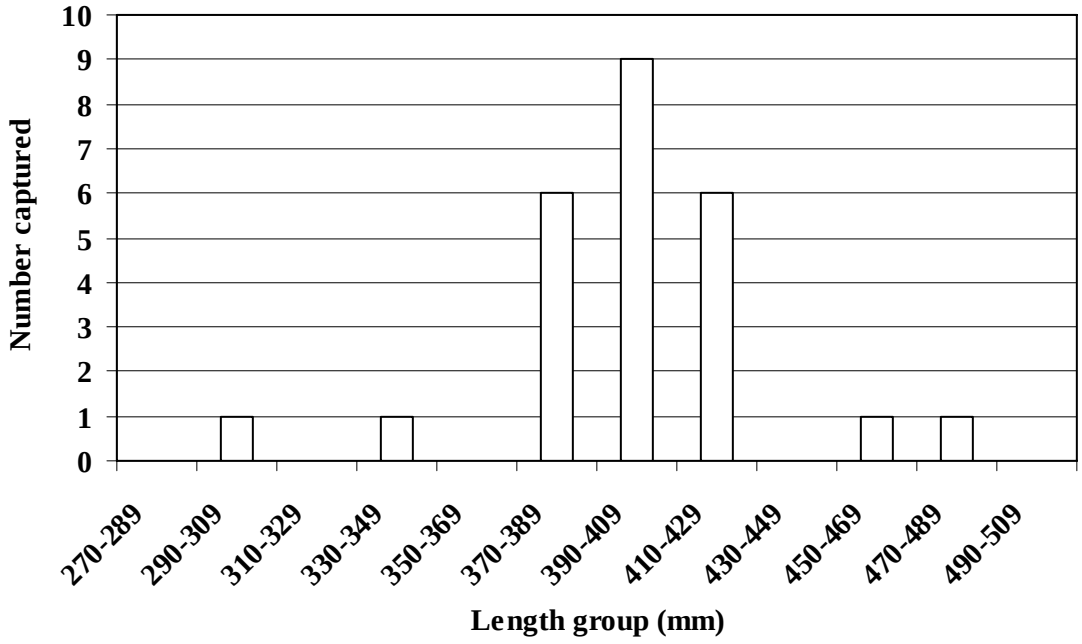

Figure 4. Length frequency histogram for lake whitefish (n = 25) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in spring, 2006.

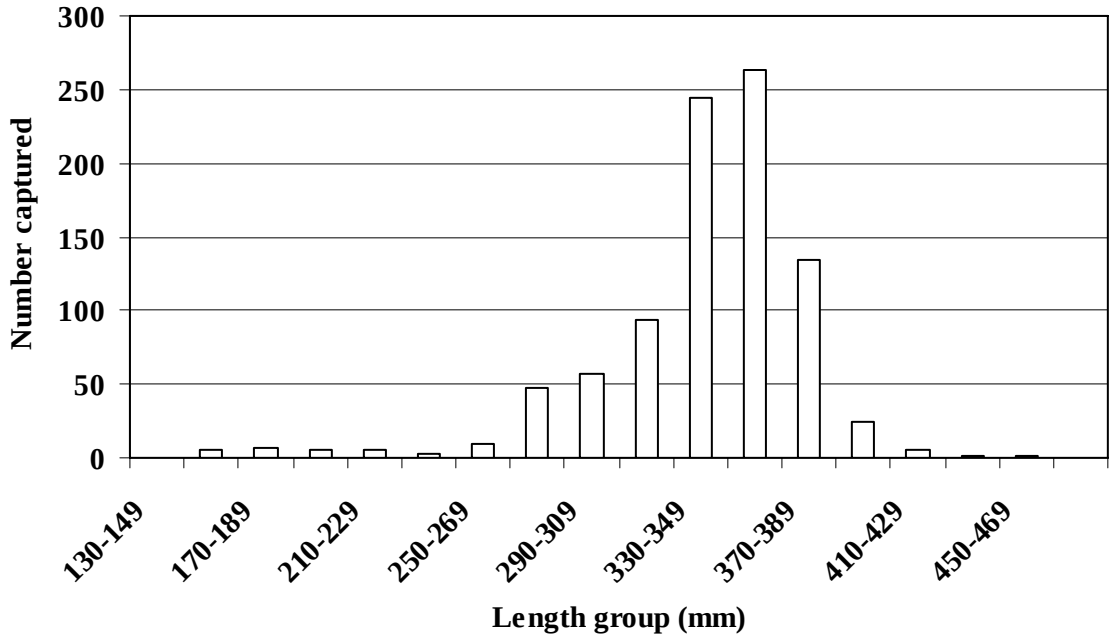

Figure 5. Length frequency histogram for mountain whitefish (n = 907) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in spring, 2006.

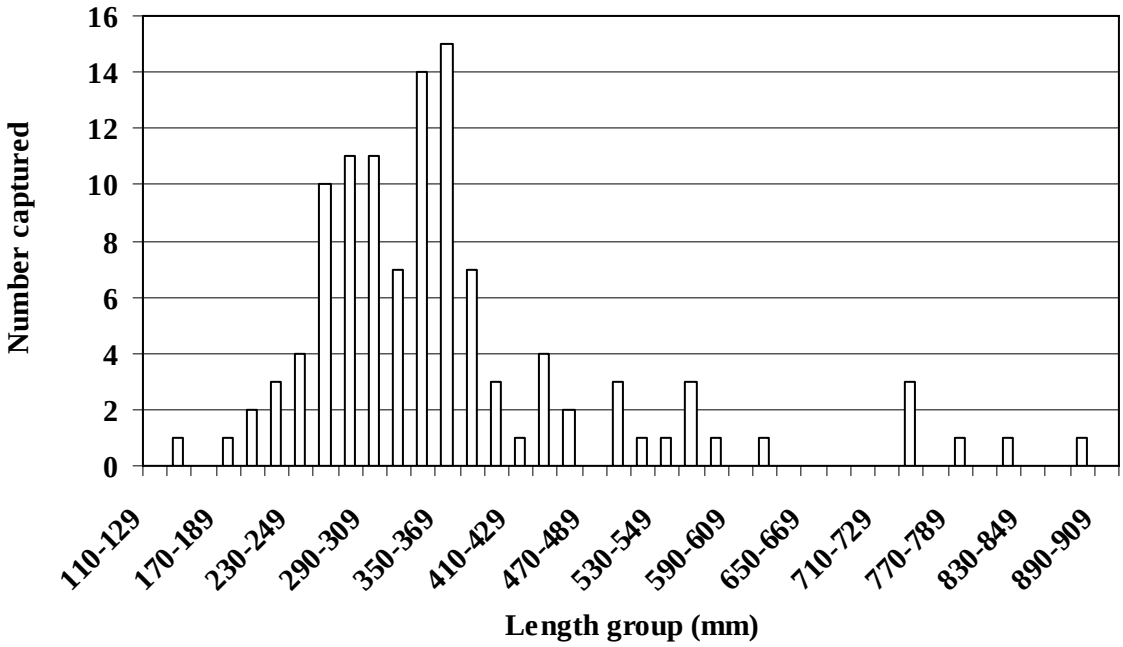

Figure 6. Length frequency histogram for rainbow trout (n = 112) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in spring, 2006.

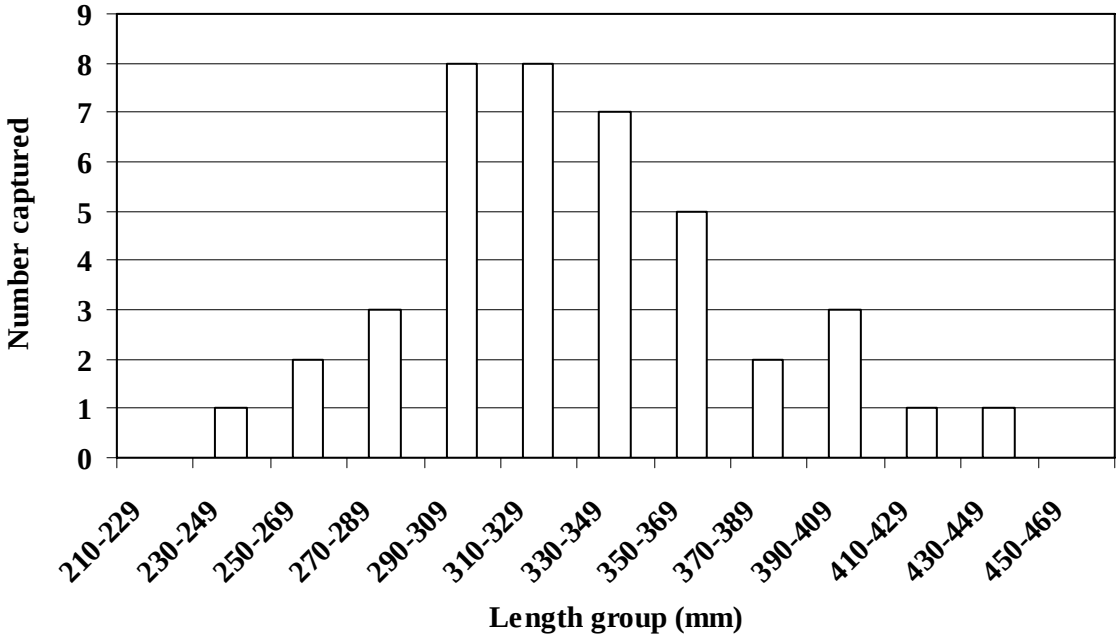

Figure 7. Length frequency histogram for westslope cutthroat trout (n = 41) captured in the 6.6 km long study reach of the Clark Fork River, Idaho, during the marking and recapture runs, combined, in spring, 2006.

Table 4. Proportional (PSD) and quality (QSD) stock densities for target salmonid species from the 6.6 km long study reach of the Clark Fork River, Idaho, in spring, 2006.

PSD >305 mm (QSD > 406 mm), stock length = 200 mm		
Species	**PSD (%)**	**QSD (%)**
Brown trout	82.7	35.7
Mountain whitefish	87.1	1.1
Rainbow trout	64.8	21.3
Westslope cutthroat trout	70.7	7.3

Foster Bar Side-channel Monitoring

We captured six species of fish, as well as unidentified juvenile suckers *Catostomus sp*. while backpack electrofishing the Foster Bar side-channel. In 2006, a single fathead minnow *Pimephales promelas* was also captured. This species had never before been documented in northern Idaho. The only salmonid species encountered was brown trout. In 2006, mean juvenile brown trout length was 87.8 mm, and ranged from 56 to 167 mm. The mean weight was 11.7 g, and ranged from 2 to 41 g. In 2006, we also captured northern pikeminnow *Ptychocheilus oregonensis*, redside shiner *Richardsonius balteatus*, largescale sucker *Catostomus macrocheilus*, and longnose sucker *Catostomus catostomus* (Table 5). Water temperature during sampling ranged from 18^0 C to 21^0 C.

Table 5. 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 2006.

Species	**Mean length (mm) (SD) (n)**	**Length range**	**Mean weight (g) (SD) (n)**
Brown trout	87.8 (47.1) (6)	56-167	11.7 (15.8) (6)
Fathead minnow	61.0 (N/A) (1)	N/A	3.0 (N/A) (1)
Largescale sucker	65.5 (16.8) (31)	49-139	3.5 (3.8) (31)
Longnose sucker	95.0 (N/A) (1)	N/A	10.0 (N/A) (1)
Northern pikeminnow	52.5 (13.4) (56)	38-108	1.7 (2.0) (56)
Redside shiner	89.8 (19.4) (6)	53-105	7.8 (3.5) (6)
Sucker *sp*.	64.3 (6.2) (11)	52-74	3.3 (0.9) (11)

DISCUSSION

Population Estimates and Catch-Per-Unit-Effort

Time-series comparison of spring population estimates for brown trout did not reveal a consistent trend to date (Figure 8). Overlapping 95% confidence intervals (CI's) suggest the population estimates are not significantly different from one another. The 2004 population estimate was greater than the 2002 estimate, but the population significance of this is unclear. The population point estimates for mountain whitefish has remained relatively constant from 2002 through 2006. All 95% CI's overlap, and the low population point estimate in 2002 was likely a result of bias caused by small numbers of recaptures, and the sampling crew learning how to effectively sample the large river habitats available to mountain whitefish in the Clark Fork River (Figure 9).

Spring CPUE for brown trout decreased slightly from 0.21 to 0.18 fish/minute of electrofishing from 2004 to 2006, respectively. This is consistent with the decrease observed in the population point estimate. However, only data from the right bank was used while conducting CPUE on the first night of marking, due to the inability to shock all three sections on the left bank, after one of the jet-boats became stranded on a gravel bar as discharge from Cabinet Gorge Dam dropped. Fall CPUE for mountain whitefish increased slightly from 0.66 to 0.93 fish/minute of electrofishing from 2004 to 2006, which is consistent with the increase observed in the population point estimate. Trend evaluation was conducted by performing a simple linear regression of CPUE (dependent variable) on year (independent variable), using the first night of sampling for the estimate of CPUE for each year. Although the scatter plot of CPUE for brown trout suggested an increasing trend, the regression was not significant ($r2 = 0.52$, $P > 0.1$, d.f. = 2). CPUE for mountain whitefish did not display an obvious trend and the regression was not significant ($r2 = 0.21$, $P > 0.1$, d.f. = 2). Although CPUE may provide a means to compare with earlier effort estimates on the Clark Fork River, it is sensitive to electrofishing technique and experience. For this reason, population estimates are the preferred method for monitoring population trends.

Detecting statistically significant differences in population abundance among target species will remain a challenge due to small sample sizes and considerable variability within the population estimates themselves. There is also the possibility of making a type II error due to small sample size, and concluding there is no difference in abundance over time when there actually is. 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 any trends in abundance resulting from the increased minimum flow in the Clark Fork River.

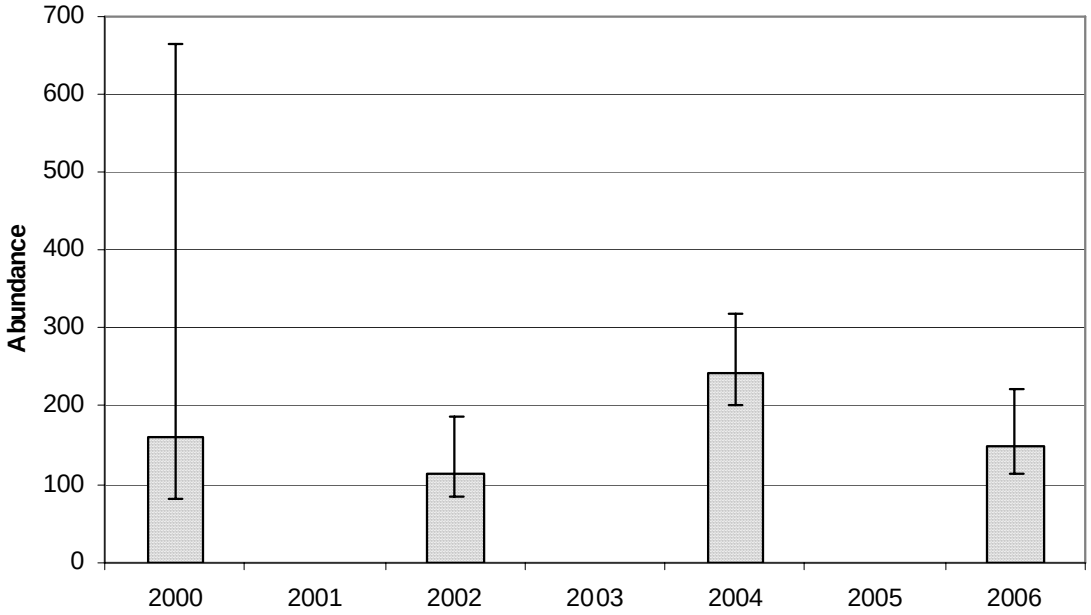

Figure 8. Comparison of population estimates and associated 95% confidence intervals, conducted for brown trout in the 6.6 km long study reach of the Clark Fork River, Idaho.

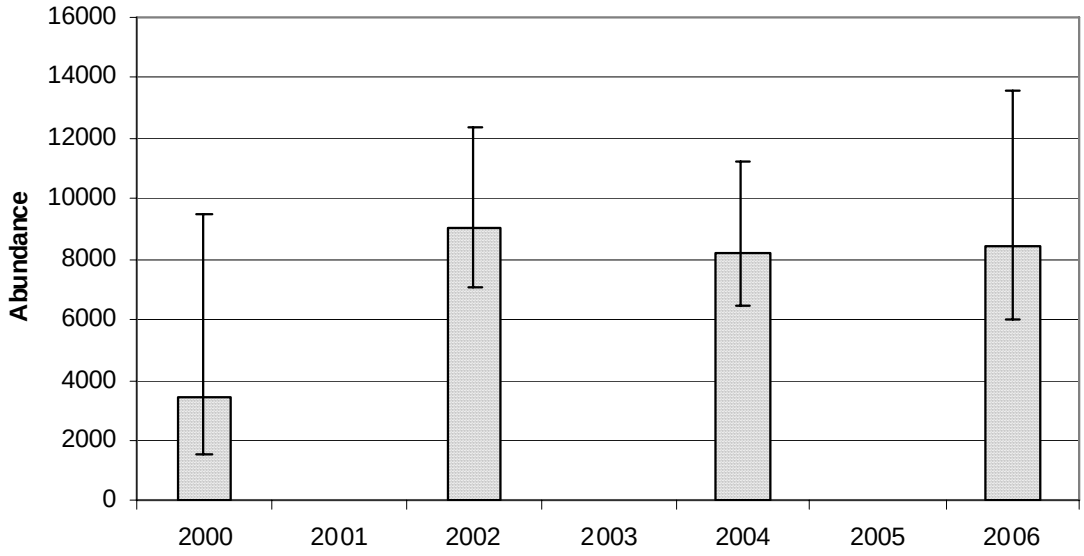

Figure 9. Comparison of population estimates and associated 95% confidence intervals, conducted for mountain whitefish in the 6.6 km long study reach of the Clark Fork River, Idaho.

Population Size Structure and Condition

PSD's for brown trout have shown some variability, but linear regression results do not reveal any consistent trends (r2 = 0.10; p = 0.67; d.f. = 3) (Table 6). QSD for brown trout remains high, indicating a population comprised of a relatively high proportion of individuals greater than 406 mm in length. Linear regression suggests an improving population size structure for mountain whitefish, approaching statistical significance (r2 = 0.89; p = 0.06; d.f. = 3) (Table 6). However, we have some concerns that this trend may be affected by increased sampling effort in areas of the river that appear to hold larger fish. When we compare mean lengths across the entire sampling area for multiple years it appears as though average length is increasing (Table 7; Figure 10). However, sample sizes in later years were much greater than earlier years. The larger sample sizes are a direct result of figuring out how to effectively sample the high quality mountain whitefish habitat in the Clark Fork River. The apparent increase in average length may be somehow related to our improving effectiveness at sampling the higher quality mountain whitefish habitat. This concept has some limited support when we plot the average length of mountain whitefish captured within Whitehorse Rapids only (Figure 11). Although average size within the Whitehorse Rapids sample was larger in 2006, the difference in mean lengths is not as great (2000 data is not available for Whitehorse Rapids alone). The mean lengths are consistently larger when we analyze the Whitehorse data separately, and this could be impacting the magnitude of the average length differences over time when much larger samples were taken from Whitehorse in later sampling years.

When we compare back-calculated mean lengths for mountain whitefish, we see a significant difference in length-at-age 4 from 2000 to 2006 (Figure 12). It appears that average length-at-age 4 has declined from 2000 to 2006. Growth rates as indicated through comparison of the growth increment from age-3 to age-4 do not show any significant change (Figure 13). A comparison of slopes of the length-weight relationship appears to indicate reduced growth in later years of the study (Figure 14). The combination of larger average size in the sampled population, reduced back-calculated length-at-age 4, and lower slope of the length-weight relationship would suggest mountain whitefish might be living longer and growing slower in later years of the study. However, sampling bias is likely affecting some of these estimates. Future estimation of mortality rates may help answer this question.

Table 6. Proportional stock density (>305) and quality stock density (>406) estimated for mountain whitefish and brown trout captured in the Clark Fork River, Idaho, during spring sampling from 2000 through 2006. Stock length is 200 mm.

	Mountain whitefish		**Brown trout**	
	PSD	**QSD**	**PSD**	**QSD**
2000	67.1	0.7	73.3	43.1
2002	79.3	1.5	86.3	32.9
2004	80.1	2.4	74.2	18.4
2006	87.1	1.1	82.7	35.7

Table 7. Mean total length (TL; mm) estimated for mountain whitefish and brown trout captured in the Clark Fork River, Idaho, during spring sampling from 2000 through 2006.

	Mountain whitefish		Brown trout	
	Mean TL (mm) (SD)	**Sample size**	**Mean TL (mm) (SD)**	**Sample size**
2000	323.6 (39.3)	282	386.6 (107.3)	52
2002	328.6 (40.7)	177	387.1 (71.5)	70
2004	330.1 (44.8)	1,245	359.2 (84.8)	167
2006	340.3 (39.0)	907	383.8 (97.3)	100

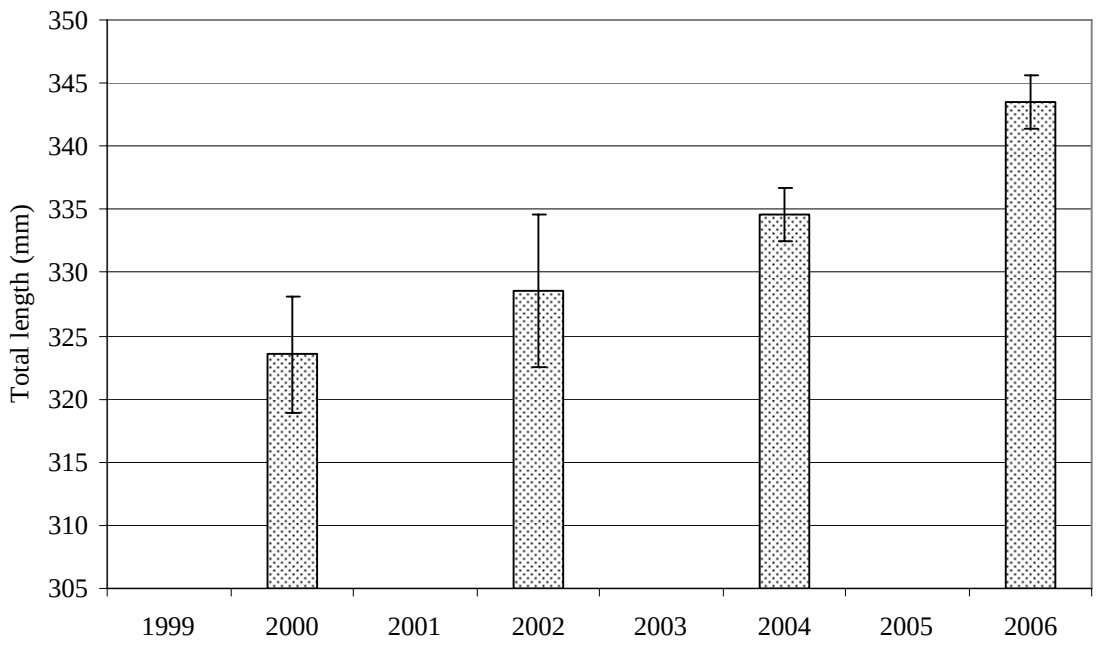

Figure 10. Average lengths and associated 95% confidence intervals for mountain whitefish captured in the Clark Fork River, Idaho.

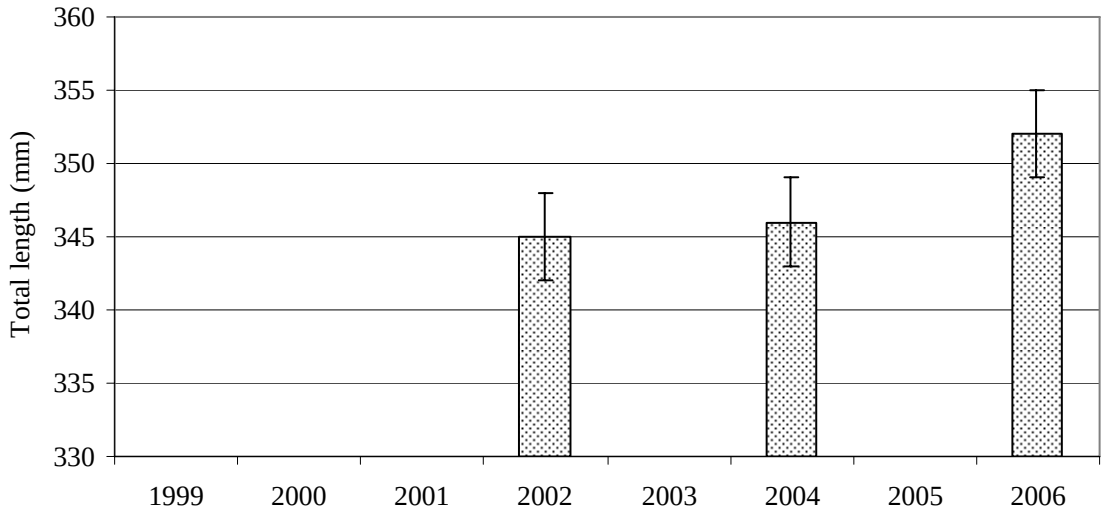

Figure 11. Mean length and 95% confidence intervals for mountain whitefish captured at Whitehorse Rapids only in the Clark Fork River, Idaho.

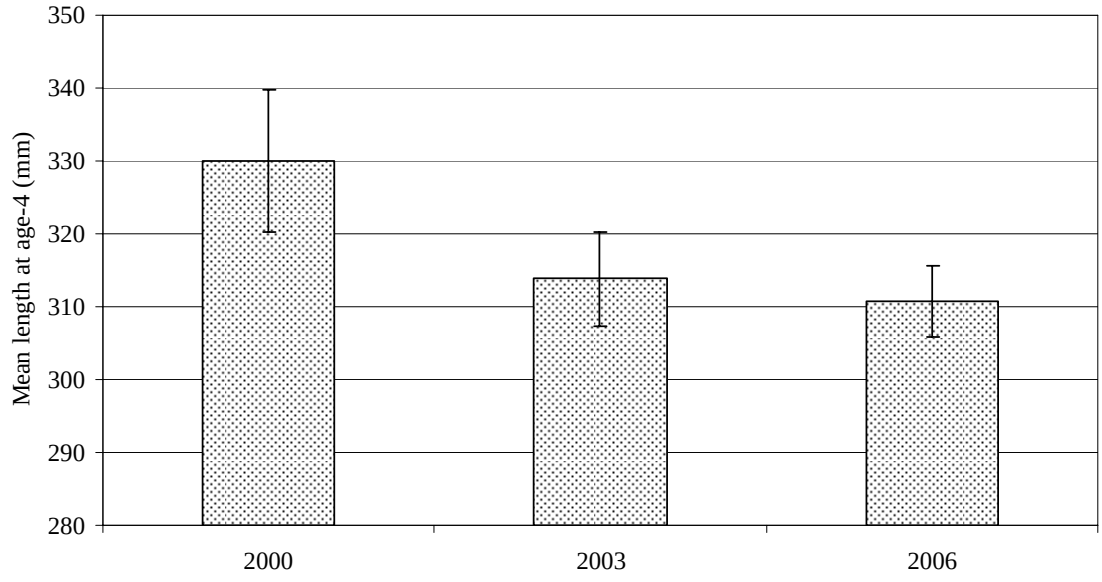

Figure 12. Backcalculated mean length-at-age-4 for mountain whitefish captured in the Clark Fork River, Idaho.

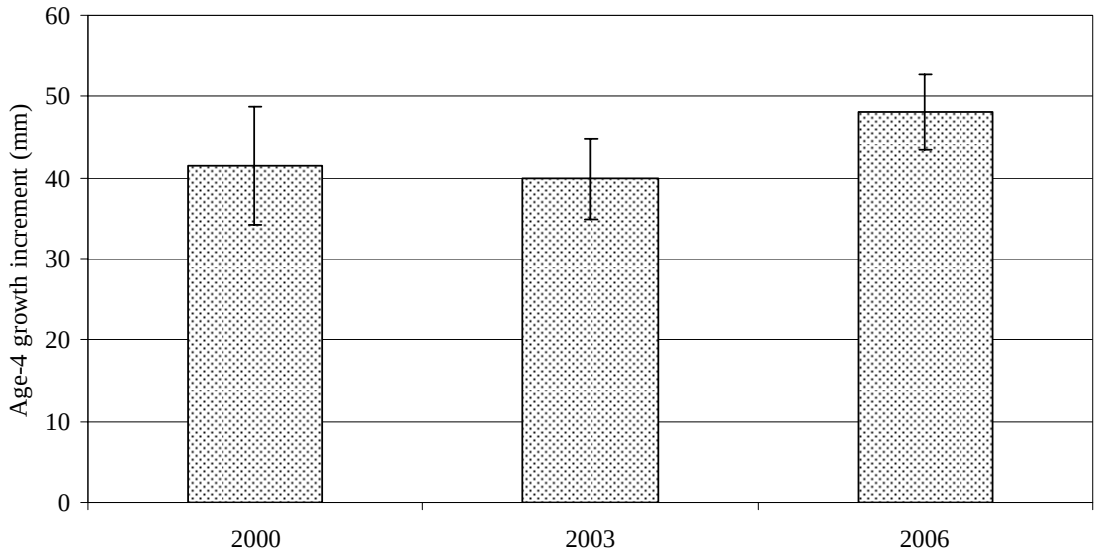

Figure 13. Mean growth increment from age-3 to age-4 for mountain whitefish captured in the Clark Fork River, Idaho.

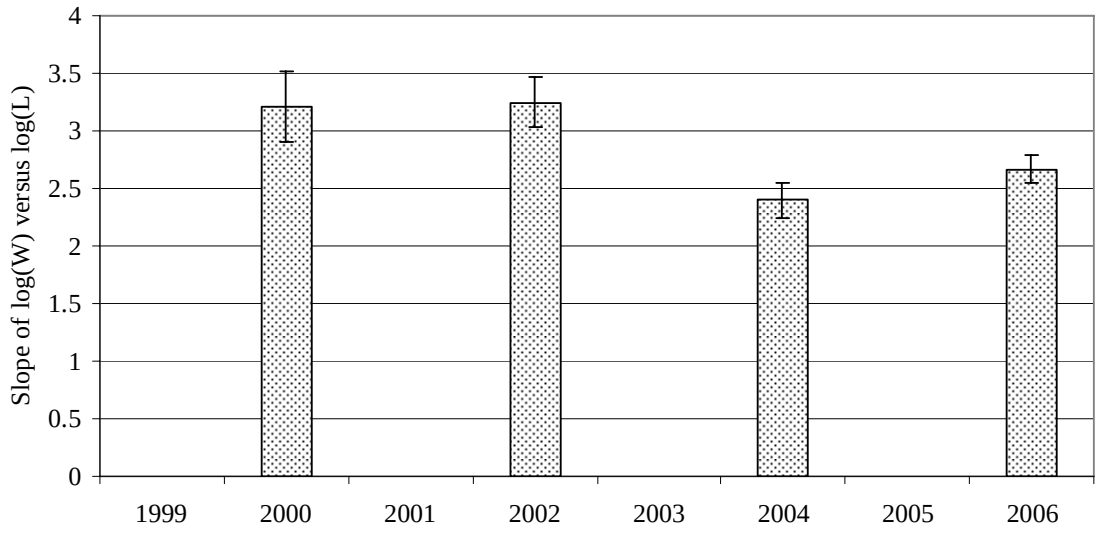

Figure 14. Comparison of length-weight relationship slopes for mountain whitefish captured in the Clark Fork River, Idaho.

Point estimates of *Wr* across years suggests an increasing trend for mountain whitefish may be developing, but at this point a consistent significant upward trend has not been detected. Some years are significantly higher than others, but variability clouds any trends (Figure 15). Brown trout condition appears to be declining over time (Figure 16). Caution should be used when reading into the condition data, as late March or early April sampling would be expected to sample fish in "poorer" condition as they emerge from winter. It should however provide a

reasonable statistic for trend monitoring as the samples are taken from consistent time periods within each year.

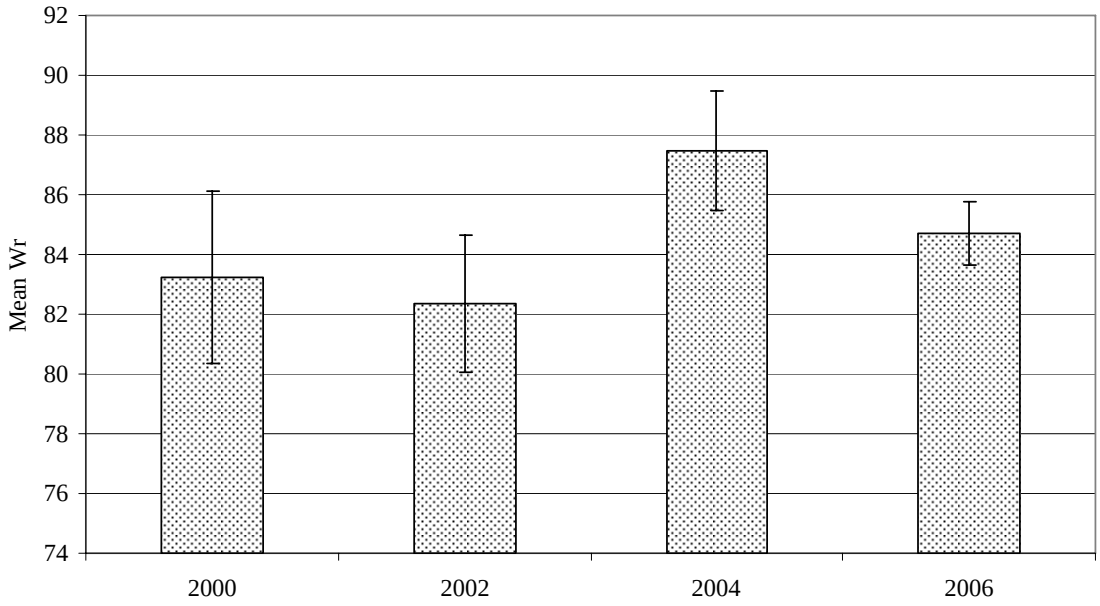

Figure 15. Mean relative weights (*Wr*) for mountain whitefish captured during spring sampling in the Clark Fork River, Idaho.

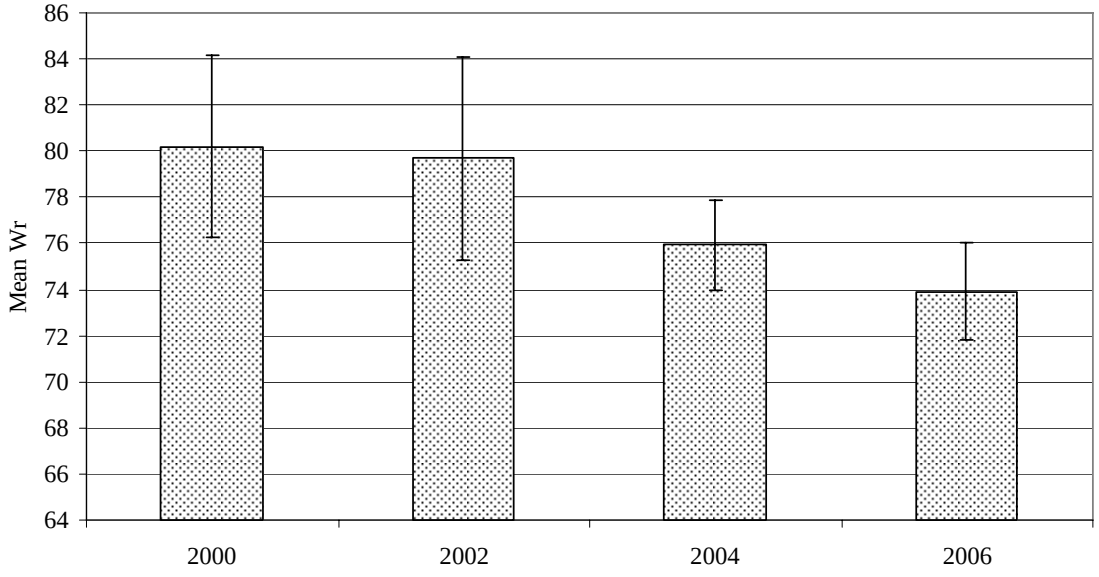

Figure 16. Mean relative weights (*Wr*) for brown trout captured during spring sampling in the Clark Fork River, Idaho.

A number of factors acting in combination may be regulating salmonid abundance and condition in the study reach of 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), 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 also captured with the jetboat electrofishing equipment in the side-channel in 2005. This may be the result of very low density, or the result of inadequate sampling to date. We feel the former is more likely the case. 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

Thanks to Shaun Wilkenson, Sean Moran, Jeremy Stover, John Suhfras, Shana Bernall and Ryan Weltz of Avista, for assistance with field work. We would also like to thank Bill Horton and Ned Horner of the Idaho Department of Fish and Game, Jon Hanson of Montana Fish, Wildlife, and Parks, Joe DosSantos of Avista Corp., and Larry Lockard of the U.S. Fish and Wildlife Service for their reviews of this report.

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2006 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 2006, as well as a weir during 2005 and 2006, to identify marked bull trout upon their return as adults. 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 2006, while 51 of the 350 juveniles (14.6%) originally marked outmigrating from Trestle Creek in 2001, were detected in Trestle Creek between 2003 and 2006. Twenty-three of the 302 juveniles (7.6%) originally marked outmigrating in 2002, were detected in 2005 and 2006. 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, 23 were detected in 2005, and 18 were detected in 2006. Of these 18, 16 were repeat spawners from 2005. We marked 95 juvenile bull trout with PIT tags in Twin Creek for lake survival estimation from 2000 through 2003. We have not detected any returns from the marked juvenile bull trout in Twin Creek to date. We captured 16 individual adult bull trout in 2006 at the weir on Twin Creek. Of these, 14 were new fish. Of the two recaptures, one had been captured and PIT tagged in the Clark Fork River below Cabinet Gorge Dam on April 30, 2006, while the other had been captured and tagged in Twin Creek during 2004, and also returned in 2005.

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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 generally supports the largest annual run of any of the LPO tributaries. Trestle Creek represents a large proportion of the bull trout spawning escapement from LPO on an annual basis. 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 clarkii 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 kilometers 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 (Downs and Jakubowski 2006), 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 2006 marks the seventh 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.

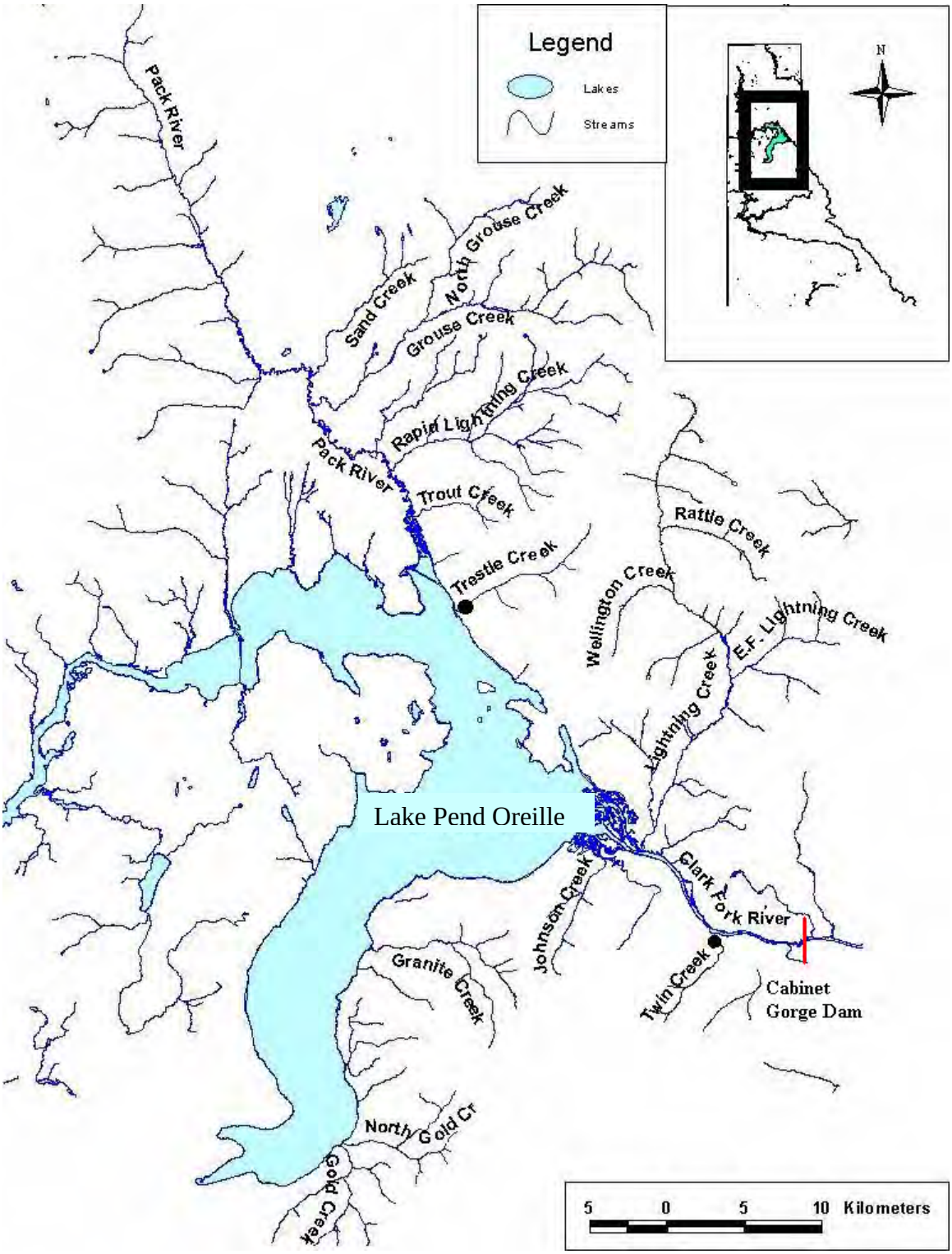

Figure 1. Trap locations on Trestle and Twin creeks, Idaho, tributaries to Lake Pend Oreille and the Clark Fork River, Idaho, below Cabinet Gorge Dam.

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 in previous years (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 2006, the remote PIT tag detection weir was installed in Trestle Creek on August 16 and removed on October 30, having operated for all but one night.

In 2006, 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 August 25, and removed on October 27, 2006. 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.

Captured bull trout were anesthetized using MS-222, 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 mark as an out-migrating juvenile in the tributary to subsequent return as an adult was estimated as the proportion of individual bull trout marked in Trestle Creek in 2000, 2001, and 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, 2001, or 2002)

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

Survival Estimation Twin Creek

On August 25, 2006, 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 30, 2006.

Captured bull trout were anesthetized using MS-222, 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 2006, an electronic temperature recorder was installed in Twin Creek on June 28 and removed on November 3.

RESULTS and DISCUSSION

Trestle Creek

To date, a total of 29 unique bull trout originally marked as juveniles 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, 51 unique individuals (14.6%) have returned to date. Twenty-three unique individuals (7.6%) from the 2002 marking group have returned to date

(Table 1). No previously undetected adult bull trout from the 2000 juvenile marking group returned to Trestle Creek during 2006, although two fish from that marking group that had returned in 2004, also returned in 2006.

The average length at tagging for the 29 individuals returning in 2005 from the 2001 marking group was 173.2 mm (range = 138-220, S.D. = 21.9), while it was 168.7 mm (range = 137-206, S.D. = 19.1) for the 13 returning in 2006. 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), while it was 178.1 mm (range = 136-222, S.D. = 21.4) for the 20 that returned in 2006. Based on the trend observed to date, we anticipate decreasing adult returns from the juvenile marking groups in 2007.

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
2006	2	0	18	13	21	20
Totals		29		51		23

By operating an upstream and downstream weir on Trestle Creek in 2006, 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 2006, we captured 41 returning adult bull trout with a missing adipose fin, and 25 also contained a PIT tag in their abdomen. This gives a combined tag retention rate for juveniles tagged in 2001 and 2002 of 61%. For comparison, in 2005 we also ran the Trestle Creek weir to estimate PIT tag loss, and 13 of 20 adult bull trout with an adipose clip also had a PIT tag in their abdomen. That results in an estimated PIT tag retention rate of 65% for fish captured in 2005. The combined estimate of tag loss across both years is 37.7%. 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. Adjusting for the observed tag loss (0.337), the survival estimates to date would increase to 14.8% and 20% for 2000 and 2001, respectively. These adjusted estimates should be viewed with caution as some fish may have been detected by the remote station with a PIT tag present while moving upstream, and then detected moving downstream after spawning without a PIT tag in the same year. This could have biased the adjusted estimates upward. In addition, we anticipate additional returns from the 2001 marking group which will increase the overall estimated survival rate.

In Trestle Creek in 2006, a total of 115 unique adult bull trout were captured moving upstream in the weir, 34 of which were previously PIT tagged. Of the 34 captured with a previous tag, 13 had the PIT tag located in the abdomen. All of the 13 also had an adipose clip, signifying that they were originally tagged as juveniles in 2001 or 2002. Of the remaining 21 previously tagged fish, which were tagged as adults, three were tagged moving downstream in Trestle Creek earlier in 2006, while 10 were tagged in Trestle Creek in 2005. One fish was tagged as an adult in Granite Creek in 2004. The remaining seven were tagged in Trestle Creek in either 2000 or 2002 (Table 2). Adult bull trout moving upstream ranged in size from 348 to 800 mm (Table 3; Figure 2). We also captured one 201 mm total length juvenile bull trout moving upstream in 2006, which was subsequently PIT tagged.

In the 2006 Trestle Creek downstream weir, a total of 176 unique adult and 59 juvenile bull trout were captured. Twelve of the juvenile bull trout captured were not tagged due to small size. Eighty-seven unique adults were captured with a previous PIT tag, 60 of which had been tagged in a previous year, while twenty-seven were tagged moving upstream in 2006 (Table 2). Of the 60 bull trout that had been tagged in a previous year, that had not been captured moving upstream earlier in 2006, 12 had an adipose clip in addition to a tag in their abdomen. This indicates that they had originally been tagged as juveniles in Trestle Creek in 2001 or 2002. An additional fish that had been tagged as a juvenile in Trestle Creek in 2000 was also captured. In addition to the 176 unique adults captured, we also encountered 12 adult bull trout in our downstream weir that were natural spawning mortalities. One of these had been tagged as a juvenile in Trestle Creek in 2000. Adult bull trout, including spawning mortalities, moving downstream, ranged in size from 342 to 798 mm (Table 3; Figures 3 and 4).

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
2006	7	0	18	0

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 2006.

	Mean length (mm) (SD) (n)	**Length range**	**Mean weight (g) (SD) (n)**
Adult bull trout (down)	548.2 (83.0) (188)	342-798	1,339.6 (716.3) (188)
Juvenile bull trout (down)	152.7 (49.9) (59)	49-211	34.4 (21.9) (55)
Adult bull trout (up)	539.3 (90.8) (115)	348-800	1,433.9 (845.2) (115)

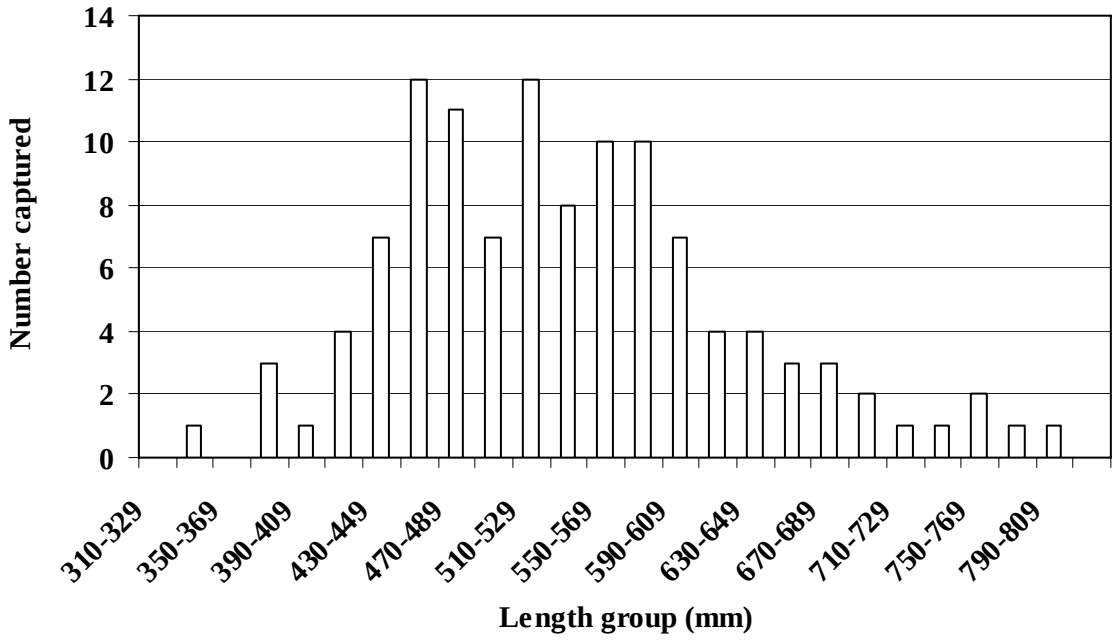

Figure 2. Length frequency histogram for adult bull trout (n = 115) captured in the upstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2006.

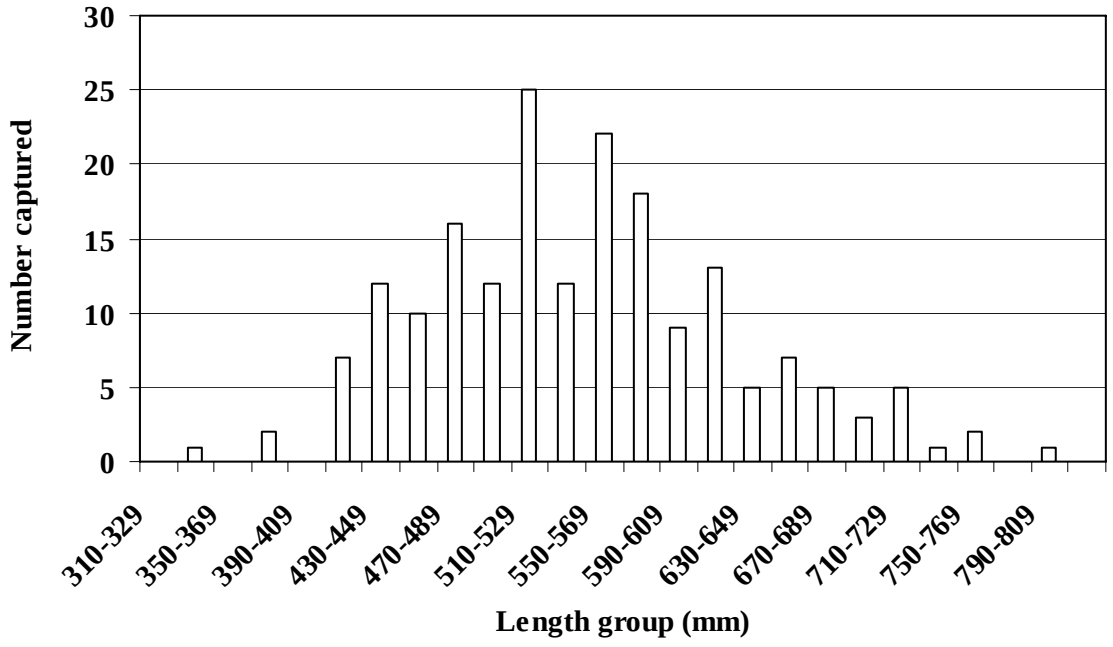

Figure 3. Length frequency histogram for adult bull trout (n = 188) captured in the downstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2006.

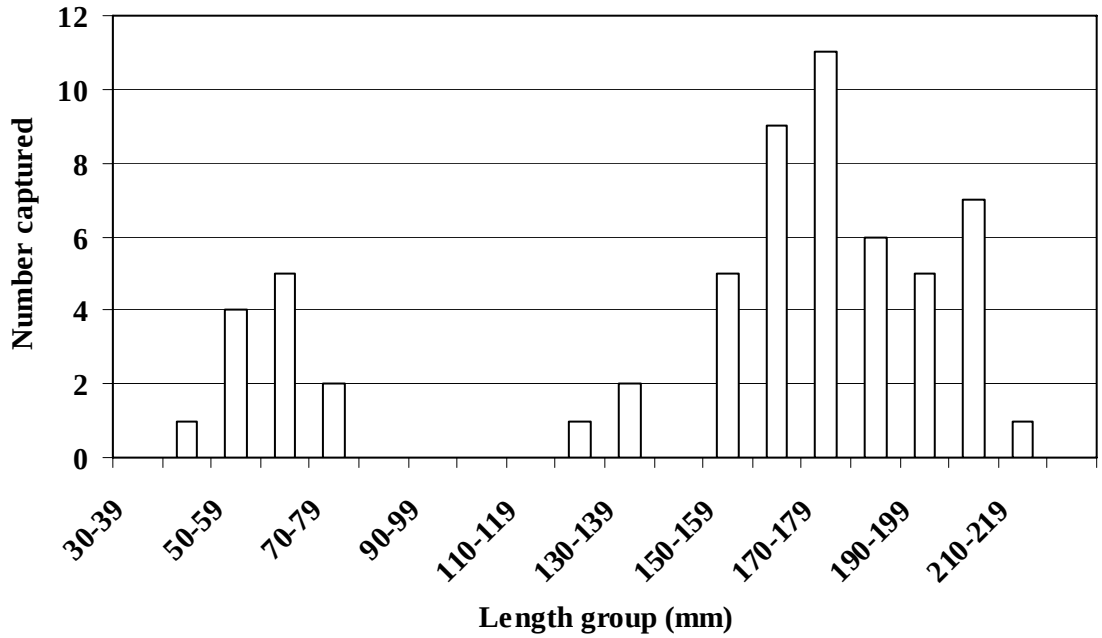

Figure 4. Length frequency histogram for juvenile bull trout (n = 59) captured in the downstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2006.

We also captured four species of salmonids in addition to bull trout in Trestle Creek in 2006. In the upstream weir we captured adult kokanee, rainbow and westslope cutthroat trout. (Table 4; Figures 5 and 6). In the downstream weir we captured adult kokanee, rainbow and westslope cutthroat trout, and mountain whitefish (Table 5; Figures 7 through 9). We also captured a single 220 mm total length westslope X rainbow trout hybrid, based on visual classification, moving downstream in 2006.

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 2006.

Species	Mean length (mm) (SD) (n)	Length range	Mean weight (g) (SD) (n)
Kokanee	372.5 (19.5) (33)	345-415	509.1 (93.7) (32)
Rainbow trout	181.4 (33.8) (7)	137-224	51.3 (23.0) (7)
Westslope cutthroat trout	190.0 (50.5) (9)	101-266	74.3 (54.1) (9)

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 2006.

Species	Mean length (mm) (SD) (n)	Length range	Mean weight (g) (SD) (n)
Kokanee	338.2 (37.9) (36)	219-400	392.1 (117.3) (36)
Mountain whitefish	190.9 (13.9) (8)	170-212	58.0 (11.1) (8)
Rainbow trout	188.8 (31.5) (12)	124-233	59.7 (25.7) (12)
Westslope cutthroat trout	178.1 (63.2) (8)	101-274	66.1 (61.2) (8)

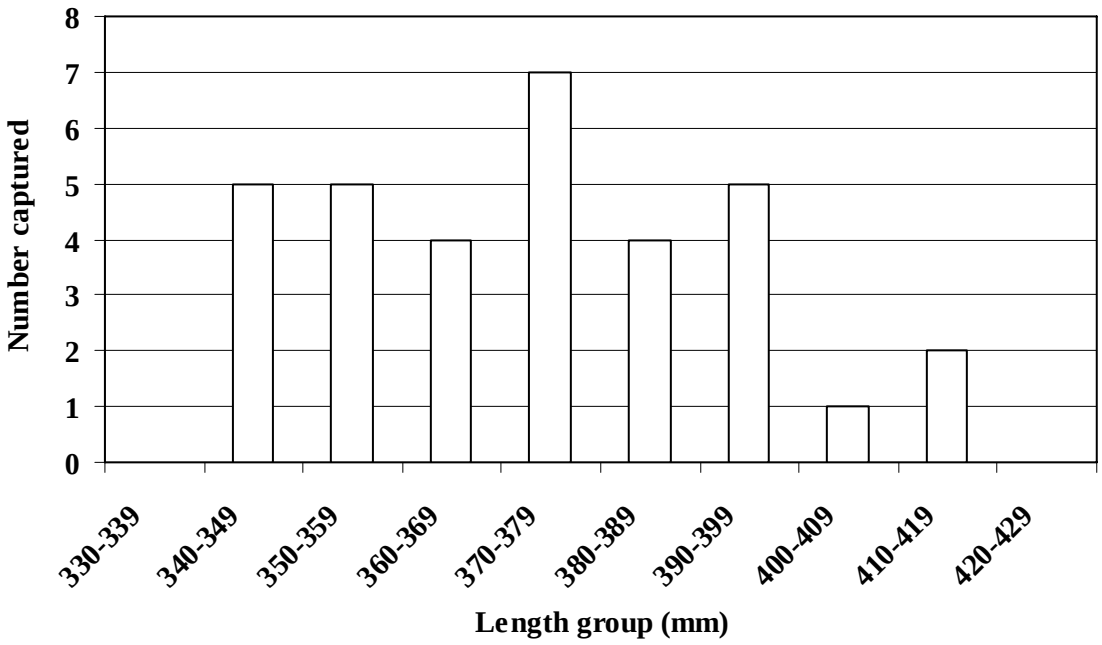

Figure 5. Length frequency histogram for kokanee (n = 33) captured in the upstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2006.

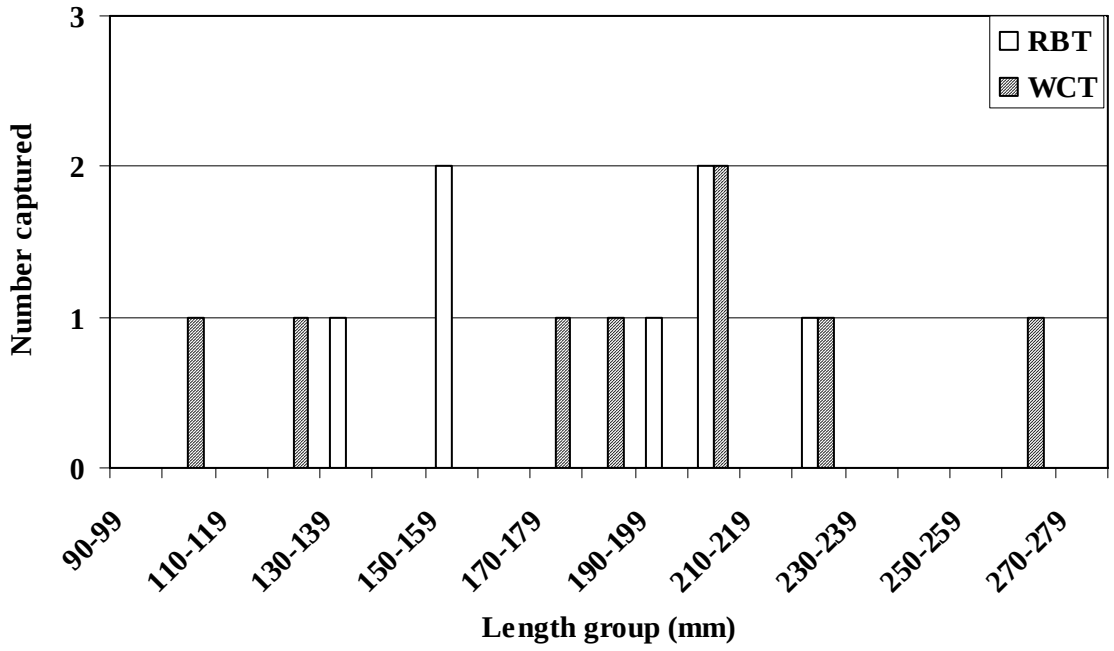

Figure 6. Length frequency histogram for rainbow (n = 7) and westslope cutthroat trout (n = 9) captured in the upstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2006.

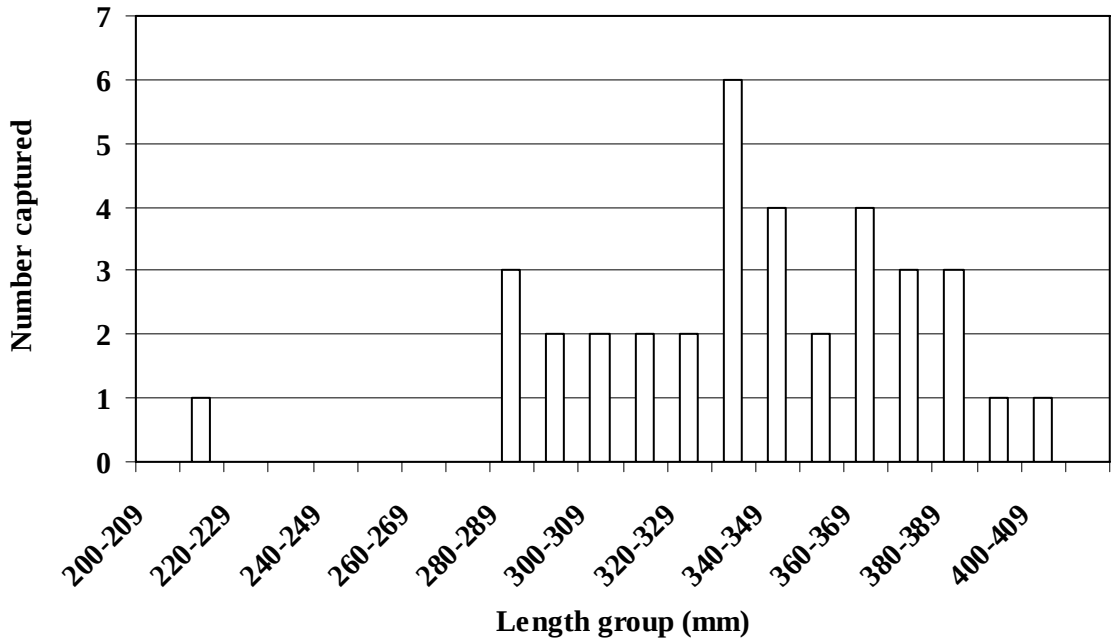

Figure 7. Length frequency histogram for kokanee (n = 36) captured in the downstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2006.

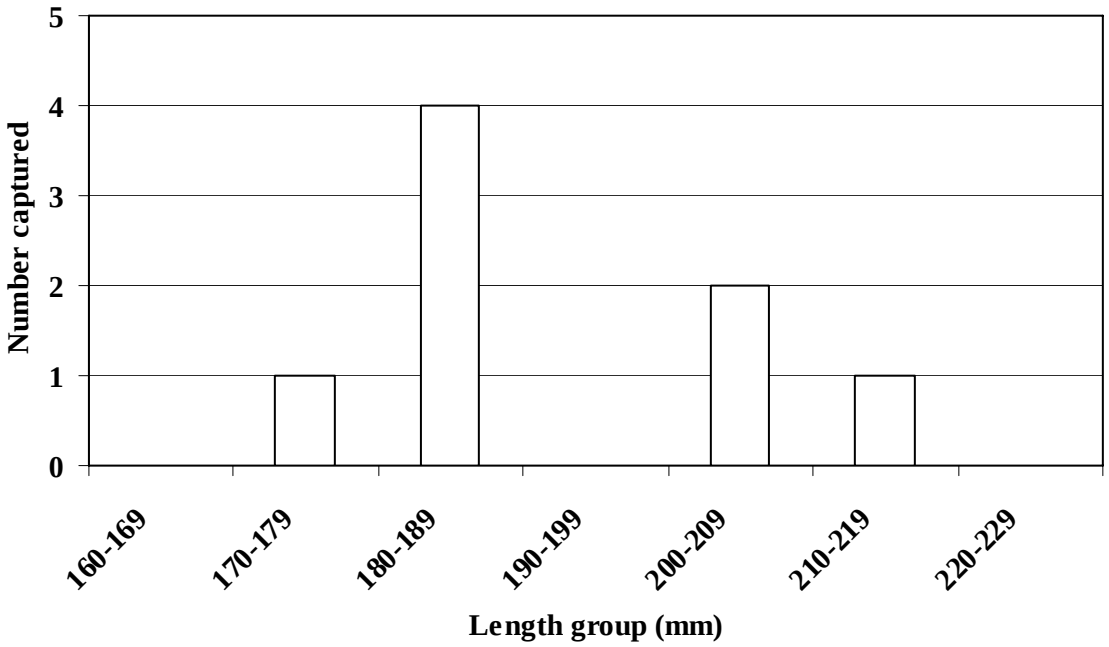

Figure 8. Length frequency histogram for mountain whitefish (n = 8) captured in the downstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2006.

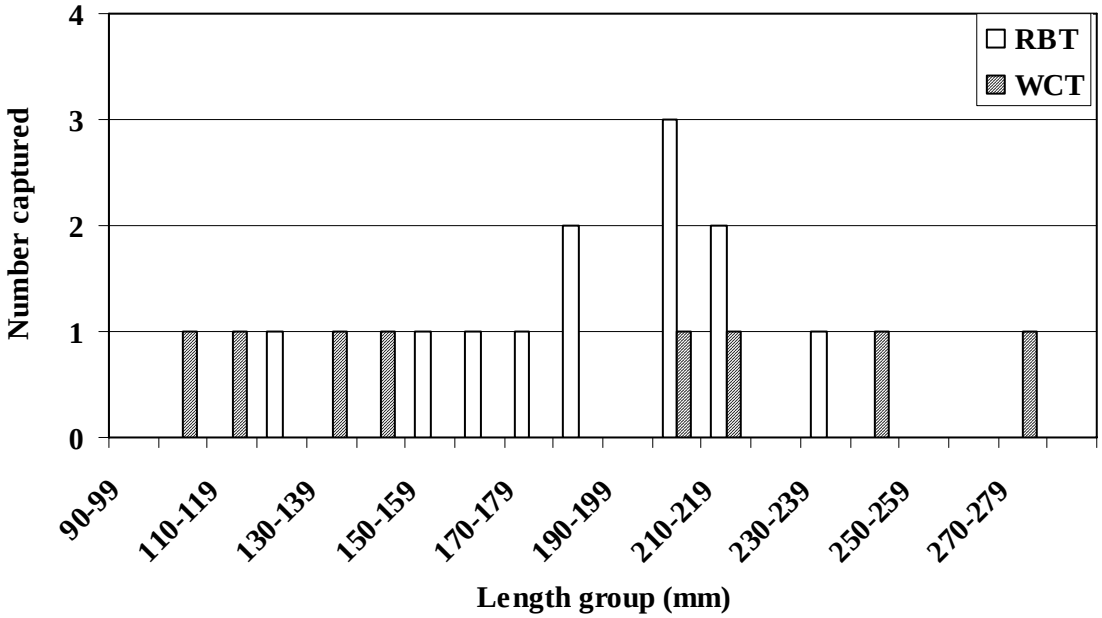

Figure 9. Length frequency histogram for rainbow (n = 12) and westslope cutthroat trout (n = 8) captured in the downstream weir in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, during 2006.

Twin Creek

We captured 11 species of juvenile fish, plus unidentified juvenile sucker *Catostomus sp*. and unidentified juvenile *Oncorhynchus sp*. in the weir moving upstream and/or downstream in Twin Creek from August 25 to October 30 in 2006 (Table 6). Brook trout and sculpin *Cottus sp*. are included with the juvenile data due to uncertainty about their age and level of sexual maturity. Three juvenile westslope X rainbow trout hybrids (80, 85 and 91 mm), based on visual classification, were also captured, but are not included in the species total (Tables 7 and 8). Rainbow trout were the most abundant fish in the downstream trap box, while rainbow and brown trout were equally abundant in the upstream trap box (Tables 7 and 8). Average lengths of juvenile salmonids ranged from 59.3 mm for unidentified *Oncorhynchus sp*. to 164.8 mm for rainbow trout. (Tables 7 and 8).

In Twin Creek in 2006, we captured one juvenile bull trout moving downstream (Table 8). It did not receive a PIT tag, due to small size. In the upstream weir box, there were no juvenile bull trout captured.

Table 6. Species captured in Twin Creek, a tributary to the Clark Fork River, Idaho, during 2006.

Species	**Abbreviation**
Bull trout *Salvelinus confluentus*	BLT
Brook trout *Salvelinus fontinalis*	BRK
Brown trout *Salmo trutta*	BRN
Catostomus species (unidentified)	UNS
Kokanee *Oncorhynchus nerka*	KOK
Largescale sucker *Catostomus macrocheilus*	LSS
Longnose sucker *Catostomus catostomus*	LNS
Mountain whitefish *Prosopium williamsoni*	MWF
Northern pikeminnow *Ptychocheilus oregonensis*	NPM
Oncorhynchus species (unidentified)	ONC
Rainbow trout *Oncorhynchus mykiss*	RBT
Redside shiner *Richardsonius balteatus*	RSS
Sculpin *Cottus Spp*.	SCL

We captured two species of adult fish moving upstream and/or downstream in Twin Creek during 2006; bull trout and kokanee (Table 9). A total of 16 individual adult bull trout were captured moving upstream between September 12 and October 24. Fourteen of the sixteen had not been previously tagged and were subsequently PIT tagged. One of the previously tagged fish had been captured and tagged while electrofishing on the Clark Fork River below Cabinet Gorge Dam on April 30, 2006. This fish had been genetically tested and was determined to be of Twin Creek origin. The other previously tagged fish had originally been captured in the weir on Twin Creek and tagged in 2004, and was recaptured in the Twin Creek weir in 2005.

Although a total of 95 juvenile bull trout were captured and PIT tagged in Twin Creek between 2000 and 2003 (8 in 2000, 30 in 2001, 5 in 2002, and 52 in 2003), using a combination of upstream and downstream weir box's, as well as electrofishing, no adult returns of previously tagged juveniles from Twin Creek have been detected to date. A failure to detect returning adults

in Twin Creek is unlikely, as the nature of the drainage as well as the trapping location allows the weir to be operated continuously through late fall without the typical trapping problems caused by fall rains and associated debris, which commonly occurs in many other tributaries. It is more likely that actual differences in survival rates exist between the two sites. We will explore these differences further when the study is concluded and all of the data has been collected. Based on return rates observed to date, we will need to run the study through 2008.

Table 7. Mean lengths (TL; mm), mean weights (g), standard deviation (SD), sample size (n), and length range for juvenile species captured in the upstream weir on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2006.

Species	Mean length (mm) (SD) (n)	Length range	Mean weight (g) (SD) (n)
BRN	148.8 (69.7) (4)	97-245	55.0 (58.8) (3)
RBT	164.8 (18.7) (4)	139-182	44.0 (16.7) (3)
UNS	86.0 (N/A) (1)	N/A	5.0 (N/A) (1)

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, and westslope X rainbow trout hybrids (WRHY) captured in the downstream weir on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2006.

Species	Mean length (mm) (SD) (n)	Length range	Mean weight (g) (SD) (n)	CPUE (fish/trap night)
BLT	72.0 (N/A) (1)	N/A	6.0 (N/A) (1)	0.01
BRK	110.7 (24.1) (7)	83-152	12.4 (8.7) (7)	0.10
BRN	96.1 (30.7) (185)	55-263	12.5 (22.2) (103)	2.76
KOK	87.0 (7.1) (2)	82-92	5.0 (1.4) (2)	0.03
LNS	88.8 (11.3) (6)	79-108	6.4 (2.2) (5)	0.09
LSS	123.3 (60.7) (3)	77-192	28.3 (37.1) (3)	0.04
MWF	116.5 (8.5) (274)	90-139	10.6 (2.3) (237)	4.09
NPM	43.0 (4.2) (2)	40-46	1.0 (0.0) (2)	0.03
ONC	59.3 (6.8) (224)	38-69	2.1 (0.8) (190)	3.34
RBT	83.9 (19.5) (293)	70-205	7.1 (10.1) (227)	4.37
RSS	45.6 (6.2) (42)	37-67	1.1 (0.3) (42)	0.63
SCL	46.2 (19.0) (29)	27-101	2.3 (2.7) (28)	0.43
UNS	65.7 (16.1) (107)	35-110	3.2 (2.3) (88)	1.60
WRHY	85.3 (5.5) (3)	80-91	6.0 (1.0) (3)	0.04

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 kokanee captured in the upstream and downstream weir combined, on Twin Creek, a tributary to the Clark Fork River, Idaho, during 2006.

Species	Mean length (mm) (SD) (n)	Length range	Mean weight (g) (SD) (n)
BLT	523.6 (88.2) (16)	409-690	1,325.3 (726.1) (16)
KOK	352.0 (19.1) (24)	319-395	419.2 (83.5) (23)

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 mid to late September and early October (Downs et al. 2003, Downs and Jakubowski 2003). In 2006, we observed a continuation

of this trend (Figure 10). This lends support to the idea that some of the spawners in Twin Creek may be 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). Redd counts in recent years have been low in Twin Creek (averaging six annually from 2001-2006). 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. This is currently being accomplished through a "rapid-response" genetic assignment test prior to upstream transport of captured adult bull trout. Use of this technique will facilitate the selective passage of upstream bull trout stocks until trapping facilities are completed at Cabinet Gorge Dam.

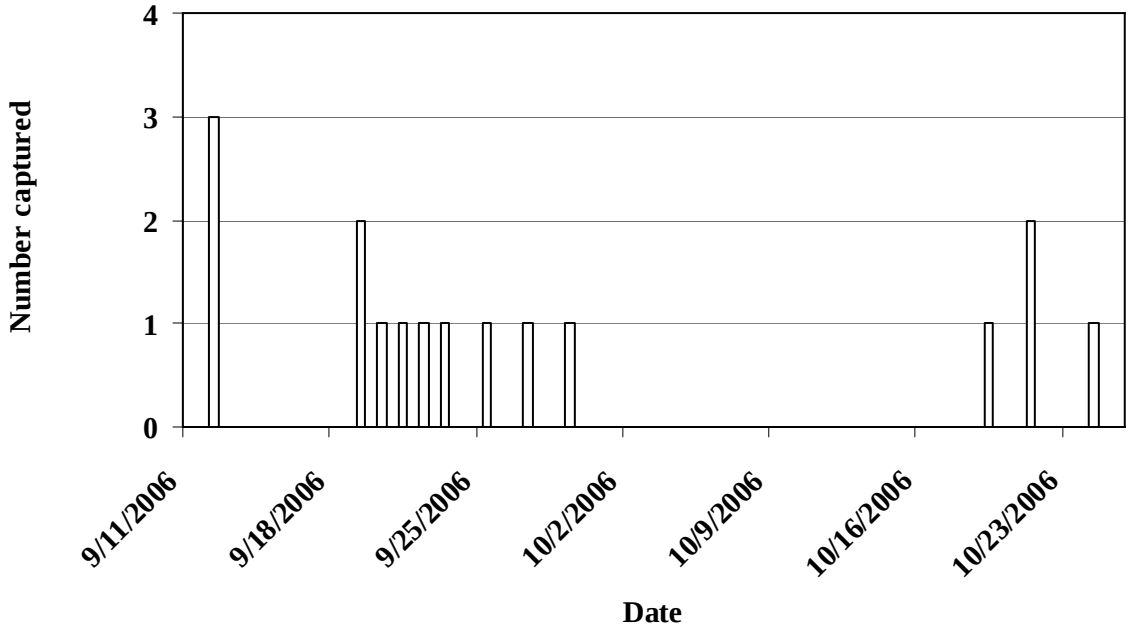

Figure 10. Timing of upstream migration of adult bull trout in Twin Creek, a tributary to the Clark Fork River, Idaho, in 2006.

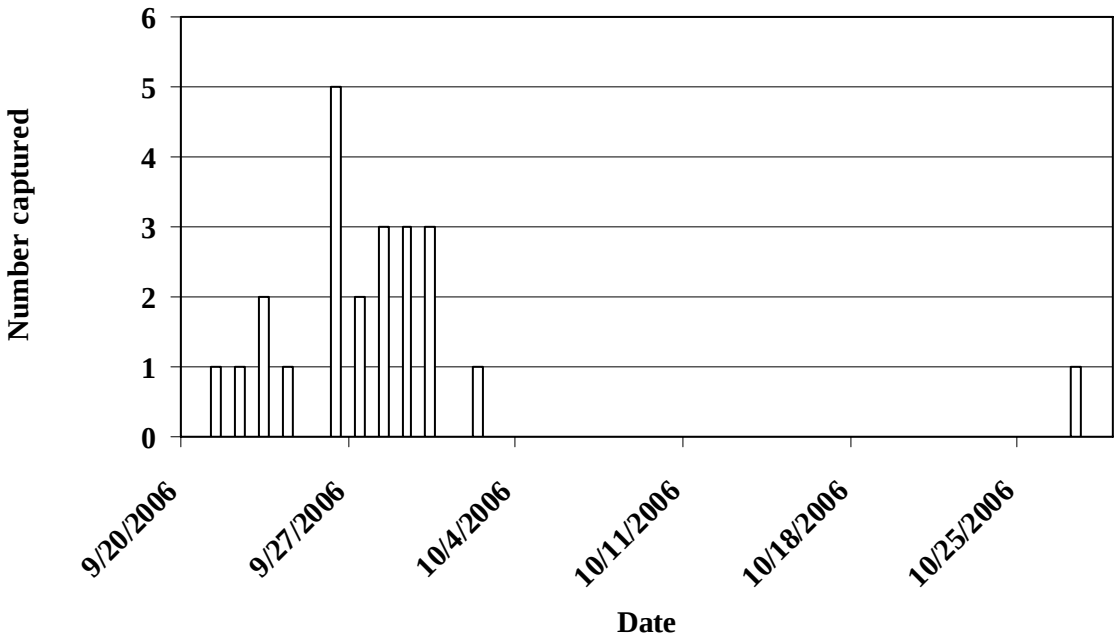

Figure 11. Timing of upstream migration of adult kokanee in Twin Creek, a tributary to the Clark Fork River, Idaho, in 2006.

Twin Creek Water Temperature

Water temperature was recorded using an electronic temperature logger from June 28 through November 3, 2006**.** The maximum daily water temperature observed over the course of the trapping season in 2006 was 18.3 ^{0}C on July 24 (Figure 12). 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, 18.0 ^{0}C on July 23, 2004, and 18.8 ^{0}C on July 31, 2005. We would anticipate maximum temperatures to decline over time as vegetation continues to grow and provides shade to the restored channel of Twin Creek. A series of two private ponds constructed at the spring source of Twin Creek are likely increasing water temperatures in Twin Creek downstream.

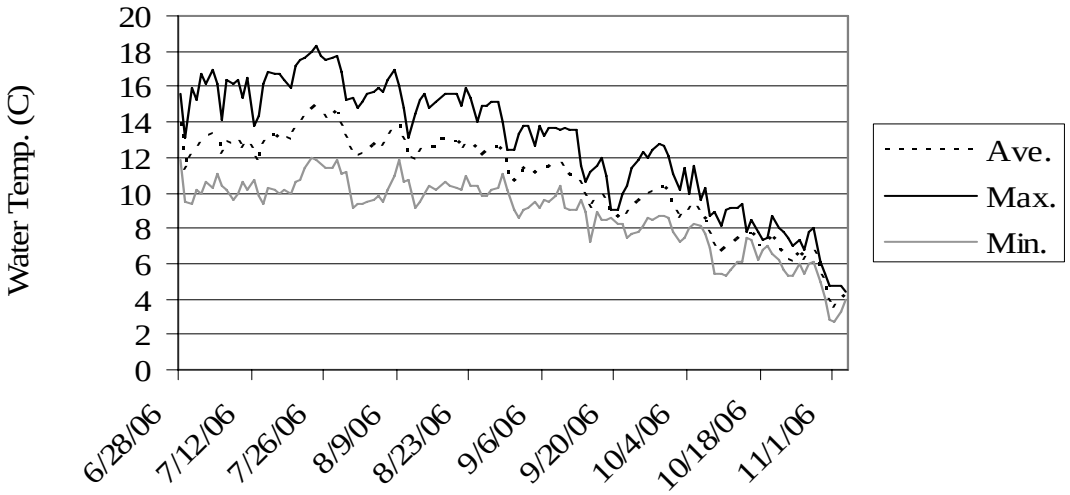

Figure 12. Mean daily water temperatures recorded by thermograph for Twin Creek, a tributary to the Clark Fork River, Idaho, in 2006.

ACKNOWLEDGEMENTS

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2006 Twin Creek Restoration Monitoring Progress Report

ABSTRACT

In 2006 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 clarkii 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 $\geq$ 100 mm abundance remains low in all sections monitored, with three captured in 2006. Rainbow trout ($\geq$ 75 mm) are the dominant species captured in the monitoring sections. Continued monitoring is needed to determine 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 clarkii 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 3.2 bull trout spawn for every redd constructed (Downs and Jakubowski, 2006), or that approximately 150 to 250 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 collected pre-treatment baseline information on fish abundance, size structure, and distribution in similar areas pre and post-construction 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.

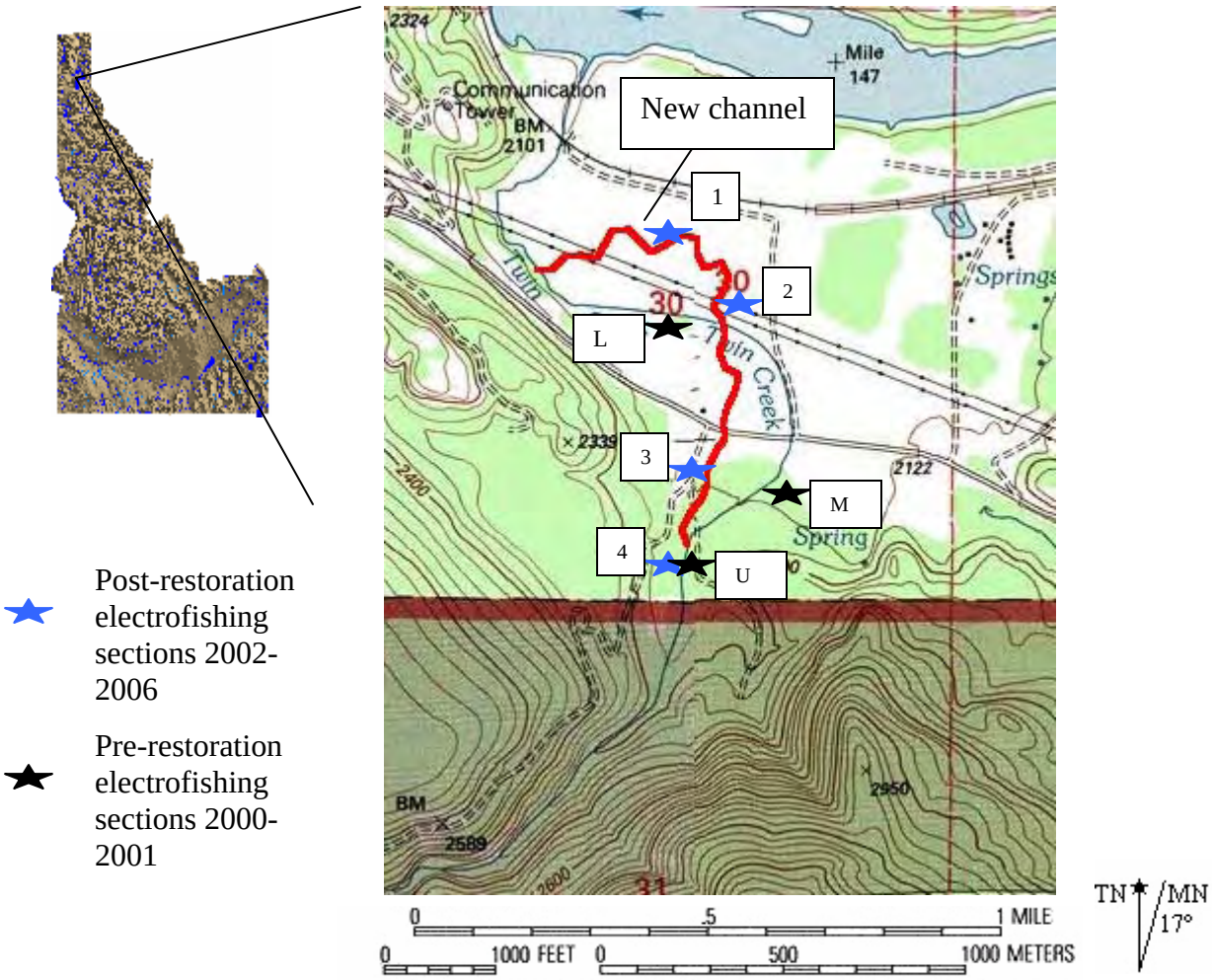

Figure 1. Vicinity map and sample site locations for Twin Creek, a tributary to the Clark Fork River, Idaho (L = lower, M = middle, U = upper pre-restoration sampling sites).

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 trout X brook trout were not included within the bull trout estimates, and those classified as hybrids of westslope cutthroat trout X rainbow trout were not included within the westslope cutthroat trout estimate. We also re-ran the population estimates from the 2002 and 2003 field seasons to provide estimates of bull trout and westslope cutthroat trout, not including hybrids in those estimates, to be used in future comparisons.

We sampled Twin Creek on July 5-7, 2006. Fish were anesthetized, measured (total length; mm), and weighed (g). Genetic samples were also collected from two bull trout 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 trout and westslope cutthroat trout.

RESULTS

We captured five salmonid species in Twin Creek in 2006 (Table 1), while conducting electrofishing depletion population estimates in four sections (Table 2). Brown trout and rainbow trout $\geq$ 75 mm were found in all sections, while bull trout $\geq$ 75 mm were found in and immediately above (Sections two and three) the sections associated with the known spawning area for bull trout in Twin Creek. Westslope cutthroat trout or westslope X rainbow trout hybrids $\geq$ 75 mm were found in the two uppermost sections, with one westslope X rainbow trout hybrid of 197 mm being captured in Section 4 (Table 3). Rainbow trout $\geq$ 75 mm were the dominant species captured in all sections, with the highest density ($16.51/100m^2$) recorded in Section 4 (Table 2). Average size of salmonids $\geq$ 75 mm captured ranged from 78.5 mm for two westslope cutthroat trout captured in Section 3, to 197 mm for a single westslope cutthroat trout hybrid (based on visual classification) captured in Section 4 (Table 3). In Section 2, a single bull trout (165 mm) was captured, while in Section 3 two bull trout (168 and 179 mm) were captured.

Table 1. Species captured in Twin Creek, a tributary to the Clark Fork River, Idaho, in 2006.

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. clarkii lewisi*	WCT

Table 2. Total number captured (all lengths) and population estimates for salmonid species and westslope X rainbow trout hybrids (WRHY) ($\geq$ 75 mm; TL) captured in all four sections in Twin Creek, a tributary to the Clark Fork River, Idaho, in July 2006.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/minute)**
Section 1	BRN	5	5 (5-5)	1.15	0.12
	RBT[a]	14	14 (14-14)	3.23	0.33
Section 2	BLT	1	N/A[b]	N/A	0.0
	BRK	1	1 (1-1)	0.26	0.04
	BRN	11	11 (11-11)	2.89	0.21
	RBT[a]	16	16 (16-25)	4.21	0.25
Section 3	BLT	2	2 (2-2)	0.49	0.03
	BRK	2	1 (1-1)	0.24	0.03
	BRN	18	18 (18-18)	4.37	0.25
	RBT[a]	38	36 (36-46)	8.74	0.44
	WCT	2	2 (2-2)	0.49	0.03
Section 4	BRK	1	1 (1-1)	0.28	0.02
	BRN	37	37 (37-37)	10.18	0.58
	RBT[a]	46	60 (47-189)	16.51	0.60
	WRHY	1	1 (1-1)	0.28	0.02

[a]No attempt made to net *Oncorhynchus* sp. fry.
[b]No estimate. One bull trout 165 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 2006.

Location	**Species**	**Mean length (mm) (S.D.) (n)**	**Length range**	**Mean weight (g) (S.D.) (n)**
Section 1	BRN	124.3 (2.2) (4)	122-127	20.3 (1.5) (4)
	RBT[a]	116.6 (14.3) (14)	88-140	17.7 (6.6) (14)
Section 2	BLT	165.0 (N/A) (1)	N/A	38.0 (N/A) (1)
	BRK	142.0 (N/A) (1)	N/A	33.0 (N/A) (1)
	BRN	128.2 (16.4) (11)	104-155	23.0 (9.3) (11)
	RBT[a]	123.4 (21.8) (16)	99-186	22.1 (14.7) (16)
Section 3	BLT	173.5 (7.8) (2)	168-179	48.0 (9.9) (2)
	BRK	83.0 (N/A) (1)	68-83	5.0 (N/A) (1)
	BRN	105.1 (11.7) (18)	90-142	11.8 (2.1) (18)
	RBT[a]	109.1 (31.1) (35)	70-180	17.3 (16.4) (35)
	WCT	78.5 (3.5) (2)	76-81	5.0 (1.4) (2)
Section 4	BRK	139.0 (N/A) (1)	N/A	29.0 (N/A) (1)
	BRN	102.4 (8.7) (37)	83-118	11.6 (3.0) (37)
	RBT[a]	109.8 (30.3) (44)	69-196	16.9 (15.8) (44)
	WRHY	197.0 (N/A) (1)	N/A	86.0 (N/A) (1)

[a]No attempt made to net *Oncorhynchus* sp. fry.

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 2006. 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 (Downs et al. 2006), 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 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).

We captured very few bull trout across all age-classes in Twin Creek using either electrofishing or trapping in 2006. Only one juvenile bull trout was captured during trapping and three with electrofishing. We did attempt to capture all bull trout, including age-0, because we were trying to collect genetics from them. Over the entire weir trapping season, we only captured one (72mm) juvenile bull trout in 2006. In contrast, we captured 20 juvenile bull trout in the weir over the entire season in 2005 (7/8/05-10/24/05). However, we only captured four of those during the same time period that we ran the weir in 2006 (8/25/06-10/30/06). We captured an unusually high number of brown trout in lower Twin Creek in 2006 (Table 4), and it is possible interference in the form of competition with brown trout fry or redd superimposition may be effecting bull trout reproductive success. Seven bull trout redds were counted in Twin Creek the previous year.

The presence of exotic species such as brook and brown trout, competing for food and space with juvenile bull trout, may adversely affect bull trout response to stream restoration work. 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 trout X brook trout hybrids from the four estimate sections in 2002. In 2003, we removed a total of 60 brook trout and 5 bull trout 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. In 2006, we only captured a total of four brook trout in all four sections. None were captured in Section One, one was captured in Section two (142 mm), two were captured in Section three (68 and 83 mm), and one was captured in Section 4 (139 mm). We did not capture any bull trout hybrids in 2006, but the total catch of bull trout was very low. Prior to 2006, 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. Despite the low numbers of juvenile brook trout captured in 2006, it is likely that brook trout in habitat adjacent to the depletion sections will rapidly re-colonized the sections. It is also possible that brown trout may be interfering with brook trout reproduction through a competition/predation mechanism, resulting in reduced brook trout abundance (Table 4). 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 brook trout in Twin Creek poses a continued hybridization risk to bull trout.

Across the seven years of available data (2000 through 2006), the total catch of juvenile bull trout (all sizes) is generally 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 seven 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 trout 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 trout 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 trout 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 2006, a single 165 mm bull trout was captured 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 trout 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 trout X brook trout hybrid 147 mm was also captured. In 2006, two bull trout, 168 mm and 179 mm were captured in the comparison Section 3, along with two brook trout, 68 mm and 83 mm. 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).

Section 4 (Upstream-most sampling reach) has been consistently sampled from 2000 through 2006 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. In 2006, a single 197 mm westslope X rainbow trout hybrid was captured. No westslope cutthroat trout were captured in Section 4 in 2006. 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, and 2004 through 2006. 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 (2002-2006), 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 $\geq$ 75 mm (TL) captured in all four sections of Twin Creek, a tributary to the Clark Fork River, Idaho, during 2002-2006.

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
		2006	N/A	0.0
	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
		2006	N/A	0.0
	BRN	2002	2 (2-2)	0.49
		2003	17 (16-18)	4.15
		2004	N/A	0.0
		2005	N/A	0.0
		2006	5 (5-5)	1.15
	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
		2006	14 (14-14)	3.23

Table 4 continued.

Location	Species	Year	Estimate (95% CI)	N/100m^2
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
		2006	N/A[a]	N/A
	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
		2006	1 (1-1)	0.26
	BRN	2002	7 (7-7)	1.44
		2003	30 (29-31)	9.38
		2004	6 (6-6)	1.88
		2005	N/A	0.0
		2006	11 (11-11)	2.89
	MWF	2002	N/A	0.0
		2003	1 (1-1)	0.31
		2004	N/A	0.0
		2005	N/A	0.0
		2006	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
		2006	16 (16-25)	4.21
	WCT	2002	N/A	0.0
		2003	1 (1-1)	0.31
		2004	N/A	0.0
		2005	N/A	0.0
		2006	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
		2006	2 (2-2)	0.49
	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
		2006	1 (1-1)	0.24
	BRN	2002	1 (1-1)	0.27
		2003	2 (2-2)	0.55
		2004	1 (1-1)	0.27
		2005	N/A	0.0
		2006	18 (18-18)	4.37
	MWF	2002	N/A	0.0
		2003	2 (2-2)	0.55
		2004	N/A	0.0
		2005	N/A	0.0
		2006	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
		2006	36 (36-46)	8.74
	WCT	2002	N/A	0.0
		2003	15 (2-28)	4.09
		2004	2 (2-2)	0.55
		2005	N/A[a]	N/A
		2006	2 (2-2)	0.49

Table 4 continued.

Location	Species	Year	Estimate (95% CI)	N/100m^2
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
		2006	1 (1-1)	0.28
	BRN	2002	N/A	0.0
		2003	N/A	0.0
		2004	N/A	0.0
		2005	N/A	0.0
		2006	37 (37-37)	10.18
	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
		2006	60 (47-189)	16.51
	WCT	2002	N/A	0.0
		2003	35 (33-37)	11.41
		2004	N/A	0.0
		2005	1 (1-1)	0.32
		2006	N/A	0.0

[a]No estimate possible due to non-declining catch pattern. Two bull trout ≥ 75 mm were captured in Section 2 in 2002, Three bull trout ≥ 75 mm were captured in Section 1 in 2004, one westslope cutthroat trout ≥ 75 mm was captured in Section 3 in 2005, and one bull trout ≥ 75 mm was captured in Section 2 in 2006.

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, also 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

To date, the Twin Creek bull trout population has not responded to the improved physical habitat conditions with increased juvenile bull trout densities. Several factors are likely working together preventing this. Although competition and hybridization with exotic species is likely having some impact, it is likely that physical habitat conditions in Twin Creek continue to be favorable to non-native salmonids and unfavorable to bull trout. Peak water temperatures continue to exceed 18^{0}C, and other authors have found an inverse correlation with water temperature and bull trout density (Saffel and Scarnecchia 1995), or a positive correlation with stream elevation (and a negative correlation with water temperature) (Rieman et al. 2006). Thurow (1997) concluded that large, unembeded substrate was important bull trout overwinter habitat. The combination of high summer water temperature and small substrate in the lower reaches of Twin Creek (within the restoration area) are likely primary habitat limiting factors to the bull trout population in Twin Creek. Although maximum summer water temperatures may decline somewhat with vegetative succession, underlying local geology and channel gradient (governing sediment transport and substrate size) are not likely to change in the foreseeable future.

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2006 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 2006 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 Fk. 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 East Fk. Lightning; two in Gold and Rattle). Bull trout *Salvelinus confluentus* were present at widely varying densities in all sections sampled. Rattle Creek supported the highest densities of juvenile bull trout ($\geq$75 mm) observed (16.15/100m^2). In general, the highest densities were estimated in the sections located highest in each tributary, with Gold and the East Fk. Lightning Creek being the notable exception. Westslope cutthroat trout *Oncorhynchus clarkii lewisi* were found in all sections sampled, with the exception of the lowest section in both the East Fk. Lightning Creek and Rattle Creek. Densities of juvenile westslope cutthroat trout ($\geq$75 mm) were highest in Trestle Creek (7.10/100m^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 clarkii lewisi*, as well as mountain whitefish *Prosopium williamsoni*. Significant investments have 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 monitoring to determine project effectiveness. In addition, tributary monitoring provides a way to measure the health of fish populations for general monitoring purposes. By only monitoring adult bull trout populations through redd counts, we may potentially miss important trends in species composition or numbers at the juvenile life stage until they reach a point where they adversely affect the adult stock. For habitat acquisition projects, data will be used to establish 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. 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 Fk. 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 Fk. Lightning Creek drains approximately 53 km^2 of the Cabinet Mountains (Philip Williams and Associates 2004). Three major tributaries to East Fk. 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 Fk. 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 2006. Based on redd counts, spawning escapement in East Fk. 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 Fk. Lightning Creek drainage for future restoration.

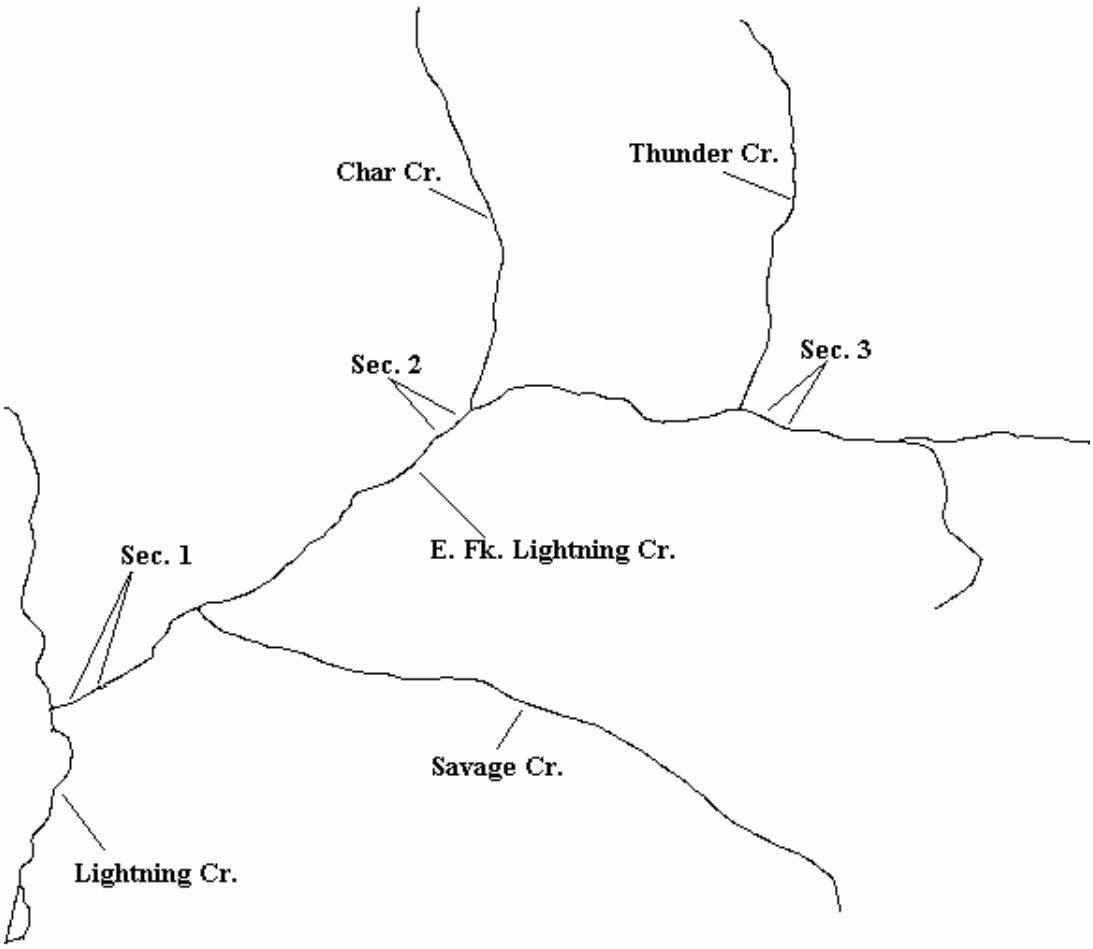

Figure 1. Electrofishing sections on East Fk. Lightning Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, sampled in 2006.

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 128 from 1983 through 2006. 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.

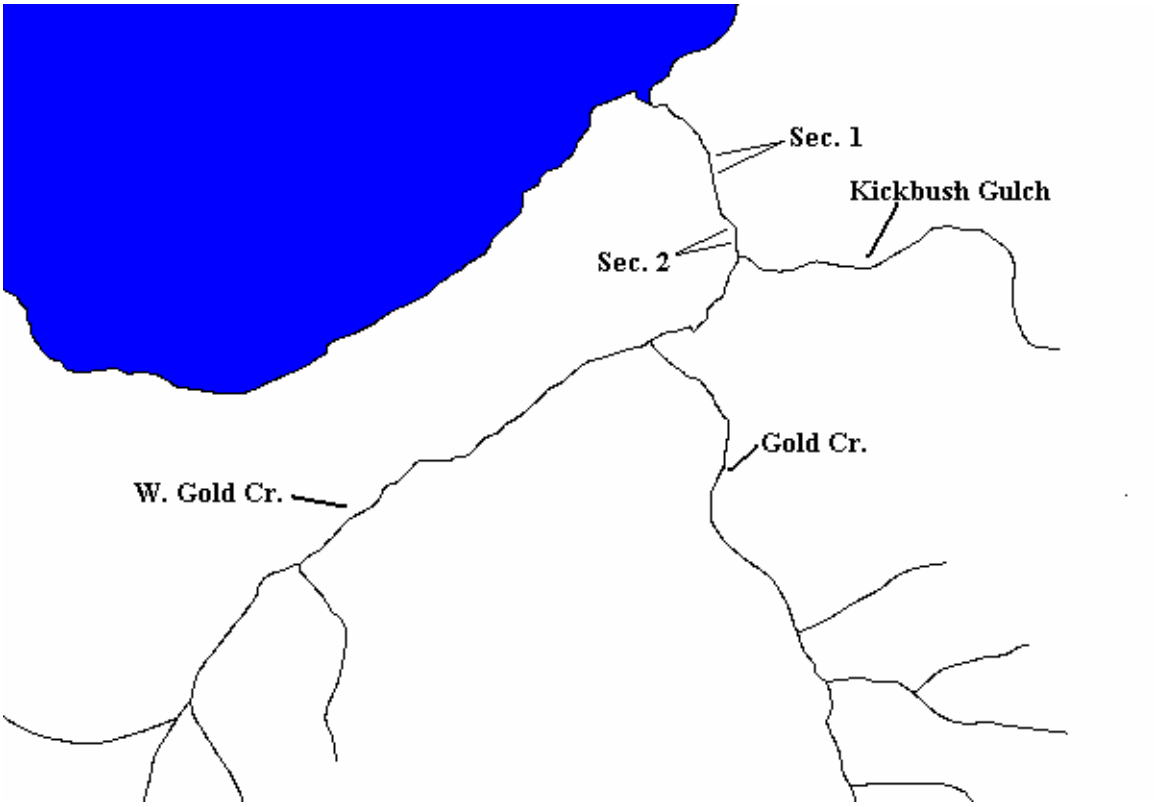

Figure 2. Electrofishing sections on Gold Creek, a tributary to Lake Pend Oreille, Idaho, sampled in 2006.

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 54 annually from 1983 through 2006. 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.

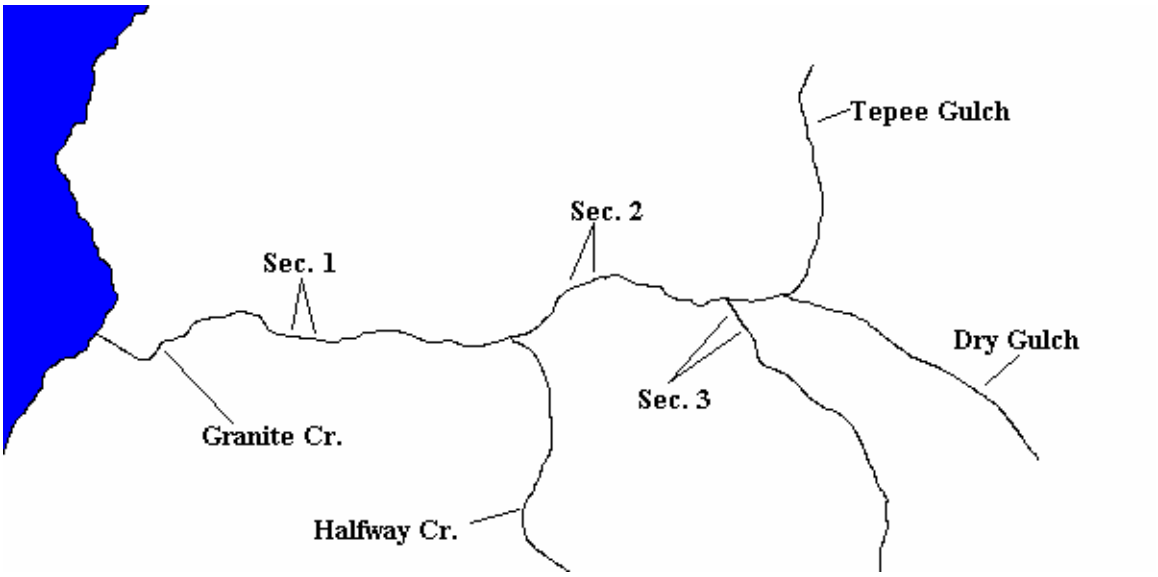

Figure 3. Electrofishing sections on Granite Creek, a tributary to Lake Pend Oreille, Idaho, sampled in 2006.

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 2006. 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. During November, 2006 a significant rain-on-snow event caused substantial damage to the road system within the Lightning Creek watershed, including the lower Rattle Creek Road immediately adjacent to the stream channel, and at this point it is unclear as to what impacts this may have on fish populations.

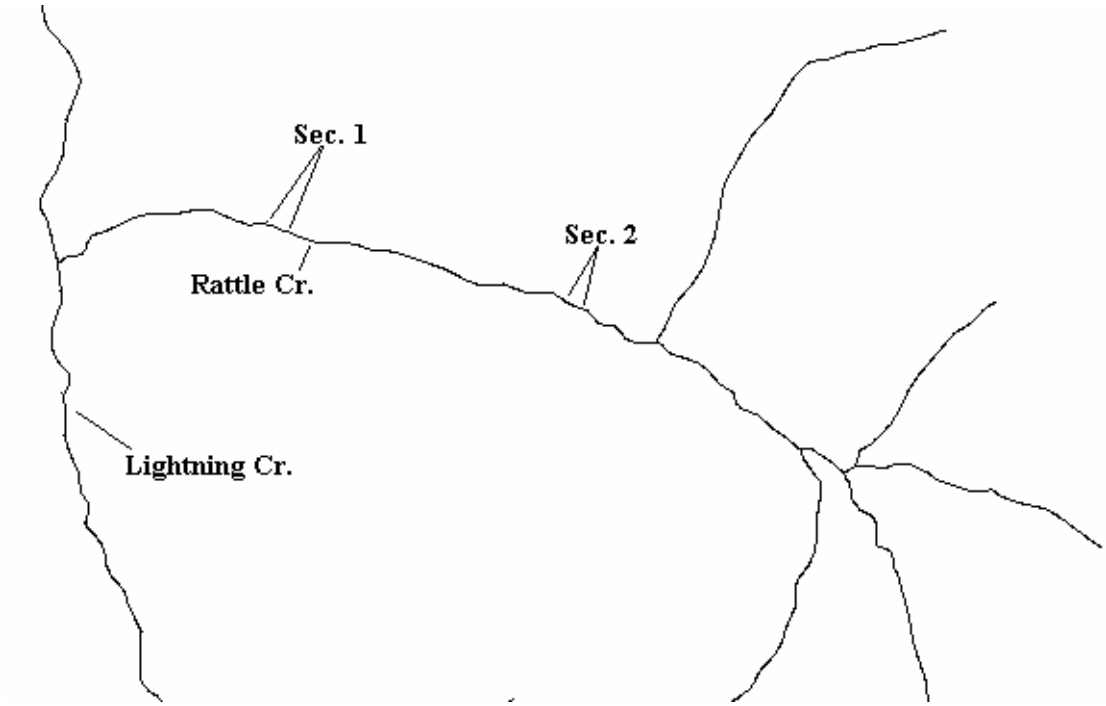

Figure 4. Electrofishing sections on Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, sampled in 2006.

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 254 from 1983 through 2006. 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.

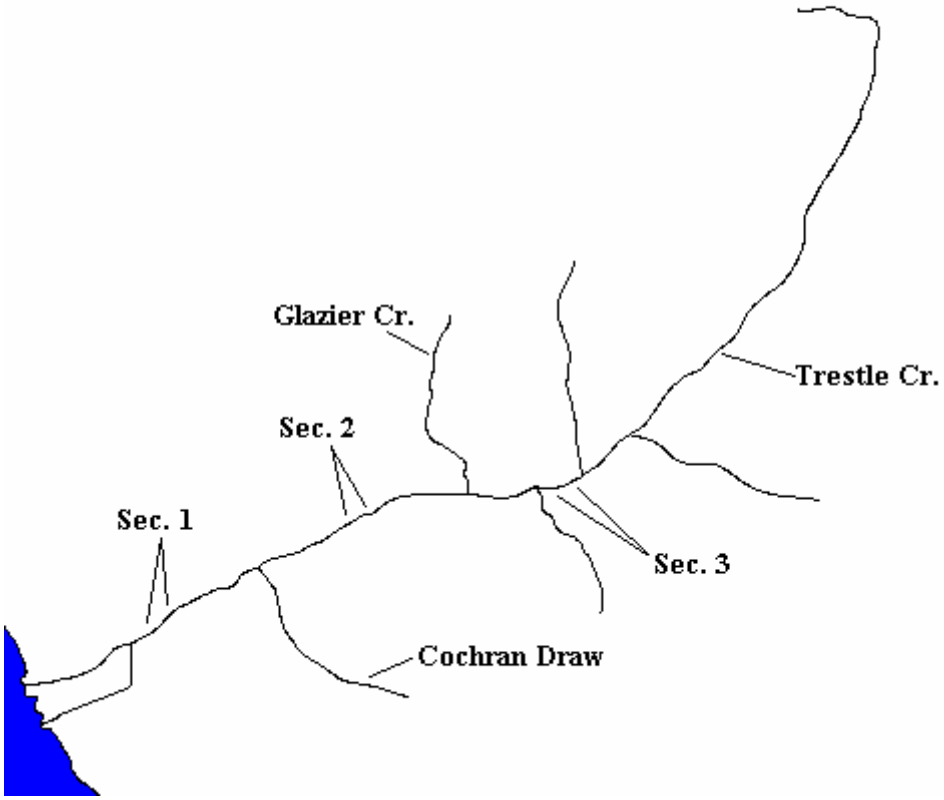

Figure 5. Electrofishing sections on Trestle Creek, a tributary to Lake Pend Oreille, Idaho, sampled in 2006.

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 (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 $\geq$ 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 westslope cutthroat trout from each stream with the exception of Gold Creek, 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 trout and westslope cutthroat trout.

Table 1. Species abbreviations for salmonids captured in the five streams surveyed near Clark Fork, Idaho, during 2006.

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. clarkii lewisi*	WCT
Mountain whitefish *Prosopium williamsoni*	MWF

RESULTS

East Fork Lightning Creek

We captured brook, bull, rainbow and westslope cutthroat trout, as well as westslope cutthroat trout X rainbow trout hybrids (WRHY), in the East Fk. Lightning Creek on July 25, 26, and 27, in 2006. In Section 1, densities ranged from 0.11/100m^2 for brook trout to 13.60/100m^2 for rainbow trout. Bull trout density in Section 1 was 0.32/100m^2. No westslope cutthroat trout were captured in Section 1 (Table 2). In Section 2, we captured bull, rainbow, westslope cutthroat trout, and westslope cutthroat trout X rainbow trout hybrids. Densities ranged from 0.85/100m^2 for westslope cutthroat trout X rainbow trout hybrids to 6.59/100m^2 for rainbow trout. The density for bull trout was 3.04/100m^2, while the density for westslope cutthroat trout was 2.37/100m^2 (Table 2). In Section 3 we captured bull and westslope cutthroat trout. Densities were 2.01/100m^2 for bull trout and 5.64/100m^2 for westslope cutthroat trout (Table 2).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 100.7 mm for rainbow trout to 130 mm for three bull 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 100.4 mm for rainbow trout to 135.4 mm for westslope cutthroat trout (Table 3). Length-frequency histograms for bull, rainbow, westslope cutthroat trout and cutthroat X rainbow trout hybrids indicate multiple age-classes present (Figures 7 and 8). Average size of salmonids $\geq$ 75 mm in Section 3 ranged from 98.4 mm for bull trout to 127.9 mm for westslope cutthroat trout (Table 3). Length-frequency histograms for bull and westslope cutthroat trout indicate the presence of multiple age-classes (Figure 9).

Table 2. Total number captured (all lengths) and population estimates for salmonid species and westslope cutthroat trout X rainbow trout hybrids (WRHY) (≥ 75 mm; TL) captured in the three sections in the East Fk. Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2006.

Location	Species	Total captured	Estimate (95% CI)	N/100m^2	CPUE (fish/minute)
Section 1	BLT	3	3 (3-3)	0.32	0.01
	BRK	1	1 (1-1)	0.11	0.01
	RBT	124	126 (122-139)	13.60	0.90
Section 2	BLT	31	18 (18-18)	3.04	0.22
	RBT	41	39 (39-39)	6.59	0.49
	WCT	15	14 (14-14)	2.37	0.20
	WRHY	5	5 (5-5)	0.85	0.05
Section 3	BLT	9	5 (5-5)	2.01	0.09
	WCT	14	14 (14-14)	5.64	0.38

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 Fk. Lightning Creek, a tributary to Lightning Creek near Clark Fork, Idaho, in 2006.

Location	Species	Mean length (mm) (S.D.) (n)	Length range	Mean weight (g) (S.D.) (n)
Section 1	BLT	130.0 (37.2) (3)	101-172	23.0 (19.2) (3)
	BRK	112.0 (N/A) (1)	N/A	14.0 (N/A) (1)
	RBT	100.7 (20.7) (119)	67-181	12.4 (10.1) (119)
Section 2	BLT	113.2 (25.6) (18)	35-180	14.7 (10.3) (18)
	RBT	100.4 (28.5) (39)	68-231	13.2 (19.6) (39)
	WCT	135.4 (44.0) (14)	71-188	32.3 (25.0) (14)
	WRHY	103.0 (25.5) (5)	85-144	12.0 (8.7) (5)
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)

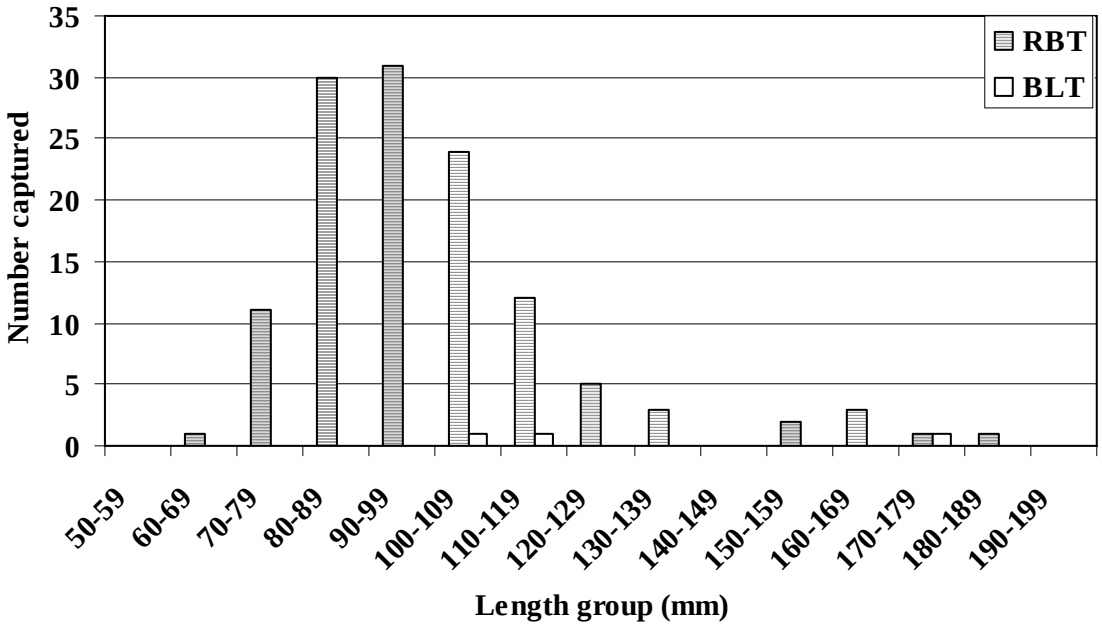

Figure 6. Length frequency histograms for all bull trout (n = 3) and rainbow trout (n = 124) captured in Section 1, East Fk. Lightning Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2006.

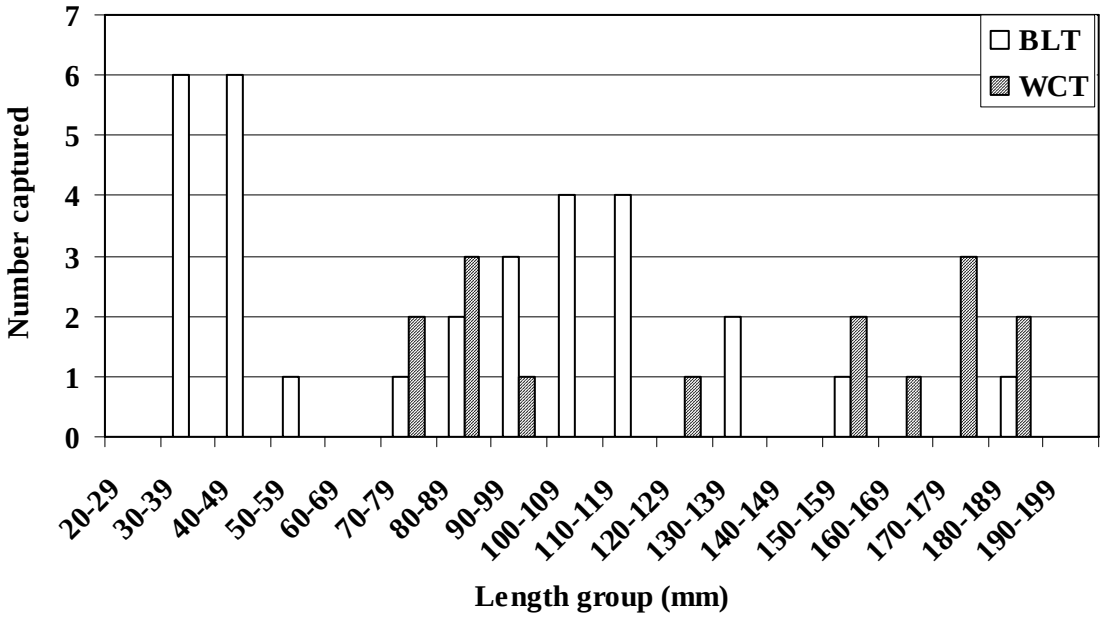

Figure 7. Length frequency histograms for all bull trout (n = 31) and westslope cutthroat trout (n = 15) captured in Section 2, East Fk. Lightning Creek, a tributary to Lightning Creek, near Clark Fork Idaho, in 2006.

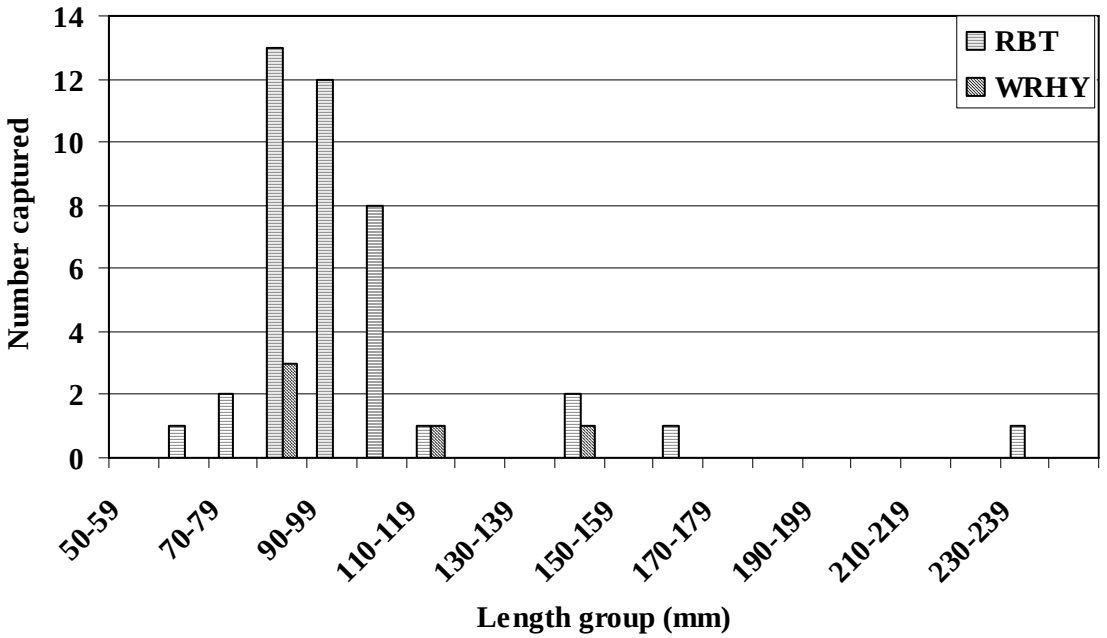

Figure 8. Length frequency histograms for all rainbow trout (n = 41) and westslope cutthroat trout X rainbow trout hybrids (n = 5) captured in Section 2, East Fk. Lightning Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2006.

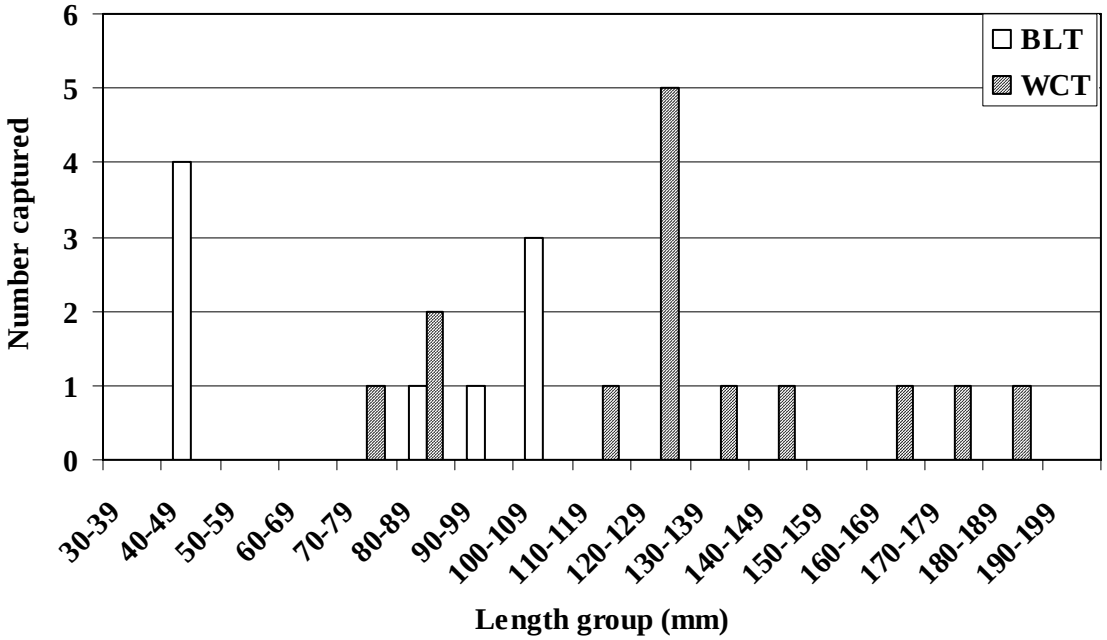

Figure 9. Length frequency histograms for all bull trout (n = 9) and westslope cutthroat trout (n = 14) captured in Section 3, East Fk. Lightning Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2006.

Gold Creek

We captured bull and westslope cutthroat trout in Gold Creek on July 12 and 13, 2006. In Section 1, bull trout had the highest density (15.00/100m^2), while the density for westslope cutthroat trout was 1.80/100m^2 (Table 4). In Section 2, bull trout also had the highest density (8.59/100m^2), while the density for westslope cutthroat trout was 1.43/100m^2 (Table 4).

Average size of salmonids ≥ 75 mm in Section 1 ranged from 122.6 mm for bull trout to 146.7 mm for westslope cutthroat trout (Table 5). Length-frequency histograms from Section 1 indicate the presence of multiple age-classes of both bull and westslope cutthroat trout (Figure 10). In Section 2, average size of salmonids ≥ 75 mm ranged from 121.3 mm for bull trout to 127.7 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 (≥ 75 mm; TL) captured in the two sections in Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

Location	Species	Total captured	Estimate (95% CI)	N/100m^2	CPUE (fish/minute)
Section 1	BLT[a]	98	100 (99-107)	15.00	1.03
	WCT	12	12 (12-12)	1.80	0.14
Section 2	BLT[a]	52	54 (53-63)	8.59	0.66
	WCT	10	9 (9-9)	1.43	0.15

[a]No attempt made to net bull trout fry.

Table 5. 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 Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

Location	Species	Mean length (mm) (S.D.) (n)	Length range	Mean weight (g) (S.D.) (n)
Section 1	BLT[a]	122.6 (20.0) (98)	87-193	18.0 (9.4) (98)
	WCT	146.7 (62.9) (12)	75-240	50.8 (50.9) (12)
Section 2	BLT[a]	121.3 (15.4) (52)	88-180	17.4 (7.5) (52)
	WCT	127.7 (53.7) (9)	68-210	33.6 (38.6) (9)

[a]No attempt made to net bull trout fry.

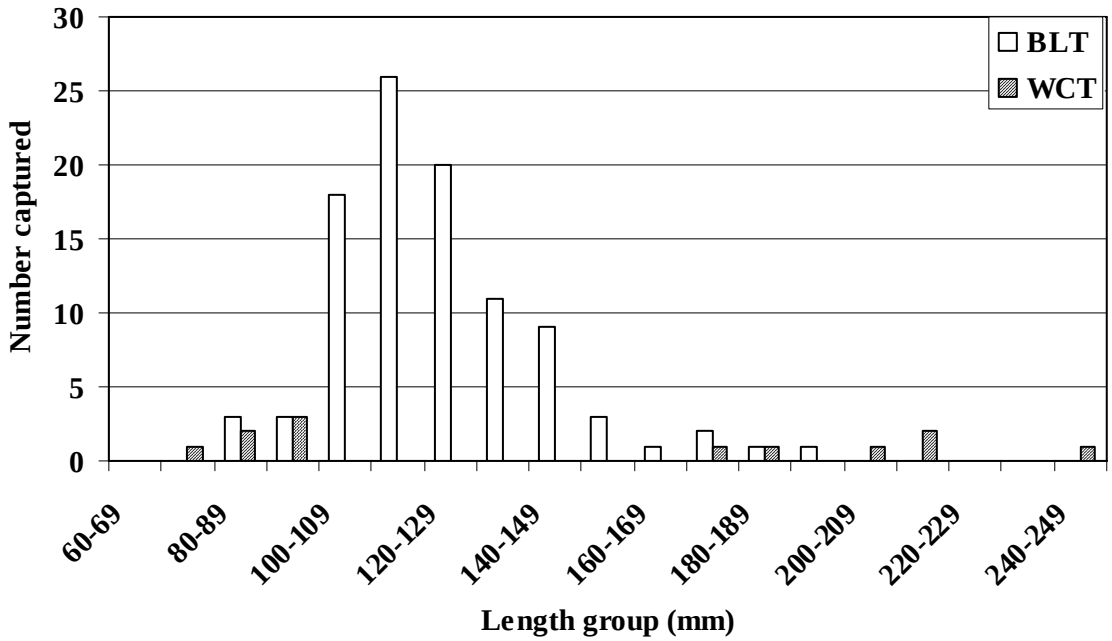

Figure 10. Length frequency histograms for bull trout ≥ 75 mm (n = 98) and all westslope cutthroat trout (n = 12) captured in Section 1, Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

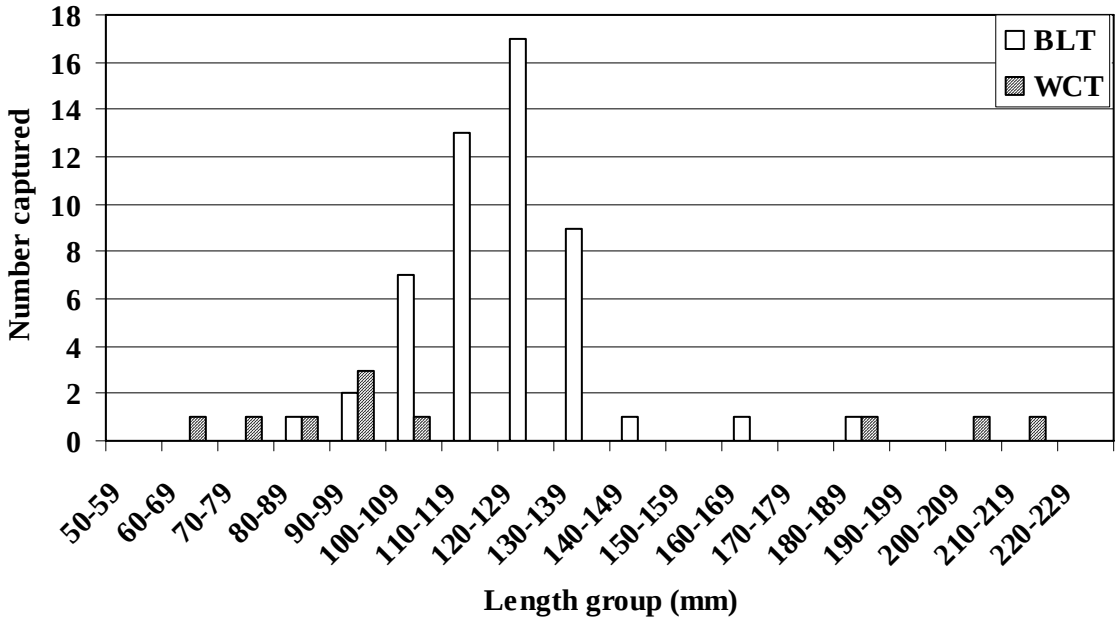

Figure 11. Length frequency histograms for bull trout ≥ 75 mm (n = 52) and all westslope cutthroat trout (n = 10) captured in Section 2, Gold Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

Granite Creek

We captured bull, rainbow, and westslope cutthroat trout, as well as a single westslope cutthroat trout X rainbow trout hybrid in Granite Creek on July 14, 19 and 20, 2006. In Section 1, westslope cutthroat trout had the highest density (5.21/100m^2), while the density for bull trout was 2.72/100m^2 (Table 6). In Section 2, the density for bull trout was 3.10/100m^2, while it was 3.98/100m^2 for westslope cutthroat trout (Table 6). In Section 3, the density for bull trout was the highest of all three sections, (8.42/100m^2), while the density for westslope cutthroat trout was (4.53/100m^2) (Table 6).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 108.7 mm for westslope cutthroat trout to 243.0 mm for a single westslope cutthroat trout X rainbow trout hybrid (Table 7). Length-frequency histograms from Section 1 indicate multiple age-classes present for both bull trout and westslope cutthroat trout (Figure 12). In Section 2, average size of salmonids $\geq$ 75 mm ranged from 127.1 mm for bull trout to 133.7 mm for westslope cutthroat 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 108.7 mm for westslope cutthroat trout to 125.7 mm for bull trout (Table 7). The length-frequency histograms from Section 3 indicate multiple age-classes present for bull trout and westslope cutthroat trout (Figure 14).

Table 6. Total number captured (all lengths) and population estimates for salmonid species and westslope cutthroat trout X rainbow trout hybrids (WRHY) ($\geq$ 75 mm; TL) captured in the three sections in Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/minute)**
Section 1	BLT[a]	12	12 (12-12)	2.72	0.22
	RBT	2	2 (2-2)	0.45	0.02
	WCT	23	23 (23-23)	5.21	0.38
	WRHY	1	1 (1-1)	0.23	0.02
Section 2	BLT	27	21 (21-23)	3.10	0.29
	WCT	29	27 (27-29)	3.98	0.40
Section 3	BLT	39	39 (39-39)	8.42	0.58
	WCT	26	21 (21-31)	4.53	0.22

[a]No attempt made to net bull trout fry.

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 2006.

Location	Species	Mean length (mm) (S.D.) (n)	Length range	Mean weight (g) (S.D.) (n)
Section 1	BLT[a]	149.7 (26.6) (12)	123-205	33.3 (18.6) (12)
	RBT	112.5 (17.7) (2)	100-125	14.0 (8.5) (2)
	WCT	108.7 (14.8) (23)	85-133	14.0 (5.8) (23)
	WRHY	243.0 (N/A) (1)	N/A	37.0 (N/A) (1)
Section 2	BLT	127.1 (24.5) (21)	44-199	20.3 (13.6) (21)
	WCT	133.7 (56.6) (27)	62-284	36.9 (49.0) (27)
Section 3	BLT	125.7 (31.4) (39)	89-197	21.4 (16.8) (39)
	WCT	108.7 (41.9) (20)	58-198	17.9 (21.4) (20)

[a]No attempt made to net bull trout fry.

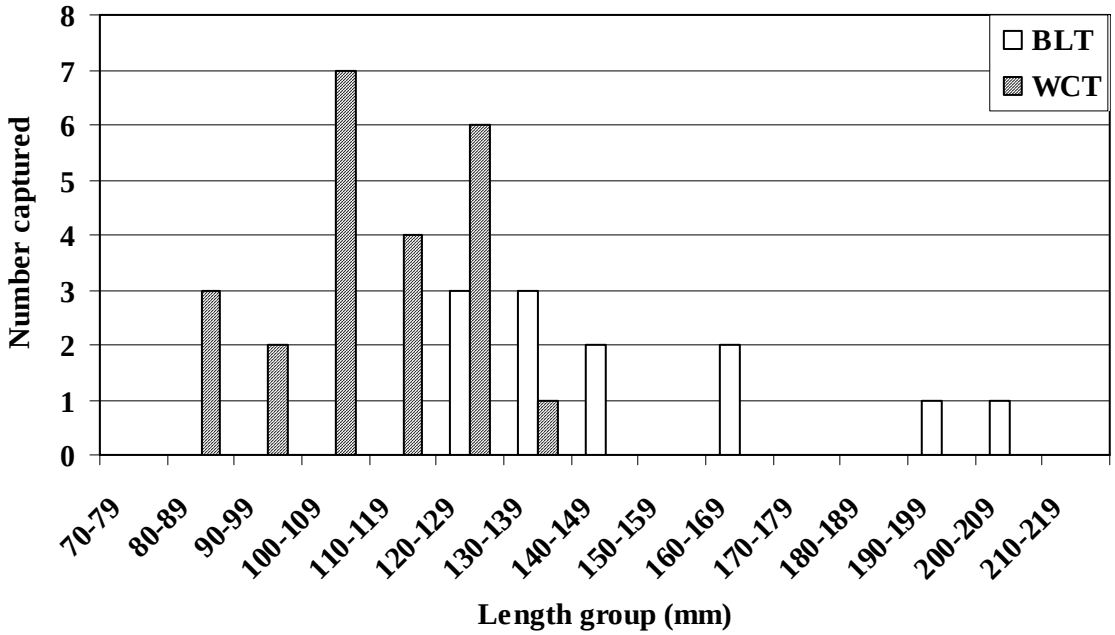

Figure 12. Length frequency histograms for bull trout ≥ 75 mm (n = 12) and all westslope cutthroat trout (n = 23) captured in Section 1, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

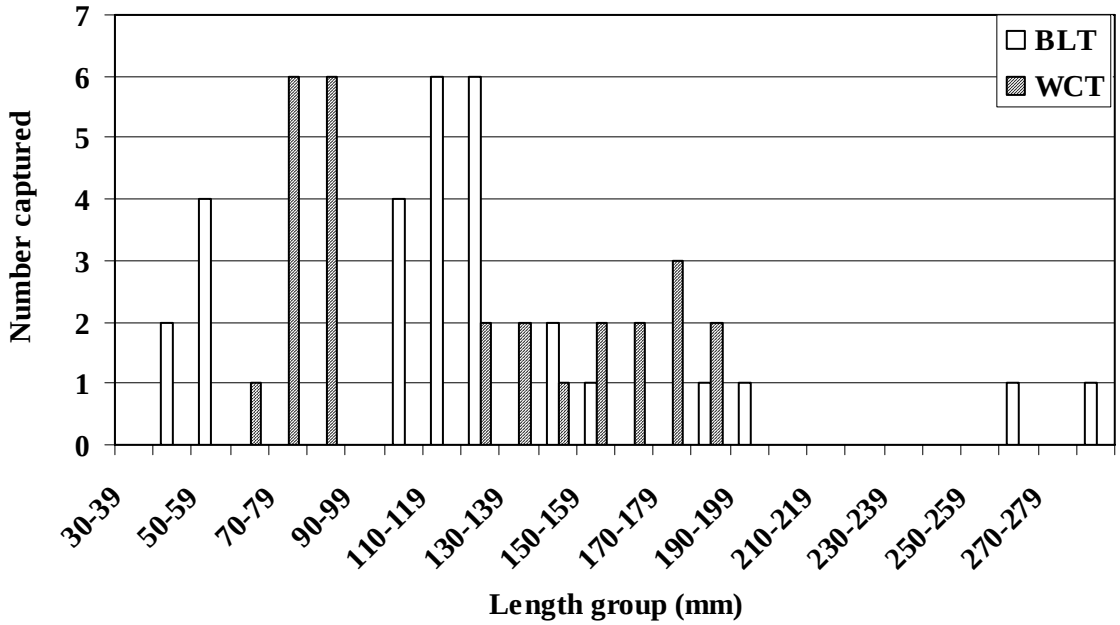

Figure 13. Length frequency histograms for all bull trout (n = 27) and westslope cutthroat trout (n = 29) captured in Section 2, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

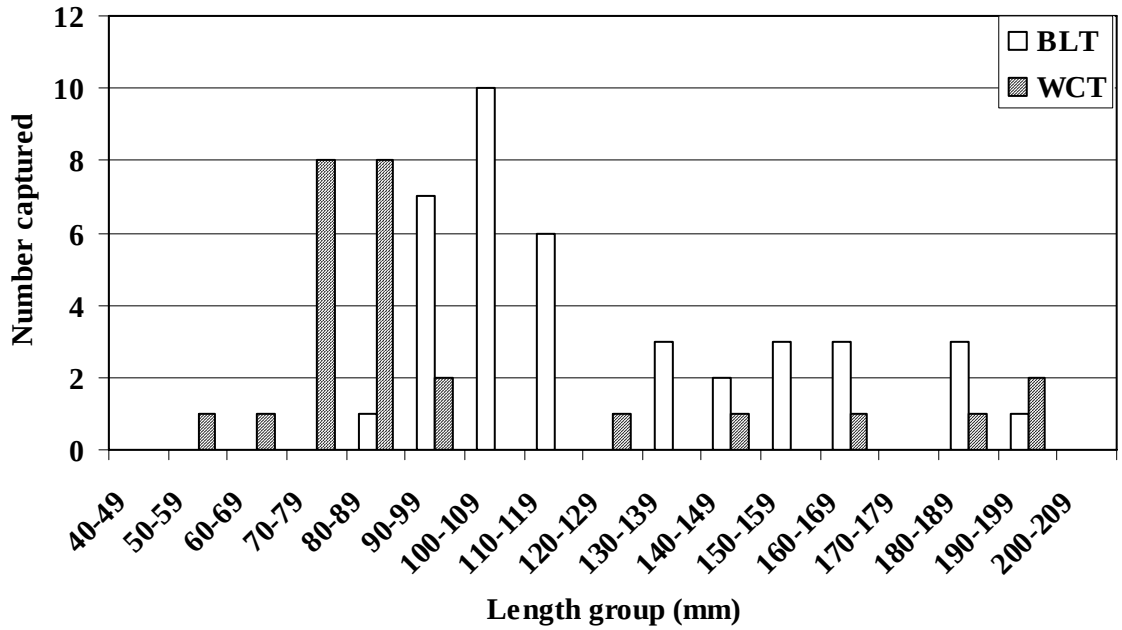

Figure 14. Length frequency histograms for all bull trout (n = 39) and westslope cutthroat trout (n = 26) captured in Section 3, Granite Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

Rattle Creek

We captured bull, rainbow and westslope cutthroat trout, in addition to westslope cutthroat trout X rainbow trout hybrids, in Rattle Creek on July 21 and 24, 2006. In Section 1, bull trout had the highest density (5.24/100m^2), while the density for rainbow trout was (3.21/100m^2). No westslope cutthroat trout were captured in Section 1 (Table 8). In Section 2, bull trout had the highest density (16.15/100m^2) across all streams and sections, while westslope cutthroat trout X rainbow trout hybrids had the lowest (0.38/100m^2). The density for westslope cutthroat trout could not be determined due to a non-declining catch pattern, although three $\geq$ 75 mm were captured (Table 8).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 108.7 mm for bull trout to 127.9 mm for rainbow trout (Table 9). Length-frequency histograms from Section 1 indicate the presence of multiple age-classes for both bull trout and rainbow trout (Figure 15). In Section 2, average size of salmonids $\geq$ 75 mm ranged from 92.9 mm for bull trout to 146.5 mm for two westslope cutthroat trout X rainbow trout hybrids. The average length for westslope cutthroat trout was 108.0 mm (Table 9). Length-frequency histograms from Section 2 indicate the presence of multiple age-classes for bull trout, westslope cutthroat, and rainbow trout (Figures 16 and 17).

Table 8. Total number captured (all lengths) and population estimates for salmonid species and westslope cutthroat trout X rainbow trout hybrids (WRHY) ($\geq$ 75 mm; TL) captured in the two sections in Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2006.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/minute)**
Section 1	BLT	28	31 (29-46)	5.24	0.28
	RBT	22	19 (19-19)	3.21	0.26
Section 2	BLT	88	84 (84-91)	16.15	0.78
	RBT	12	6 (6-6)	1.15	0.06
	WCT	5	N/A[a]	N/A	0.01
	WRHY	2	2 (2-2)	0.38	0.03

[a]No estimate possible. Three westslope cutthroat trout $\geq$ 75 mm were 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 2006.

Location	Species	Mean length (mm) (S.D.) (n)	Length range	Mean weight (g) (S.D.) (n)
Section 1	BLT	108.7 (23.7) (28)	83-155	12.8 (8.2) (28)
	RBT	127.9 (63.6) (19)	63-310	42.9 (81.4) (19)
Section 2	BLT	92.9 (23.5) (83)	69-190	8.7 (8.8) (83)
	RBT	107.3 (31.5) (6)	63-138	15.2 (11.2) (6)
	WCT	108.0 (13.5) (3)	68-121	13.0 (5.0) (3)
	WRHY	146.5 (4.9) (2)	143-150	32.0 (2.8) (2)

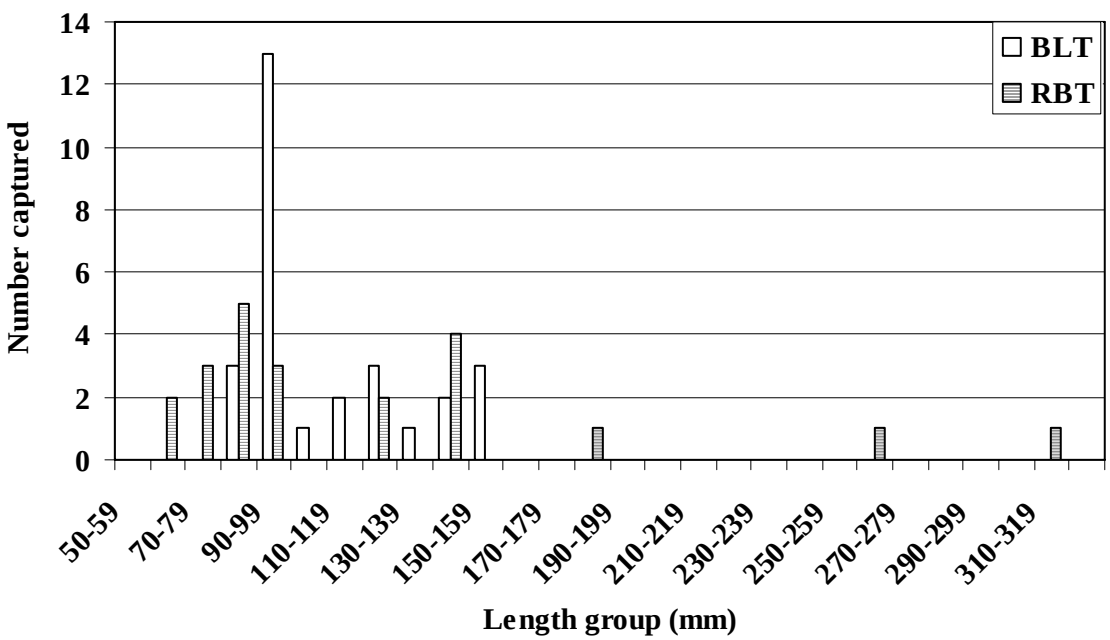

Figure 15. Length frequency histograms for all bull trout (n = 28) and rainbow trout (n = 22) captured in Section 1, Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2006.

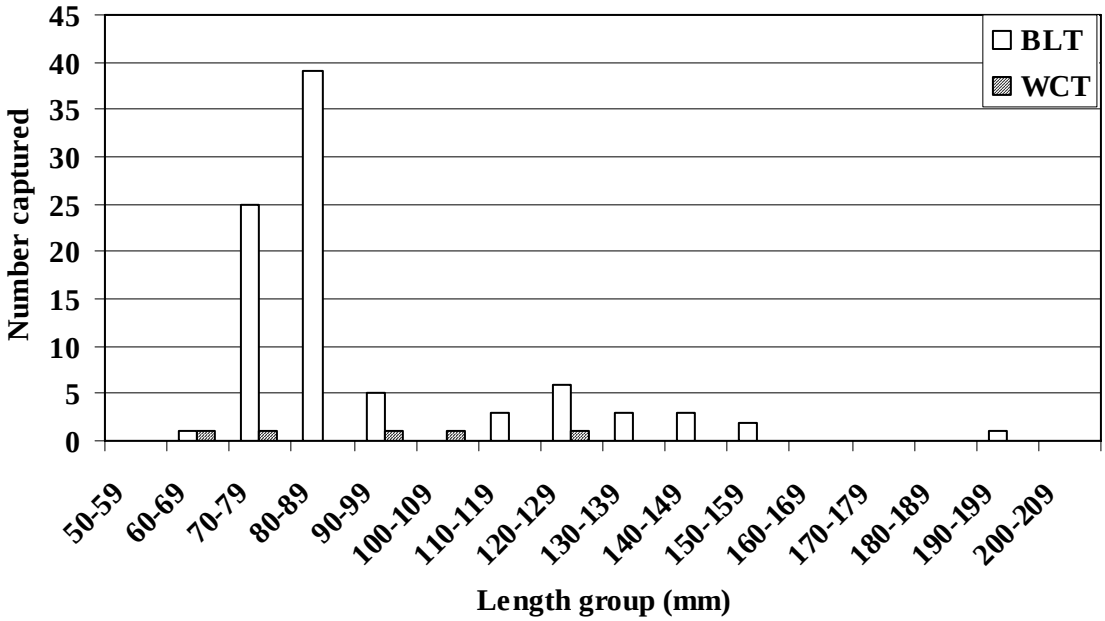

Figure 16. Length frequency histograms for all bull trout (n = 88) and westslope cutthroat trout (n = 5) captured in Section 2, Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2006.

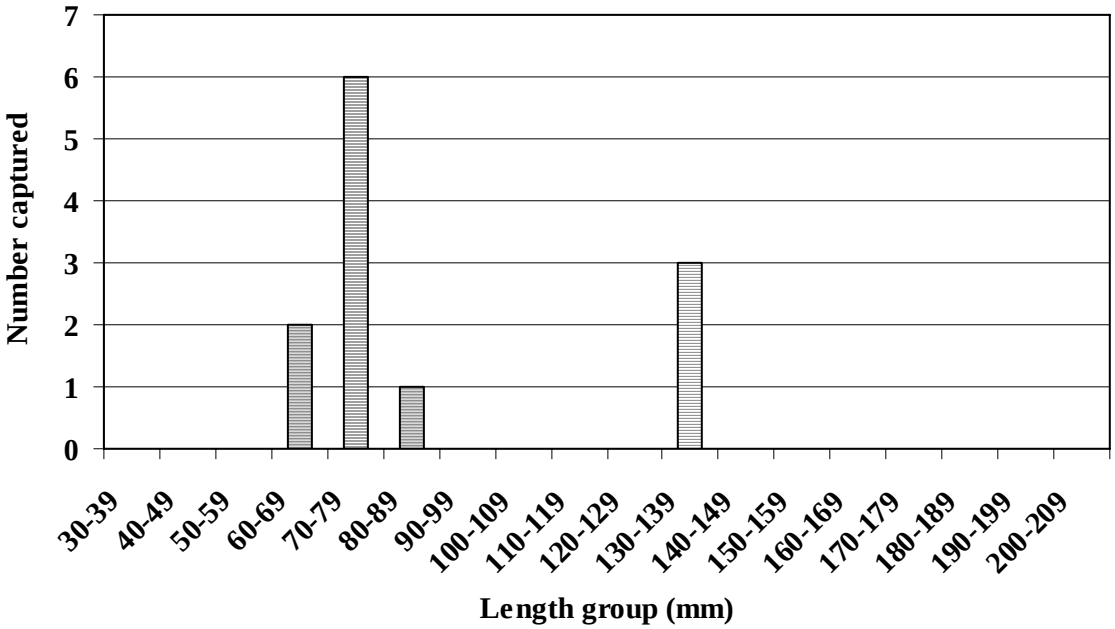

Figure 17. Length frequency histogram for all rainbow trout (n = 12) captured in Section 2, Rattle Creek, a tributary to Lightning Creek, near Clark Fork, Idaho, in 2006.

Trestle Creek

We captured mountain whitefish, as well as bull, brown, rainbow, and westslope cutthroat trout in Trestle Creek on July 31, and August 1 and 2 in 2006. In Section 1, westslope cutthroat trout had the highest density (4.20/100m^2), while both brown trout and rainbow trout shared the lowest (0.16/100m^2) (Table 10). In Section 2, the density for westslope cutthroat trout was 7.10/100m^2, while the density for bull trout was 0.73/100m^2 (Table 10). In Section 3, bull trout had the highest density (13.80/100m^2), while the density for westslope cutthroat trout was 1.84/100m^2 (Table 10).

Average size of salmonids $\geq$ 75 mm in Section 1 ranged from 119.4 mm for westslope cutthroat trout to 172.6 mm for mountain whitefish. The average length for bull trout in Section 1 was 133.0 mm (Table 11). Length-frequency histograms from Section 1 for bull trout and westslope cutthroat trout indicate multiple age-classes present, while the length-frequency histogram for mountain whitefish indicates the presence of likely a single age-class (Figures 18 and 19). In Section 2, average size of salmonids $\geq$ 75 mm ranged from 107.6 mm for westslope cutthroat trout, to 165.5 mm for bull trout (Table 11). Length-frequency histograms for bull trout and westslope cutthroat trout from Section 2 indicate multiple age-classes present (Figure 20). Average size of salmonids $\geq$ 75 mm in Section 3 ranged from 110.1 mm for bull trout to 115.6 mm for westslope cutthroat trout (Table 11). Length-frequency histograms from Section 3 indicate multiple age-classes present (Figure 21).

Table 10. Total number captured (all lengths) and population estimates for salmonid species ($\geq$ 75 mm; TL) captured in the three sections in Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

Location	**Species**	**Total captured**	**Estimate (95% CI)**	**N/100m^2**	**CPUE (fish/minute)**
Section 1	BLT	33	1 (1-1)	0.16	0.02
	BRN	1	1 (1-1)	0.16	0.02
	MWF	5	5 (5-5)	0.78	0.05
	RBT	1	1 (1-1)	0.16	0.02
	WCT	27	27 (27-27)	4.20	0.33
Section 2	BLT	12	4 (4-4)	0.73	0.07
	WCT	39	39 (39-41)	7.10	0.63
Section 3	BLT	62	60 (60-68)	13.80	0.98
	WCT	11	8 (8-8)	1.84	0.14

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 2006.

Location	Species	Mean length (mm) (S.D.) (n)	Length range	Mean weight (g) (S.D.) (n)
Section 1	BLT	133.0 (N/A) (1)	33-133	22.0 (N/A) (1)
	BRN	165.0 (N/A) (1)	N/A	39.0 (N/A) (1)
	MWF	172.6 (7.2) (5)	167-185	40.6 (6.3) (5)
	RBT	140.0 (N/A) (1)	N/A	23.0 (N/A) (1)
	WCT	119.4 (40.9) (27)	76-259	24.7 (37.4) (27)
Section 2	BLT	165.5 (9.3) (4)	38-172	37.3 (5.5) (4)
	WCT	107.6 (32.4) (39)	75-190	15.8 (15.7) (39)
Section 3	BLT	110.1 (25.0) (59)	40-170	13.4 (9.2) (59)
	WCT	115.6 (46.2) (8)	69-191	22.9 (27.9) (8)

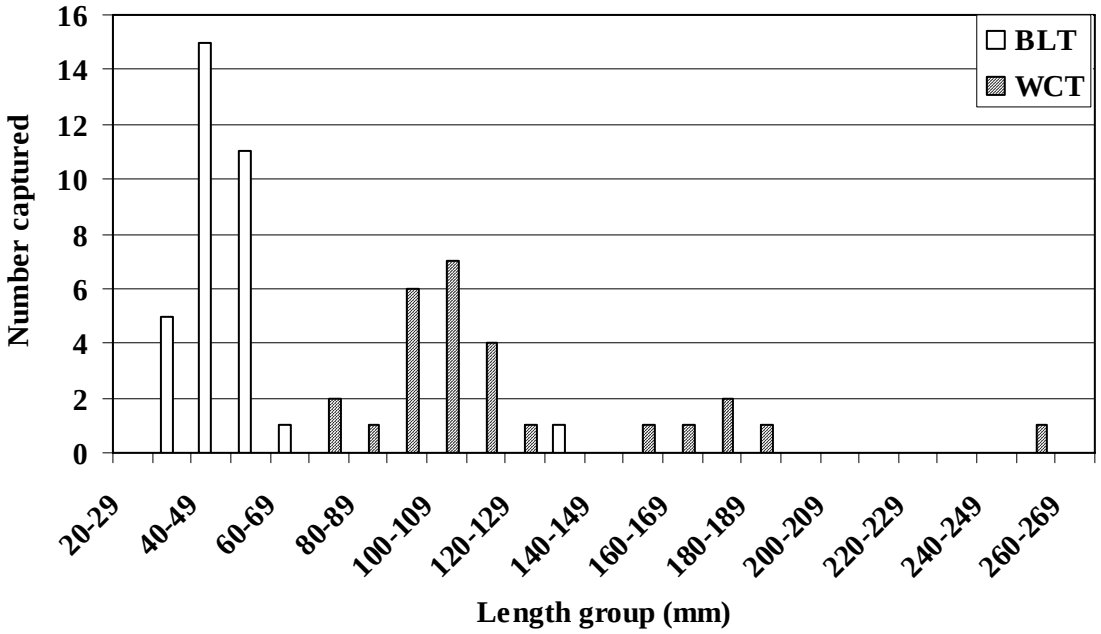

Figure 18. Length frequency histograms for all bull trout (n = 33) and westslope cutthroat trout (n = 27) captured in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

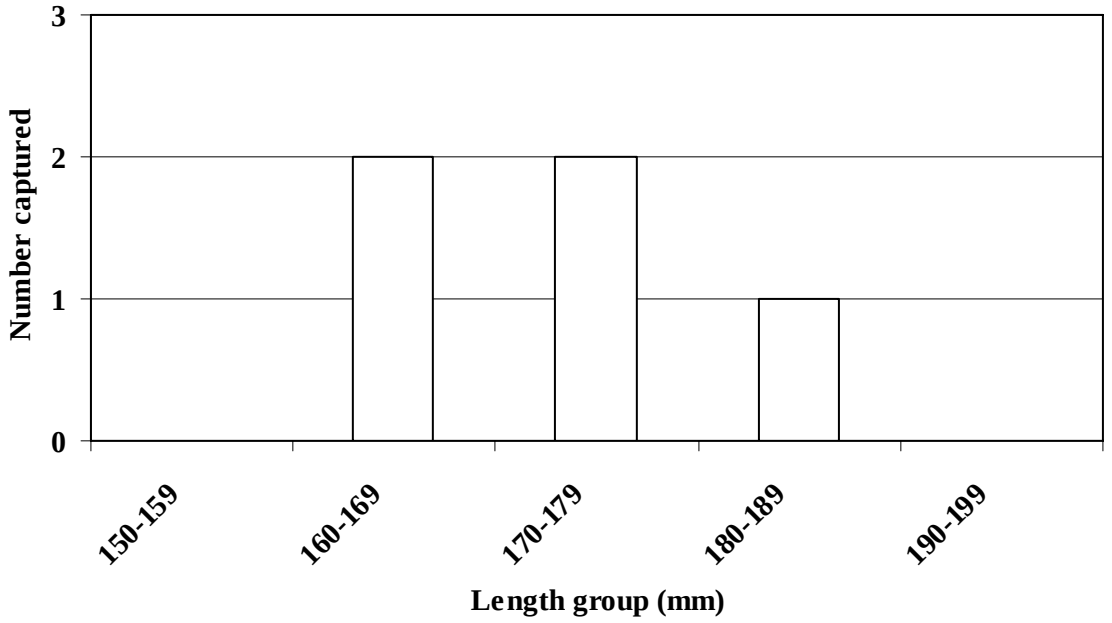

Figure 19. Length frequency histogram for all mountain whitefish (n = 5) captured in Section 1, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

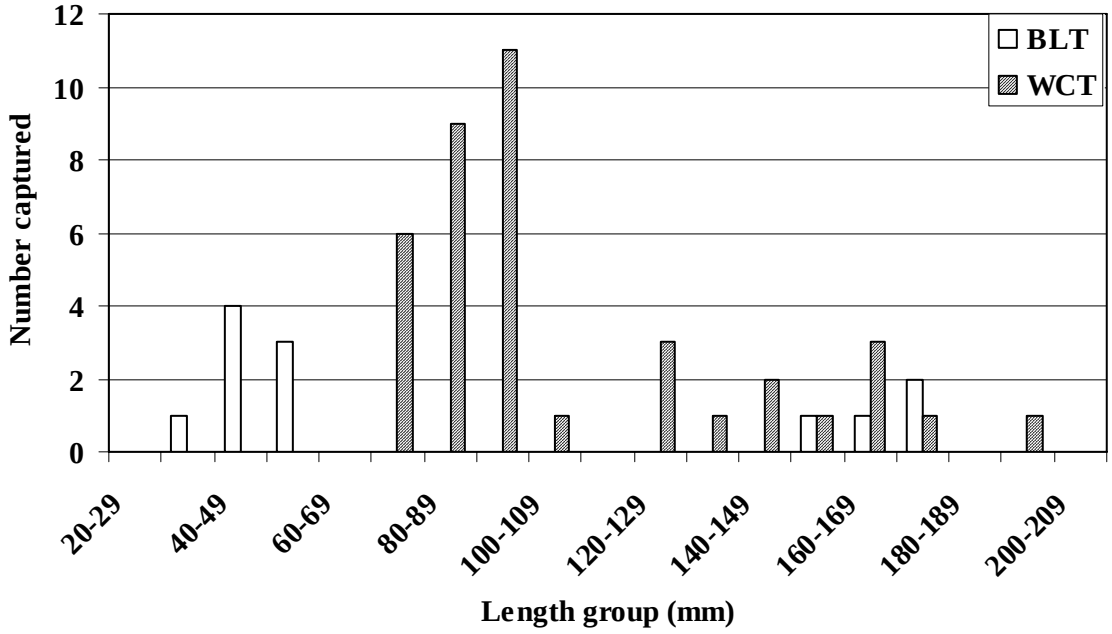

Figure 20. Length frequency histograms for all bull trout (n = 12) and westslope cutthroat trout (n = 39) captured in Section 2, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

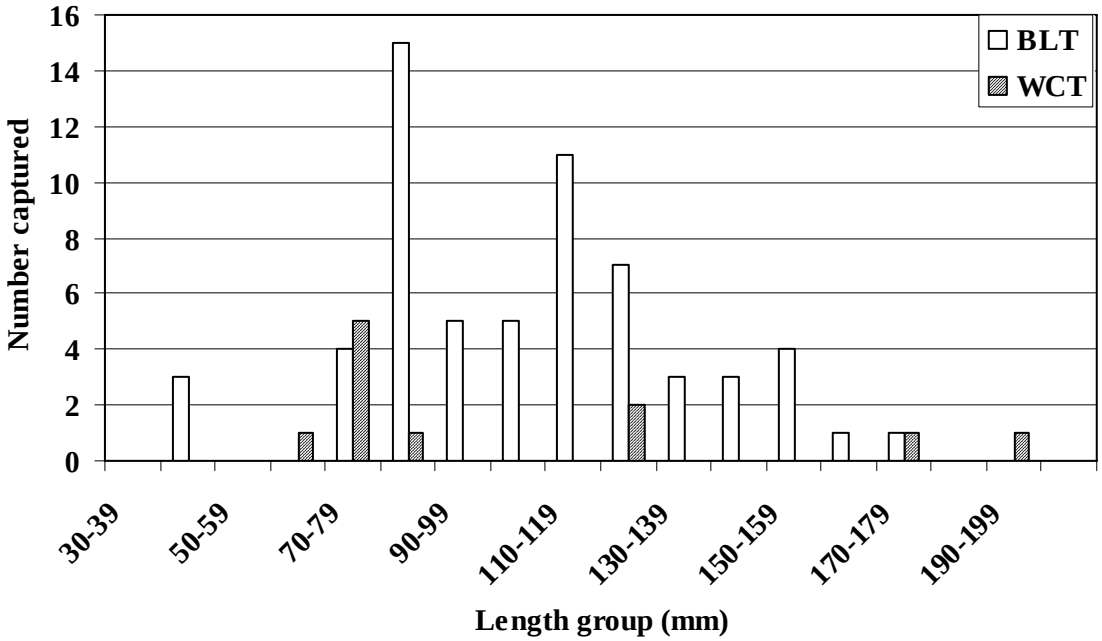

Figure 21. Length frequency histograms for all bull trout (n = 62) and westslope cutthroat trout (n = 11) captured in Section 3, Trestle Creek, a tributary to Lake Pend Oreille, Idaho, in 2006.

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 conduct 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 trout and westslope cutthroat trout were present in all streams sampled, and bull trout were found in all sections sampled. Juvenile mountain whitefish were only captured in the lower reaches of Trestle Creek. Across most streams sampled, native species (bull trout and westslope cutthroat trout) were the only species captured in the upper-most sampling sites, with the notable exception of rainbow trout in Rattle Creek. The highest juvenile ($\geq$ 75 mm) bull trout densities observed were found in Rattle Creek (16.15/100m^2), but Gold Creek had a density of 15.00/100m^2, while Trestle Creek supported a juvenile bull trout density of 13.80/100m^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 above 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.

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. Bull trout redd counts appear adequate to fully seed Trestle Creek rearing habitat. Therefore, it is likely that the lower and middle reaches of Trestle Creek are not providing optimal habitat conditions for juvenile bull trout. Likely causes 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. Although differences existed among years for individual sample sites, the decline in juvenile bull trout observed in both Sections 1 and 2 appear to be biologically significant. In Section 2, from 2004 to 2005, estimated numbers dropped from 15 to 4/100m^2. In 2006, estimated numbers for Section 2 remained unchanged at 4/100m^2. In 2006, this downward trend was also observed in Section 1, with estimated numbers dropping from 7/100m^2 in 2005, to 1/100m^2 in 2006. 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.

Estimates and associated densities for westslope cutthroat trout in both Sections 1 and 2 remained relatively high (27 and 39/100m^2, respectively) in 2006. However, a significant decline was observed in Section 1 between 2005 and 2006, with estimated numbers dropping from 47/100m^2 in 2005, to 27/100m^2 in 2006. This number does however, compare well with the 31/100m^2 estimated in 2004. Due to a non-declining catch pattern for the Section 2 of Trestle Creek in 2005, a direct comparison of estimated numbers between 2005 and 2006 is not possible. But, when we look at overall numbers captured within this section across the three study years (50 total captured $\geq$ 75 mm in 2004; 55 total captured $\geq$ 75 mm in 2005; 39 total captured $\geq$ 75 mm in 2006), we see that a decline in catch was also observed in Section 2 in 2006.

Trestle Creek is known to support an adfluvial population of westslope cutthroat trout (Downs and Jakubowski 2003), in addition to Twin and the East Fork Lightning Creek. 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).

Introduced species (primarily rainbow trout) were most abundant in the lower sampling sites, and were captured in all but Gold Creek. In Granite Creek, a total of two rainbow trout were captured in the lowest section. Although no brook trout have been captured in Granite Creek, several bull trout X brook trout hybrids (genetically tested) were collected in Granite Creek in 2005, 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 one individual was captured in lower E. Fk. Lightning Creek and none in Rattle Creek. In Trestle Creek in 2006, a single rainbow trout and brown trout *Salmo trutta* were captured in the lowest section. A single brown trout and brook trout were also captured in a screw trap on Trestle Creek in 2002 (Downs and Jakubowski 2003).

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2006 Lower Clark Fork River Westslope Cutthroat Trout Radio Telemetry and Genetic Study
Final Report

ABSTRACT

We completed a genetics and movement study of westslope cutthroat trout *Oncorhynchus clarkii lewisi* (WCT) in the Clark Fork River in Idaho during 2005 and 2006. The primary objectives of the study were to 1) evaluate genetic composition of WCT in the Clark Fork River below Cabinet Gorge Dam, 2) to determine movement patterns in the Clark Fork River as they may pertain to fish passage needs, and 3) identify spawning areas for migratory WCT in Idaho. We collected fish tissue samples from 57 WCT visually assessed as "pure" in the Clark Fork River in 2005. Of these, 50 did not show evidence of hybridization with rainbow trout *Oncorhynchus mykiss*. Of the 40 adult-sized WCT radio-tagged in the Clark Fork River in 2005 and 2006, 12 made upstream migrations to the Cabinet Gorge Dam tailrace area during the expected upstream migration period (March-May), while one other moved into the same area in early July. Four others migrated into the lower (meathole-point area) portion of the tailrace, but not into the upper portion (directly out from the generating units) during the April-early June time-period. It appears genetically pure WCT persist in the Clark Fork River and some of those are likely from tributaries upstream of Cabinet Gorge Dam. 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.

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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 clarkii 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 was 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 was 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

Determine if a migratory component of westslope cutthroat trout persists in the lower Clark Fork River in Idaho, and evaluate movement patterns and genetic composition relative to any future fish passage efforts at Cabinet Gorge Dam.

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 Clark Fork River and 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 Albeni 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 *Oncorhynchus mykiss* 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 11 in 2006), 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 died (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 2.8%, but the majority 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).

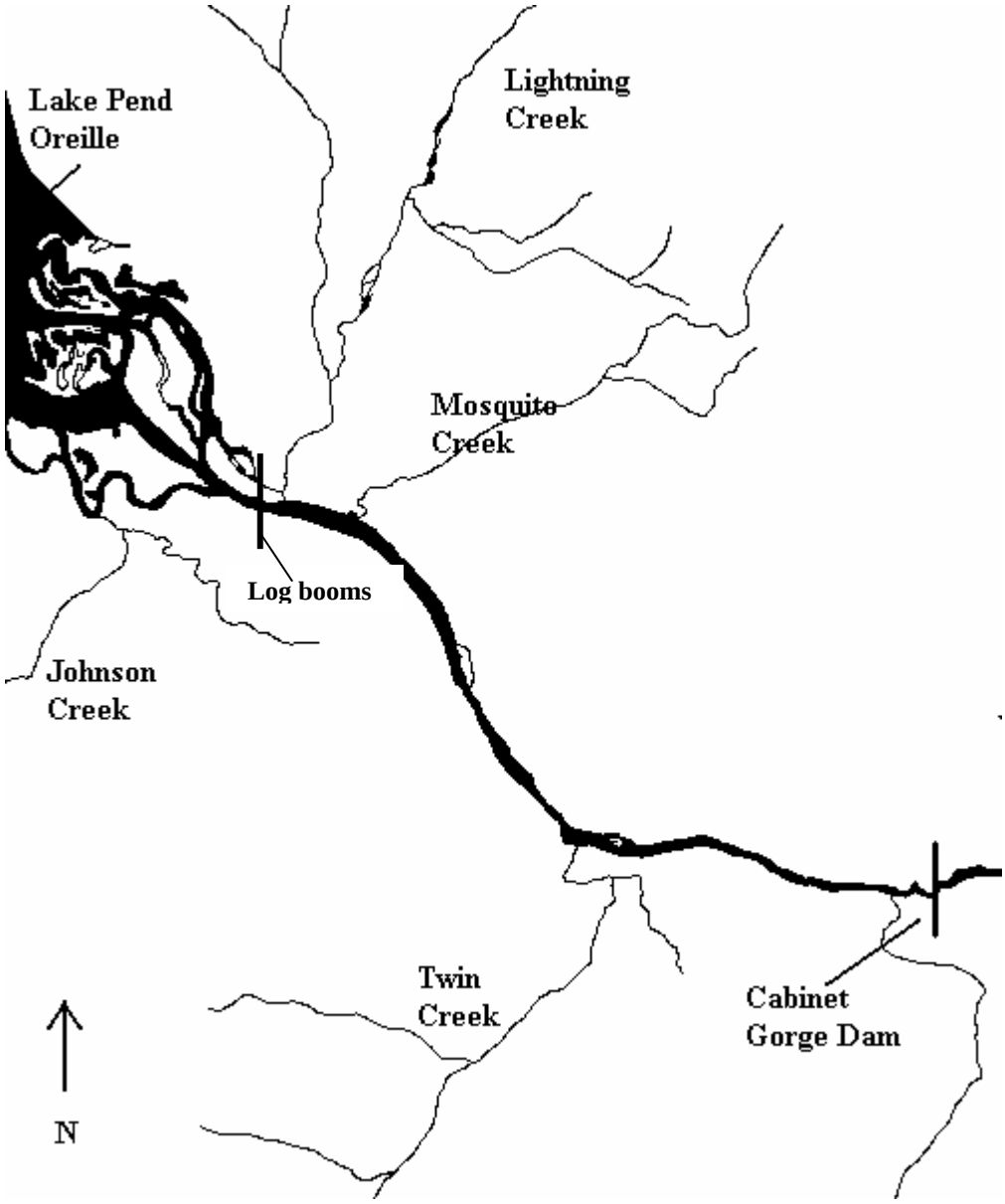

Figure 1. Westslope cutthroat trout radio telemetry and genetics study project area.

A fixed telemetry receiver array was deployed at Cabinet Gorge Dam to detect movements of WCT up to and within the tailrace (Normandeau Associates 2007). 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 during the first year of the study (2005) 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 (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 and evaluated 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 out of a target sample size of 40 (Table 1). Genetic samples were only collected from fish visually classified as genetically pure. 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 12 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; Appendices A and B) in April through June. One of these fish, (Frequency 483, code 100), was later harvested by an angler upstream of the Cabinet Gorge Fish Hatchery on November 13, having apparently remained in the river rather than migrating to the lake. 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 are provided under contract with Normandeau Associates (Appendix B). Of the 15 fish that entered the tailrace area, only four were genetically confirmed hybrids (Table 1).

The remaining 16 radio tagged individuals from 2005 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 Fk. Lightning Creek where it was first detected on May 31. It continued to be detected in the upper reaches of East Fk. 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).

On April 20, 2006, the first day of tracking by boat in 2006, a signal was detected in an osprey nest near the dam. This fish (frequency 483, code 109) had last been detected alive on July 18, 2005. It is not known whether this fish was captured by the osprey in 2005 after the transmitter had shut off, or in 2006 before it had turned back on.

Also in 2006, two of the individuals that were tagged in the Clark Fork River in 2005 migrated upstream in the Lightning Creek watershed and entered Morris Creek, a tributary to Lightning Creek near Clark Fork, Idaho. One of these individuals, (frequency 423, code 81) was tagged just upstream of Twin Creek on April

12, 2005. This individual was 360 mm in length and weighed 390 g at the time of capture. It was detected by the remote station near the town of Clark Fork on April 17, 2006, moving upstream in Lightning Creek. It was tracked into Morris Creek, where it was first detected on May 10. It was last detected in Morris Creek on May 22. The individual was subsequently detected moving back downstream by the remote station on Lightning Creek near the town of Clark Fork on May 24. The other individual, (frequency 423, code 82) was originally tagged at the Cabinet Gorge Hatchery spawning channel on May 9, 2005. This individual was 360 mm in length, and weighed 405 g at the time of tagging. This individual was detected near the Cabinet Gorge Hatchery spawning channel after tagging until June 1. It was subsequently detected at the remote station near the town of Clark Fork, moving past Mosquito Creek on June 4, presumably on its way to Lake Pend Oreille. In 2006, this individual was once again detected at the Cabinet Gorge Hatchery spawning channel from March 17 through March 29. It was then detected by the remote station near the town of Clark Fork moving past Mosquito Creek on April 12. On April 17, it was detected by the remote station near the town of Clark Fork as it moved upstream in Lightning Creek. It was first detected in Morris Creek on April 27, and remained there through May 10. It was subsequently detected moving back downstream in Lightning Creek by the remote station near the town of Clark Fork on May 11. This fish was later harvested by an individual fishing in Lake Pend Oreille near Garfield Bay on September 3.

In addition to the two individuals entering Morris Creek in 2006, one other individual tagged in 2005 also entered Lightning Creek, presumably to spawn. This individual (frequency 464, code 3) was tagged on May 3, 2005, and was 357 mm in length and weighed 425 g when tagged between Cabinet Gorge Hatchery and Twin Creek. On May 9, 2006, it was detected by airplane in Lightning Creek upstream of the Highway 200 bridge in the town of Clark Fork. It was detected in Lightning Creek a short distance downstream of the confluence with Spring Creek near the town of Clark Fork several times between May 15 and May 26, but was never detected in Spring Creek. The individual then moved downstream below the Highway 200 bridge near the railroad trestle and remained there until it was again detected above the Highway 200 bridge near Spring Creek on June 12 and 13. It was last detected June 19 back downstream of the Highway 200 bridge, and presumably moved out to Lake Pend Oreille.

Table 1. Westslope cutthroat trout capture, tagging, genetic, and movement information in the Clark Fork River, Idaho, in 2005 and 2006.

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	Y
383	610	149.483	105	985120015937335	4/29/2005	Y	Y
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
348	430	149.443	6	985120029214861	4/4/06	N/A	N
382	560	149.423	86	985120029217019	4/11/06	N/A	N
333	340	149.464	4	985120029225294	4/27/06	N/A	N
398	550	149.443	2	985120029214368	4/28/06	N/A	N
350	380	149.423	83	985120029222765	5/2/06	N/A	Y [C]
373	550	149.483	104	985120029221508	5/4/06	N/A	N
367	380	149.464	9	985120029225728	5/8/06	N/A	N
321	310	149.483	108	985120029219773	5/10/06	N/A	N
329	340	149.423	87	985120029235641	5/11/06	N/A	Y [C]

[a] Genetically determined hybrid of westslope cutthroat trout X rainbow trout. N/A means not tested.
[b] Detected in the Cabinet Gorge tailrace defined as the "meathole/point" remote station, upstream to the spillgates.
[C] Code 83 was detected in the tailrace on 7/9/06 and Code 87 was detected in the tailrace on 7/6/06.

Nine additional WCT were tagged between April 4 and May 11 in 2006. Of these fish, none were detected by the remote stations in the Cabinet Gorge Dam tailrace. However, two of these fish (frequency 423 code 87, and frequency 464 code 9) were detected by boat tracking immediately downstream of the tailrace, in the vicinity of the left bank eddy remote station. It is likely these fish should have been detected by the lower-most of the remote stations located at the left bank eddy. This raises concern over the ability of the remote stations to detect the fish under the higher flow conditions experienced earlier in the year in 2006 (Appendix B, Figure 6). Two fish from the 2005 marking group were detected in the tailrace during March 2006, but were not detected again by the remote antennae array in the tailrace in later months (frequency 464, code 10; frequency 483, code 103). However, one fish (frequency 483, code 103) was detected by boat upstream of Cabinet Gorge Hatchery, but below the tail-race area, as well as near Twin Creek on three occasions. One individual, (frequency 443, code 6) was tagged in the Clark Fork River across from Twin Creek on April 4, 2006, and was 348 mm in length and weighed 430 g when tagged. It entered lower Twin Creek on May 22, and remained there through June 2. Due to high river flows that backed up into lower Twin Creek, velocity in this area of Twin Creek was minimal, and it appeared unlikely as a suitable spawning site. It is possible that this individual moved farther upstream where we would expect spawning to occur, although it was never detected upstream during our periodic radio-tracking efforts.

CONCLUSION

Exploring the fish passage needs of migratory WCT is a primary focus of the Native Salmond Restoration Plan developed by the Fisheries Working Group of the Clark Fork Relicensing Team (Kleinshmidt Associates and K.L. Pratt 1998), as part of the Clark Fork Settlement Agreement. This study provides useful information as part of such an assessment. Through this research we have concluded that it is likely that genetically pure migratory WCT exist in the Idaho portion of the Clark Fork River, and that some of these are likely of upstream origin. These migratory WCT do use the same areas of the Cabinet Gorge tailrace as migratory bull trout, and may be captured in any facility developed to capture bull trout, if it is operated as much as possible in the spring (i.e. April-May). We continue to evaluate the genetic composition of both upstream and downstream WCT stocks to further evaluate any potential risks from an upstream passage program for WCT at Cabinet Gorge Dam.

We identified other important areas we can also focus restoration and fishery recovery efforts for migratory WCT (i.e. Lightning Creek Watershed). The Lightning Creek Watershed currently suffers from degraded tributary habitat conditions in a number of current and/or potential migratory WCT spawning streams (i.e. the East Fk. Lightning Creek sub-watershed). Morris Creek, a tributary to Lightning Creek, is currently used by migratory WCT, and should remain in its natural and unroaded state to protect stream habitat quality. However, a recent flood event in Lightning Creek may have significant impacts on both the need for, as well as our ability to complete, recently proposed stream restoration actions in the Lightning Creek Watershed with the potential to benefit migratory WCT.

The migratory component of any salmonid population requires connectivity to sustain itself. This connectivity is required between both spawning tributary rearing environments, as well as with the lake/river rearing environment. Currently, the connection between upriver migratory WCT stocks in Montana and LPO is one-way (downstream only). The current situation represents a “sink” type of situation where the upstream populations are likely losing their migratory component because they are not allowed to return to spawn. While habitat restoration contributes to the long-term recovery of depressed populations, adding spawning adults provides immediate benefits to the upriver spawning populations fragmented by dams (Schmetterling

2002). Based on anecdotal information as well as past creel survey data, migratory WCT have declined in abundance to the point that they are a remnant portion of the current fishery (Fredericks et al. 2003). Many factors have contributed to the decline of WCT in LPO including degraded habitat conditions, competition/predation/hybridization with exotic species, as well as habitat fragmentation. Through the Avista program, we are focusing on all of these limiting factors, including evaluating the risks and benefits of upstream fish passage for WCT at Cabinet Gorge Dam.

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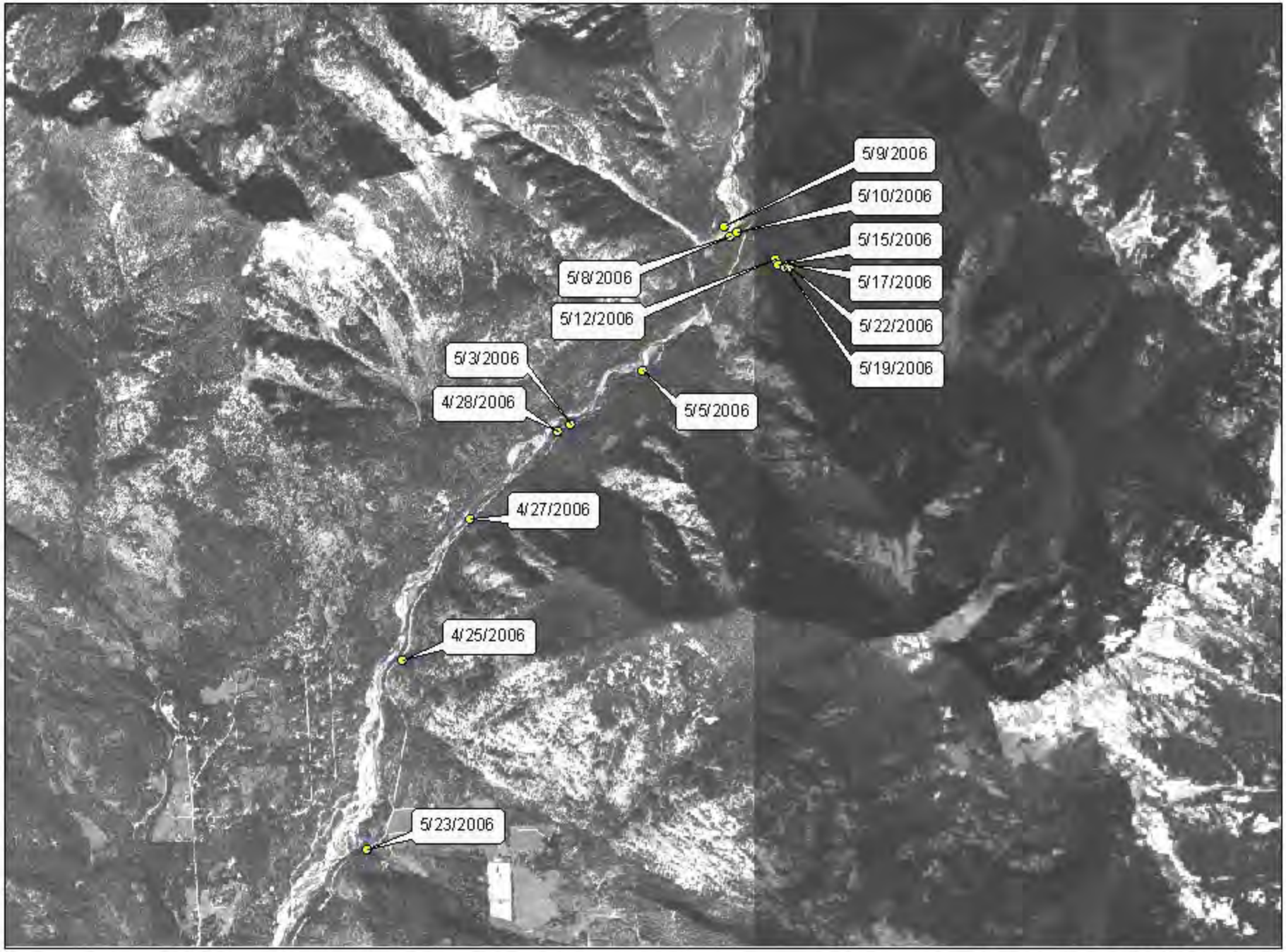
APPENDICES

Appendix A

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

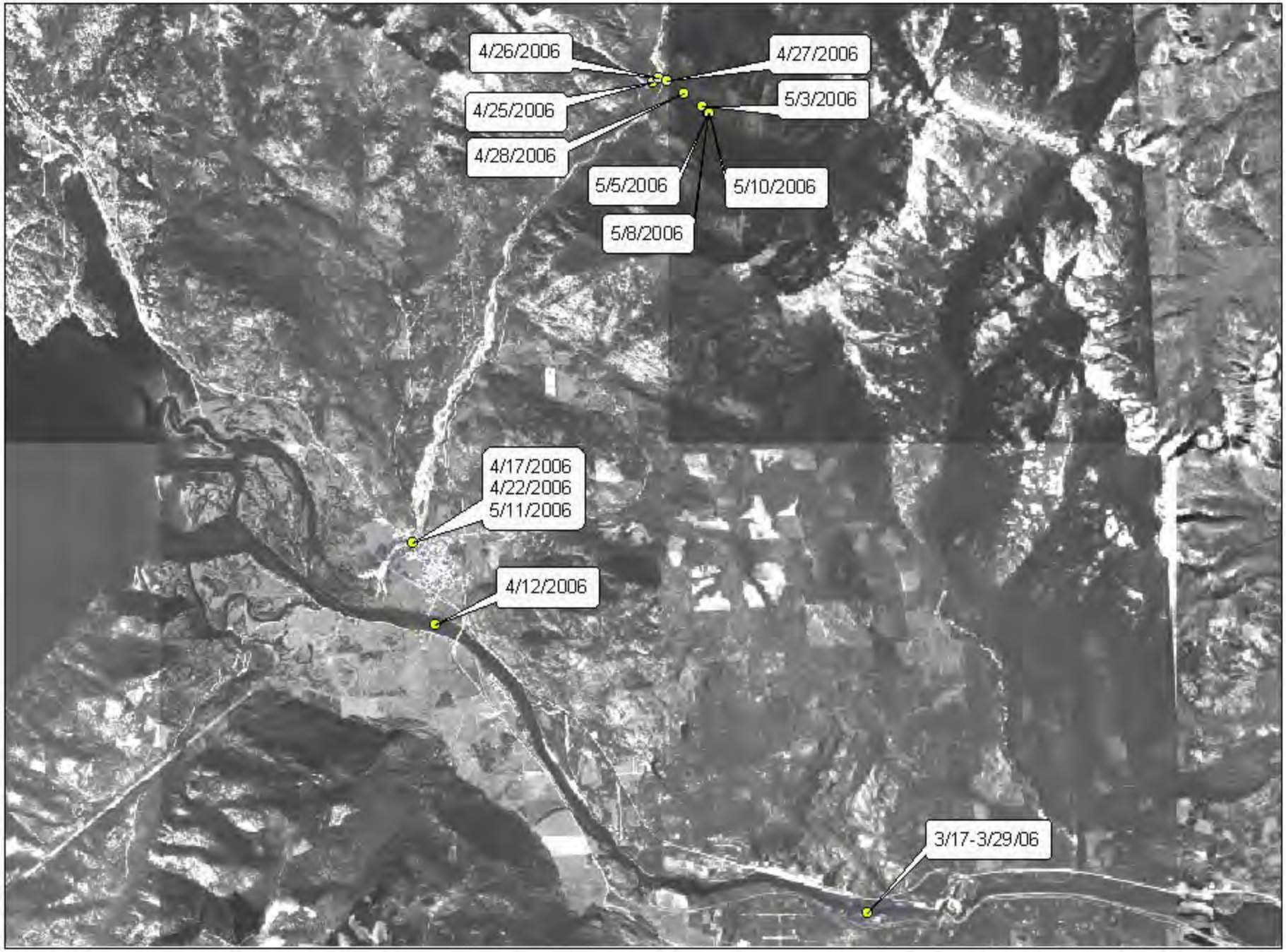


N

0 1 2 Miles

1 inch equals 3,700 feet

FISH FREQUENCY 149.423, CODE 81



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0 1 2 4 Miles

1 inch equals 8,000 feet

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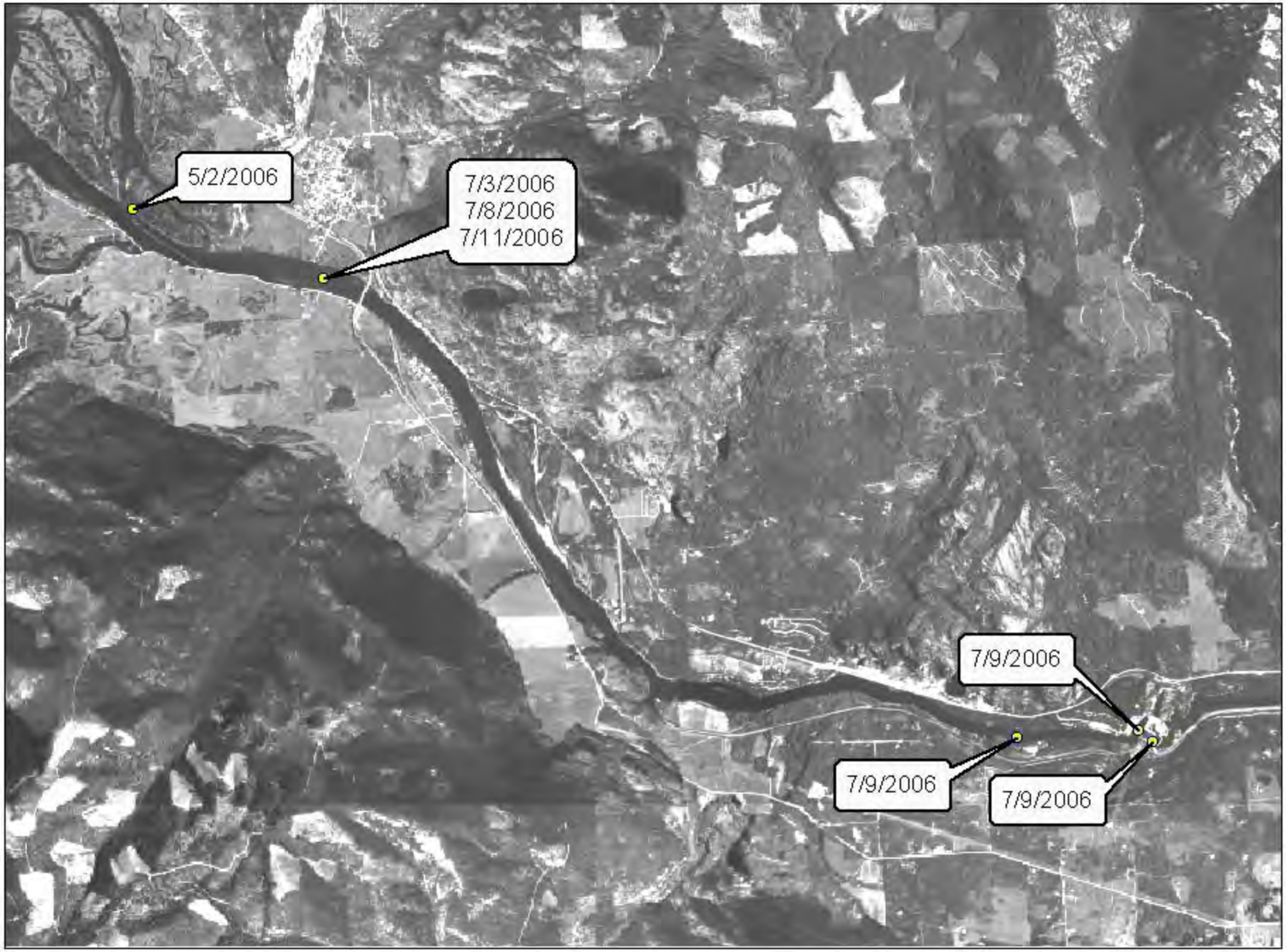

N

0 1 2 4 Miles

1 inch equals 5,000 feet

FISH FREQUENCY 149.423, CODE 83

N

0 1 2 4 Miles

1 inch equals 5,000 feet

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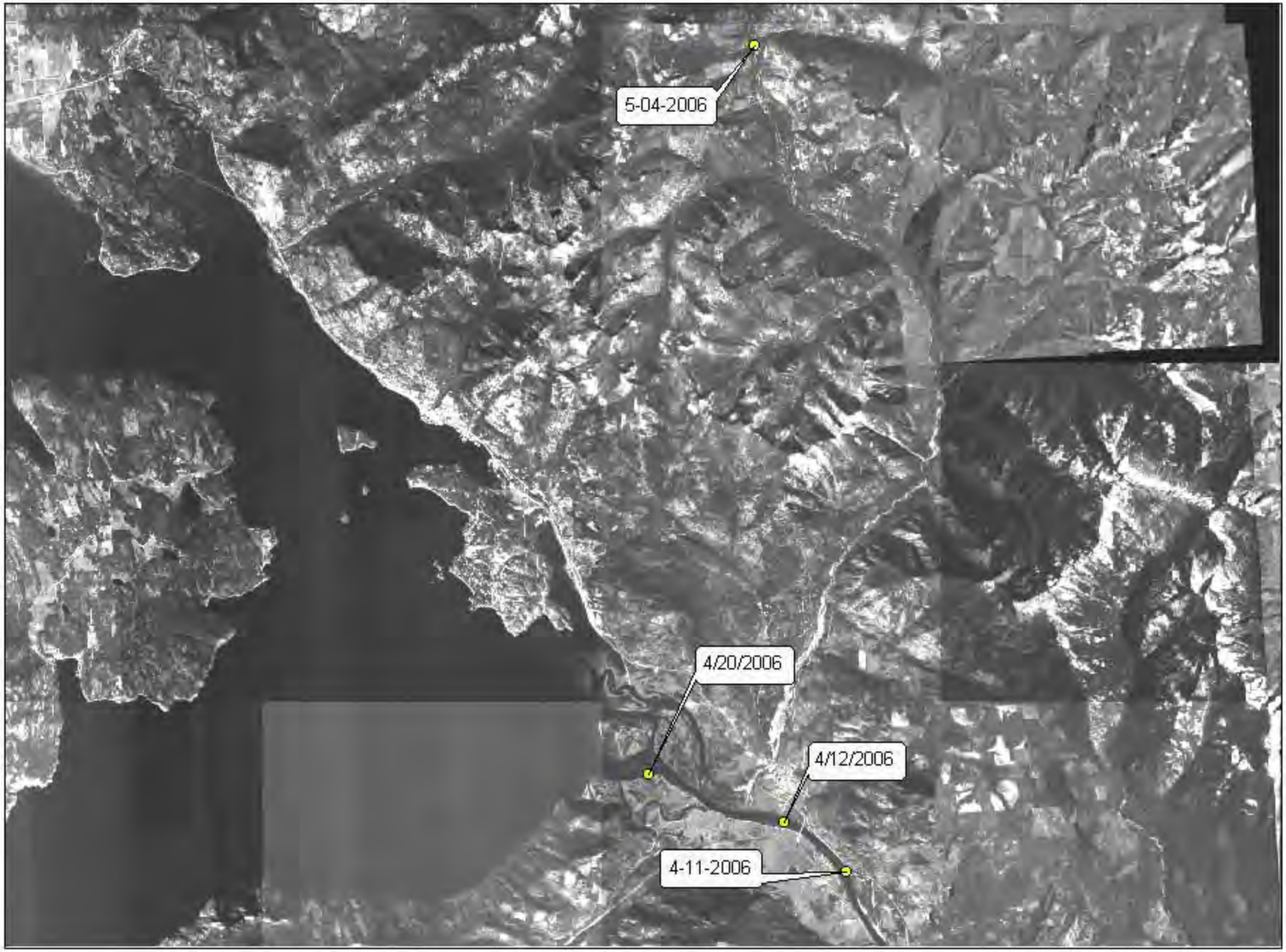

N

0 0.5 1 2 3 4 5 6 7 8 9 Miles

1 inch equals 12,000 feet

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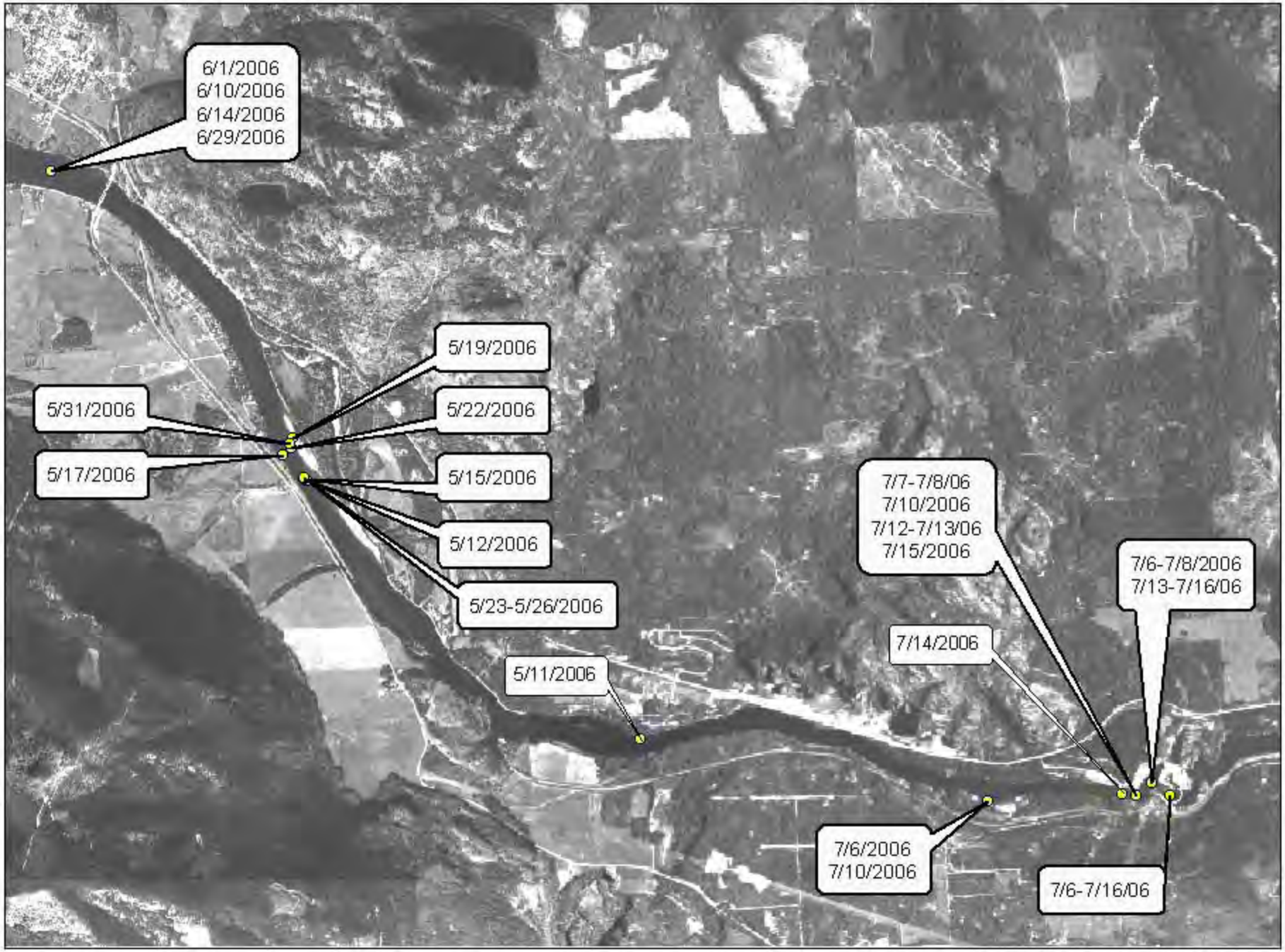

N

0 1 2 Miles

1 inch equals 3,700 feet

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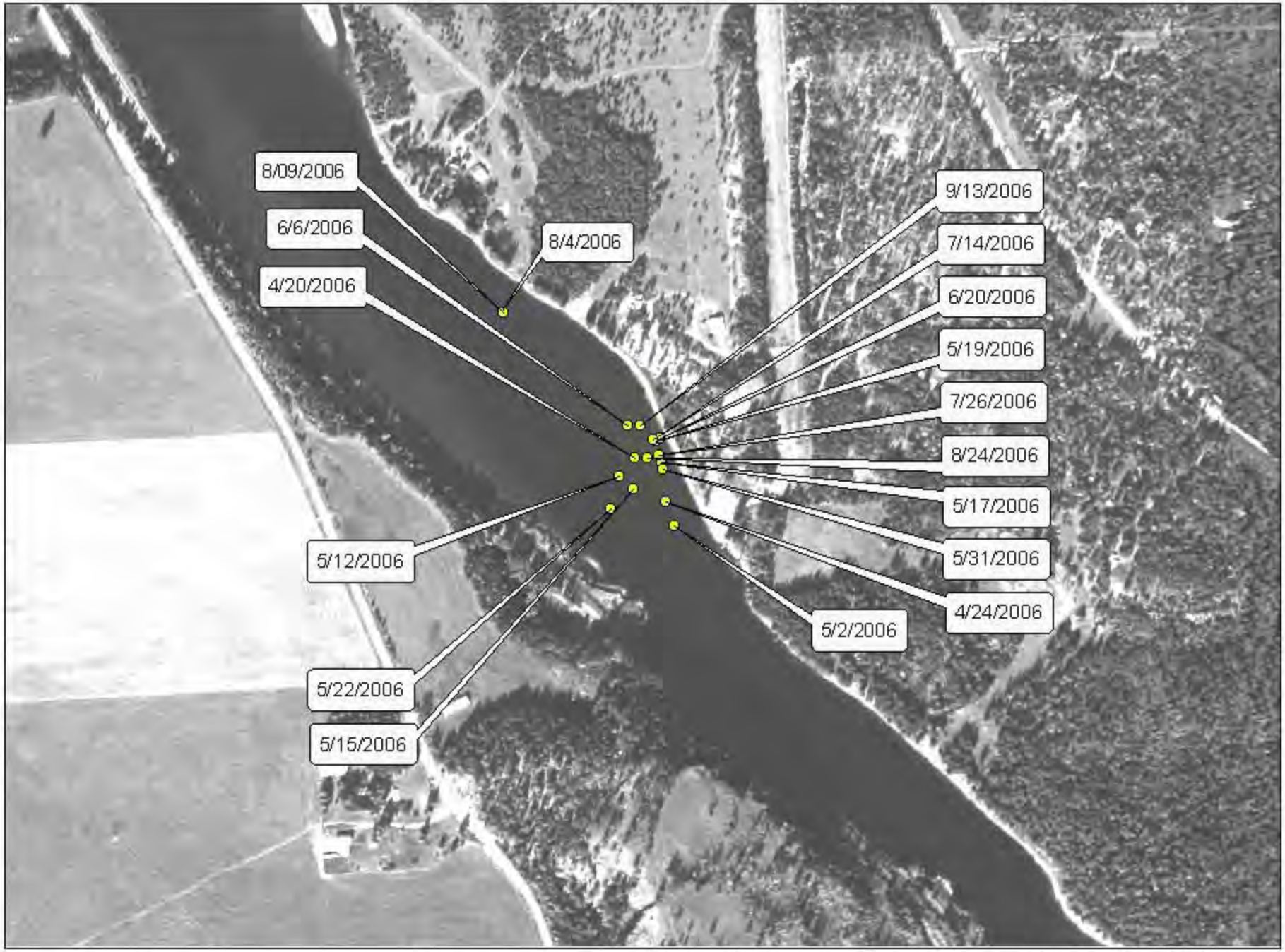
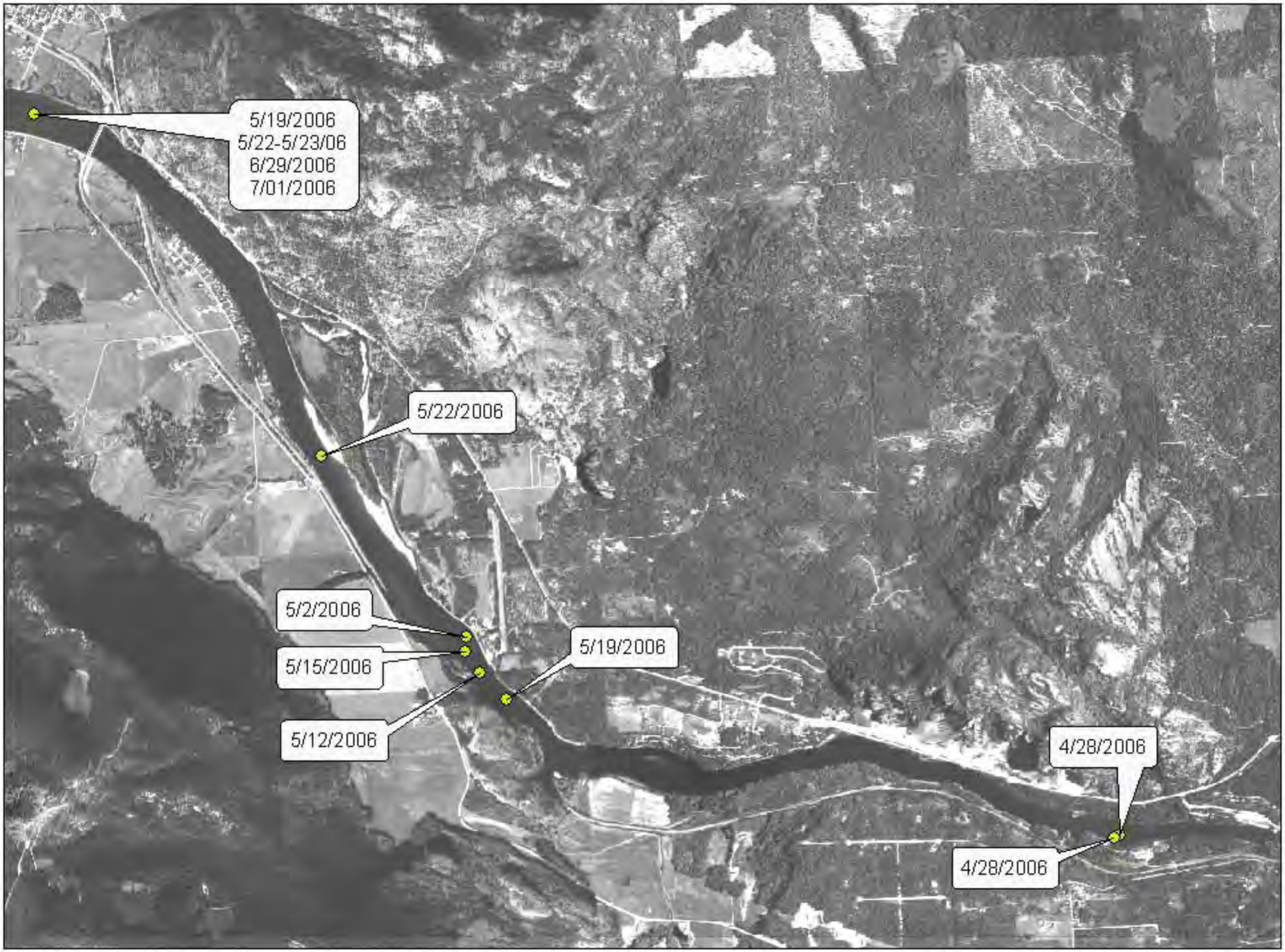


N

0 0.25 0.5 Miles

1 inch equals 600 feet

FISH FREQUENCY 149.423, CODE 88



N

0 1 2 Miles

1 inch equals 3,000 feet

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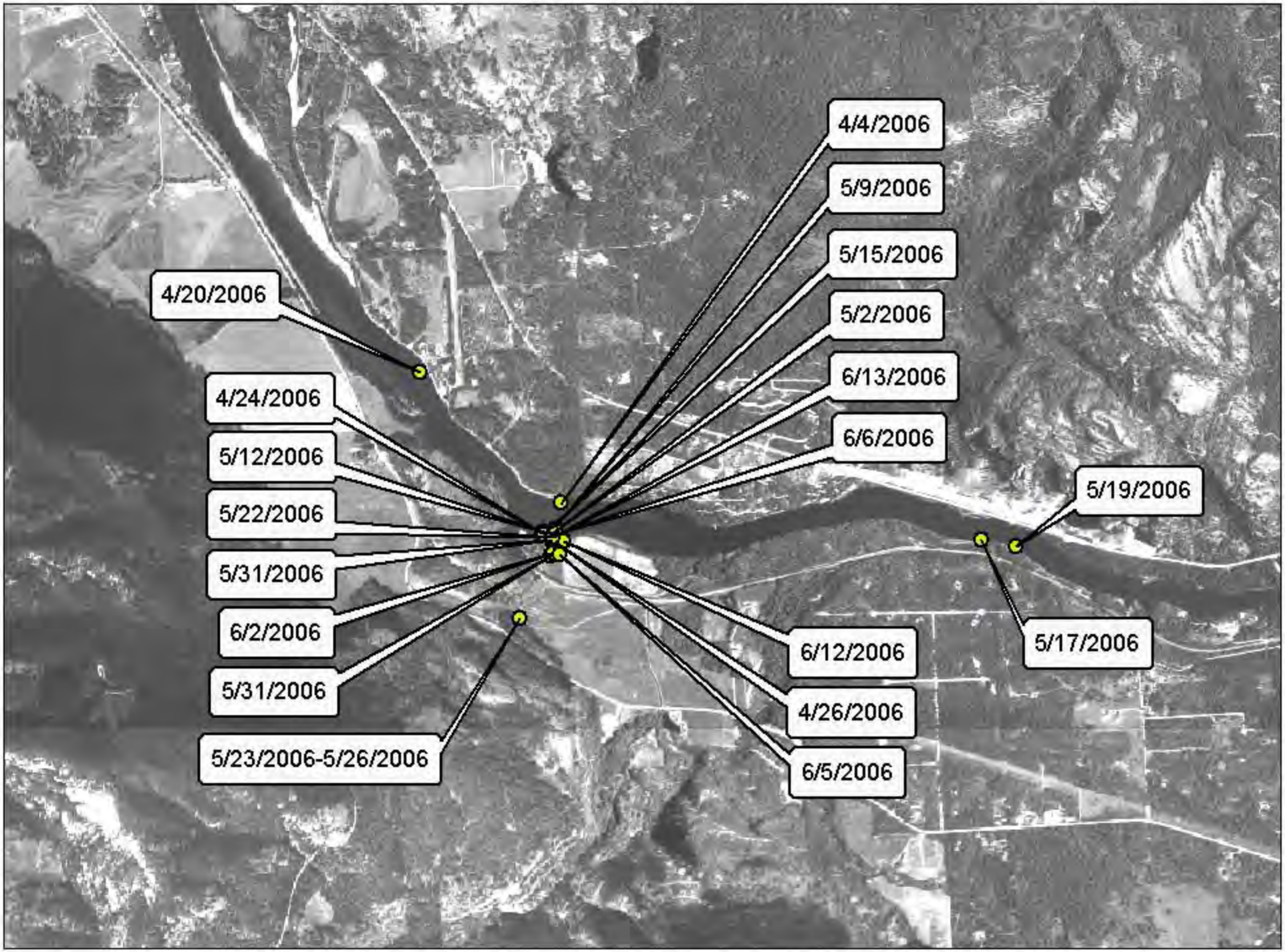

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0 0.5 1 Miles

1 inch equals 2,500 feet

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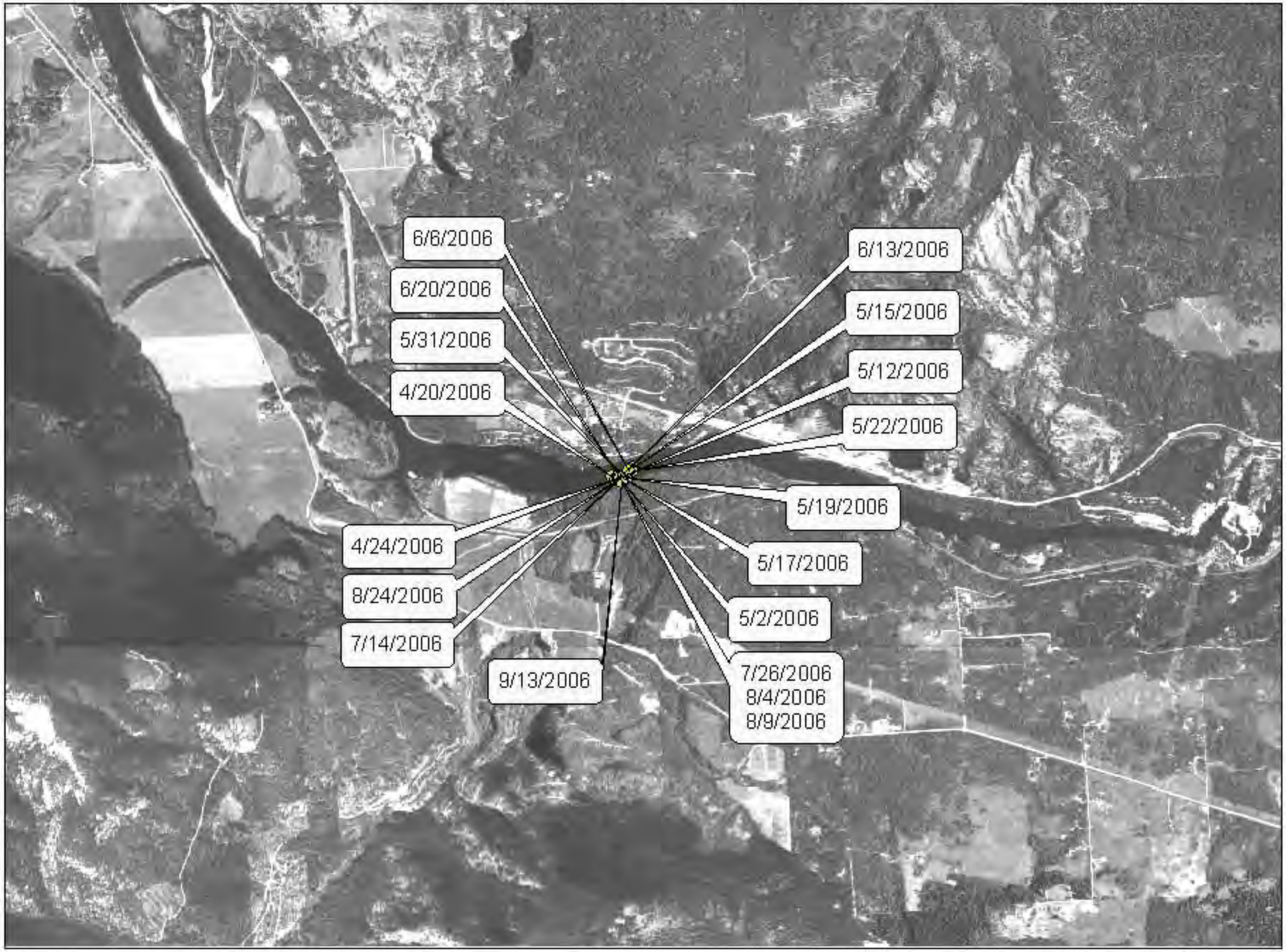

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0 1 2 Miles

1 inch equals 3,000 feet

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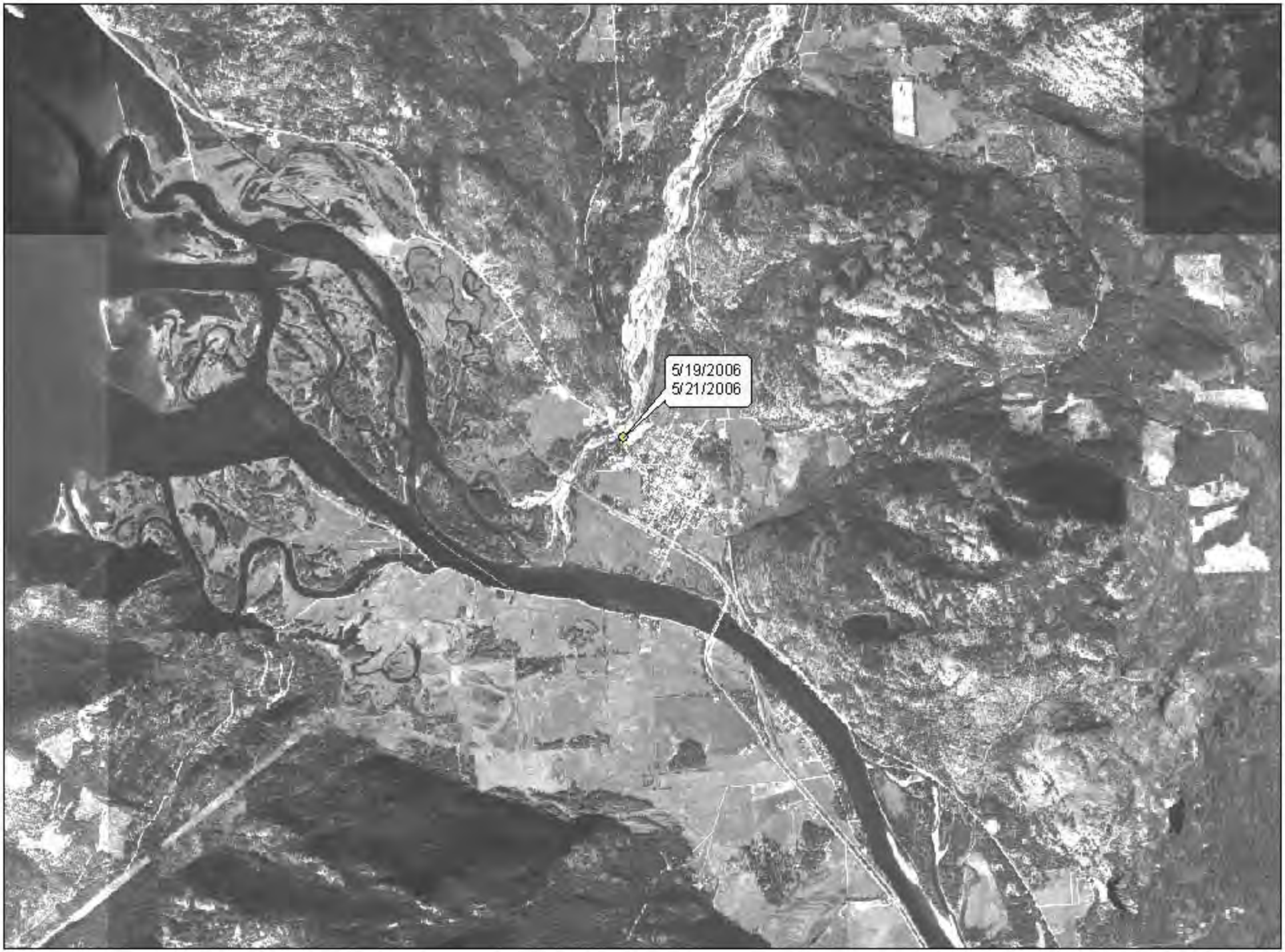

N

0 1 2 Miles

1 inch equals 3,700 feet

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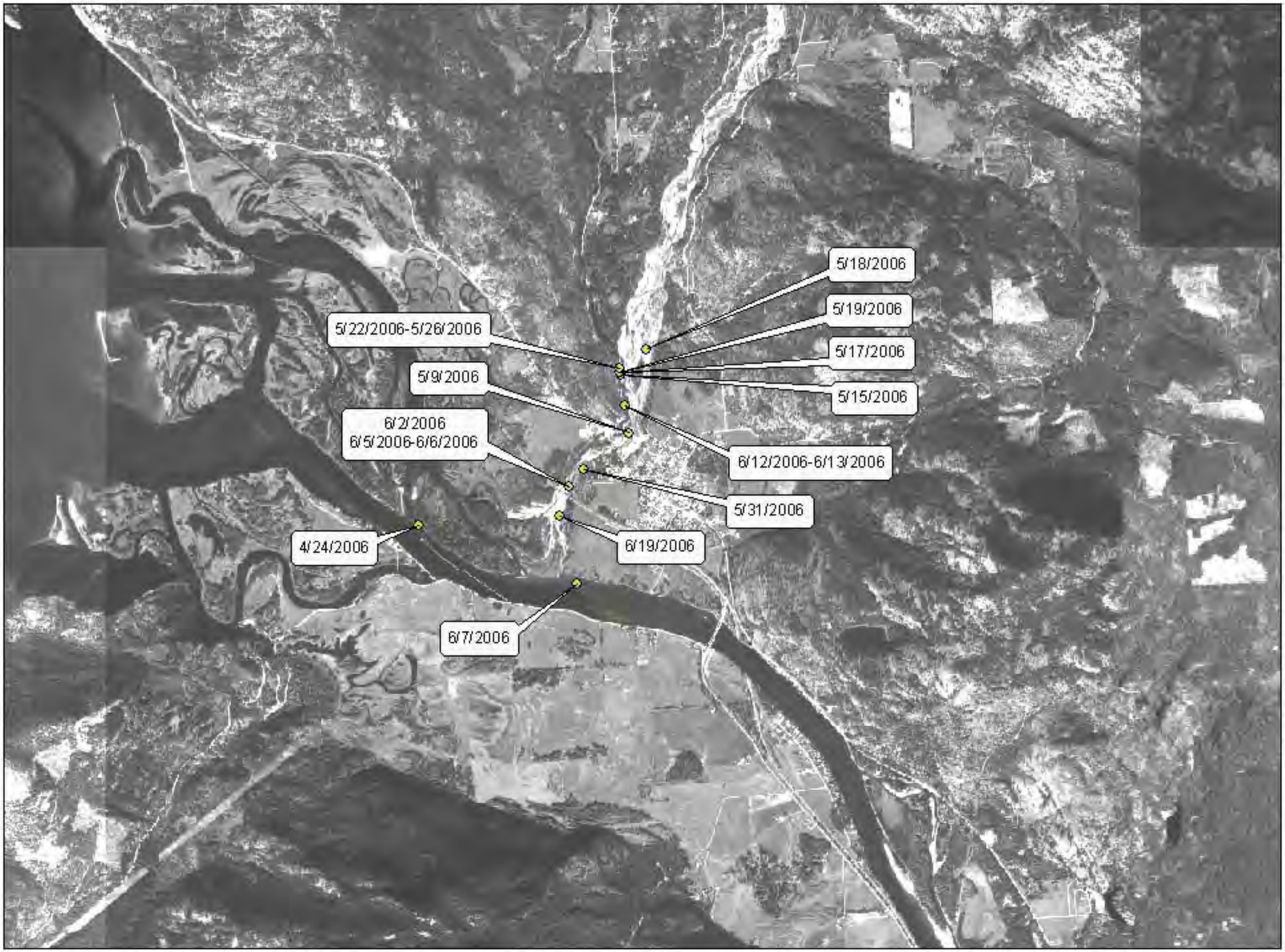

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0 1 2 Miles

1 inch equals 3,700 feet

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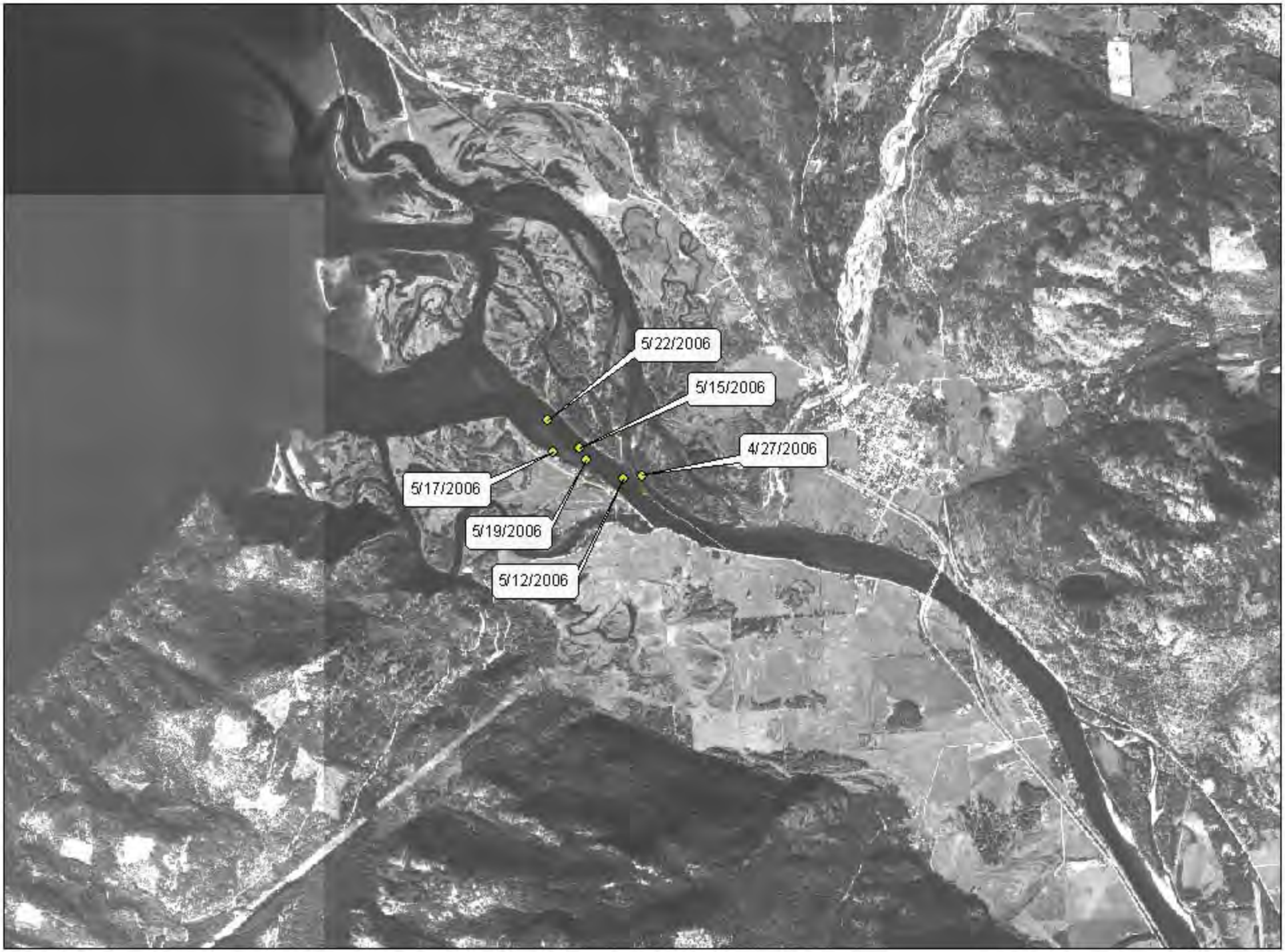

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0 1 2 Miles

1 inch equals 3,700 feet

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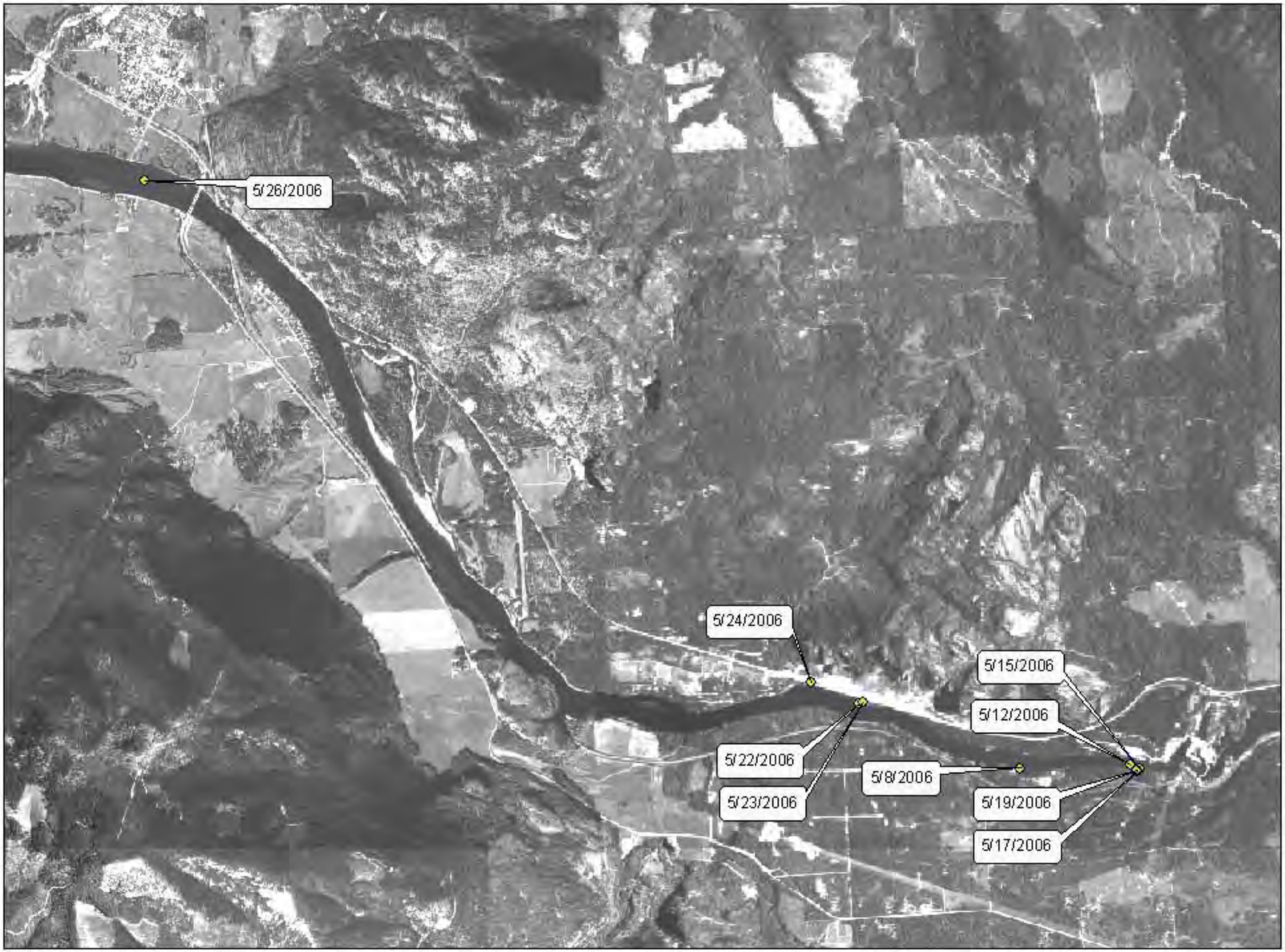

N

0 1 2 Miles

1 inch equals 3,700 feet

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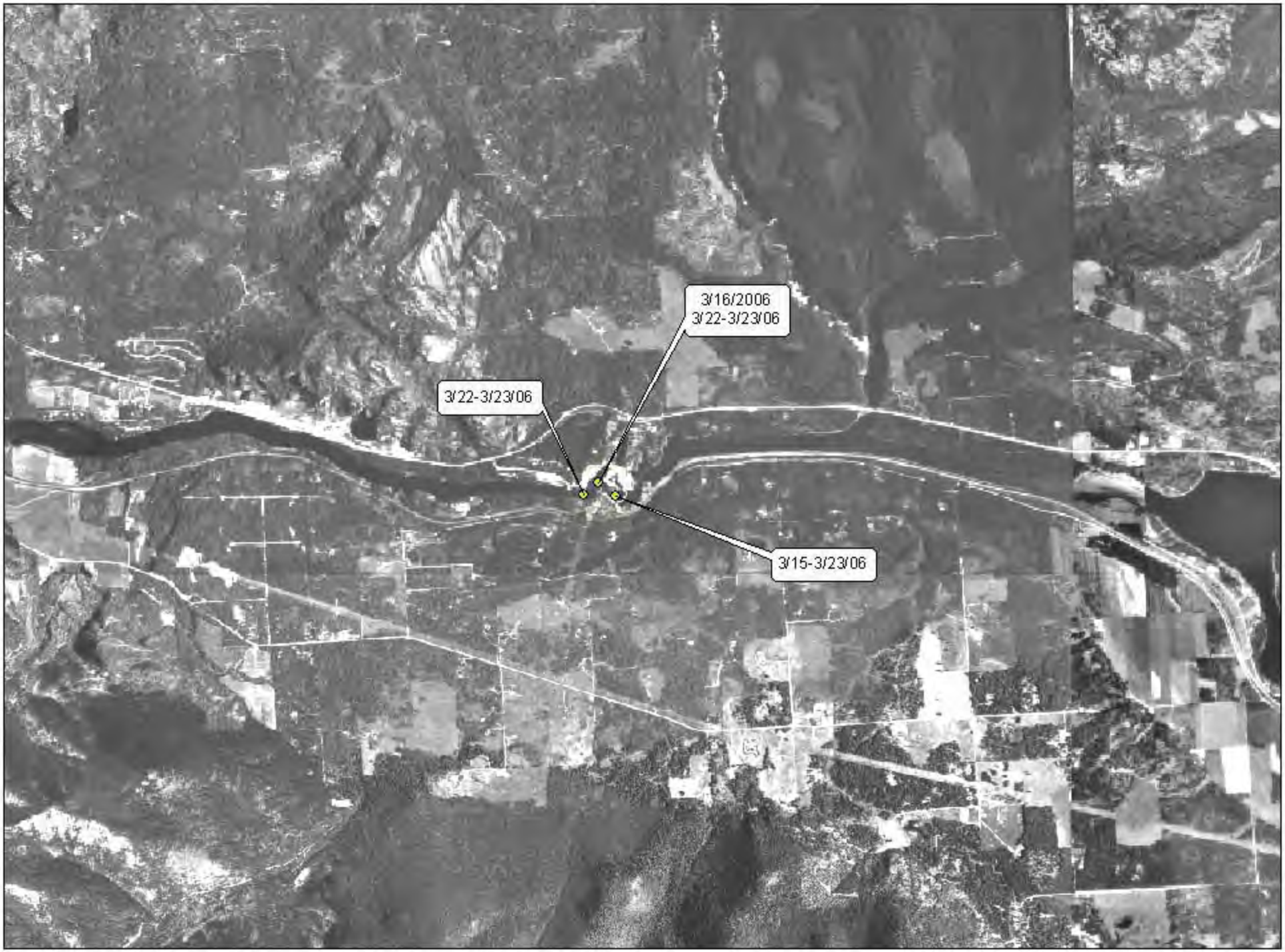

N

0 1 2 Miles

1 inch equals 3,700 feet

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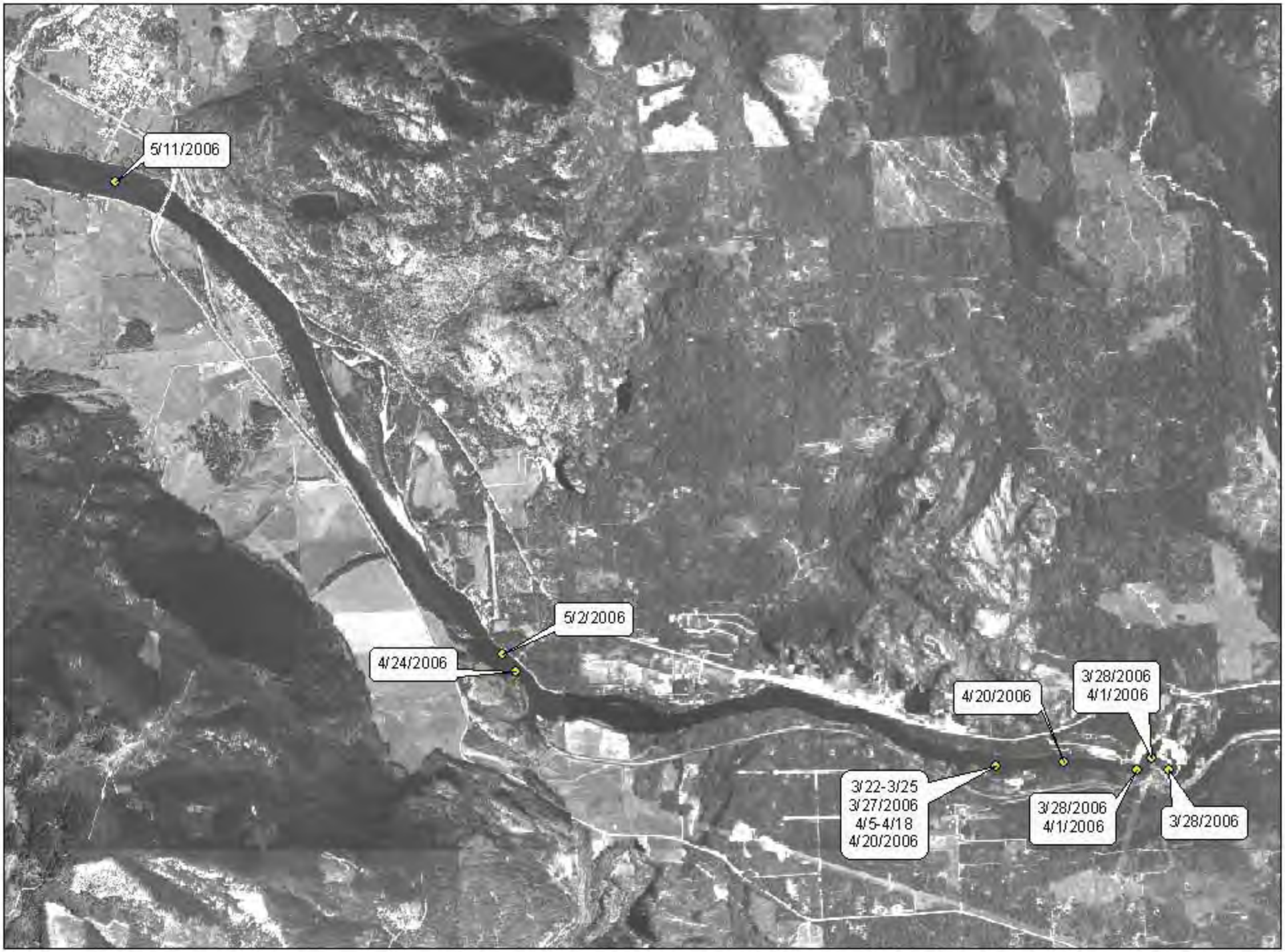

N

0 1 2 Miles

1 inch equals 3,700 feet

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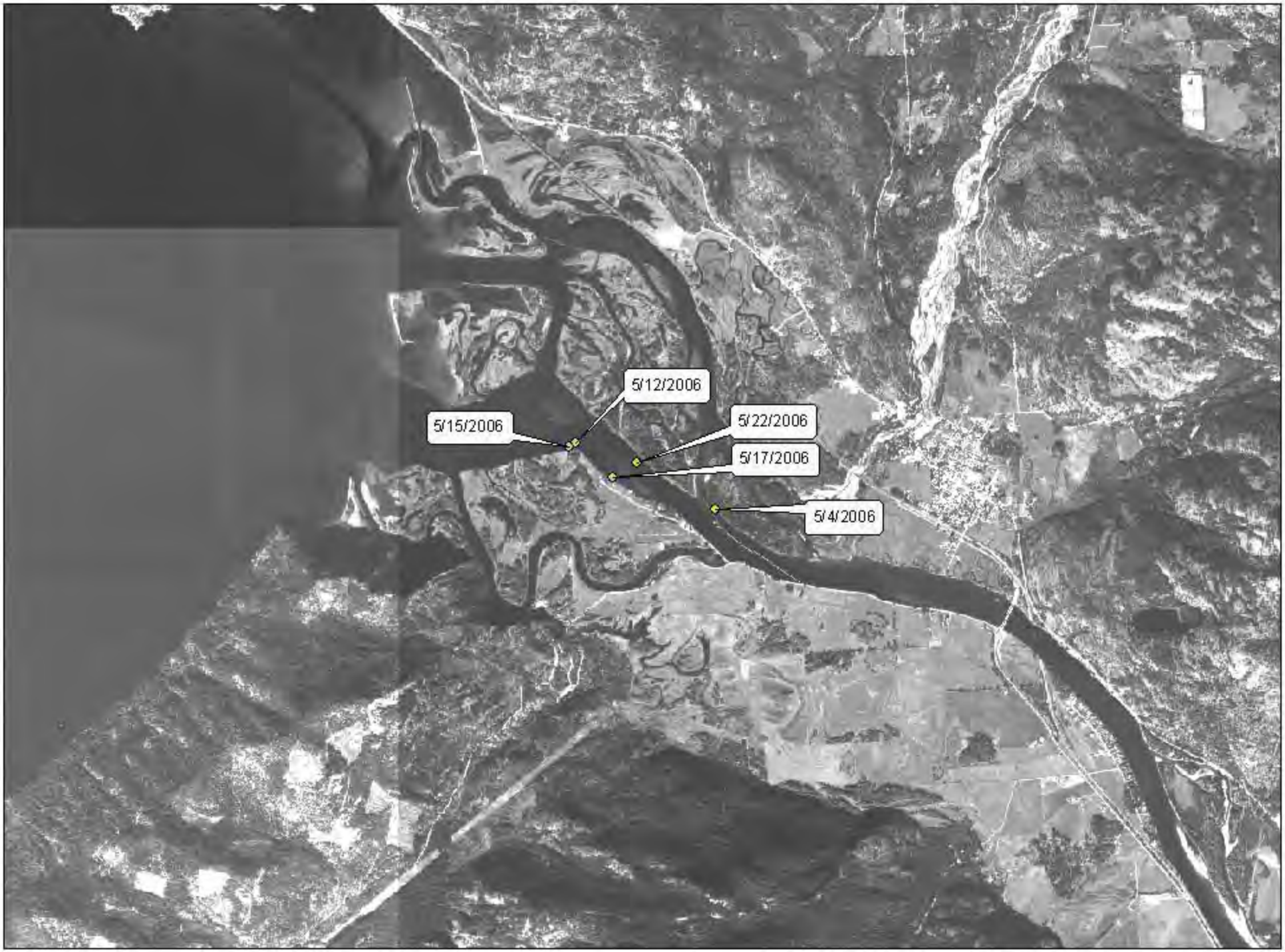

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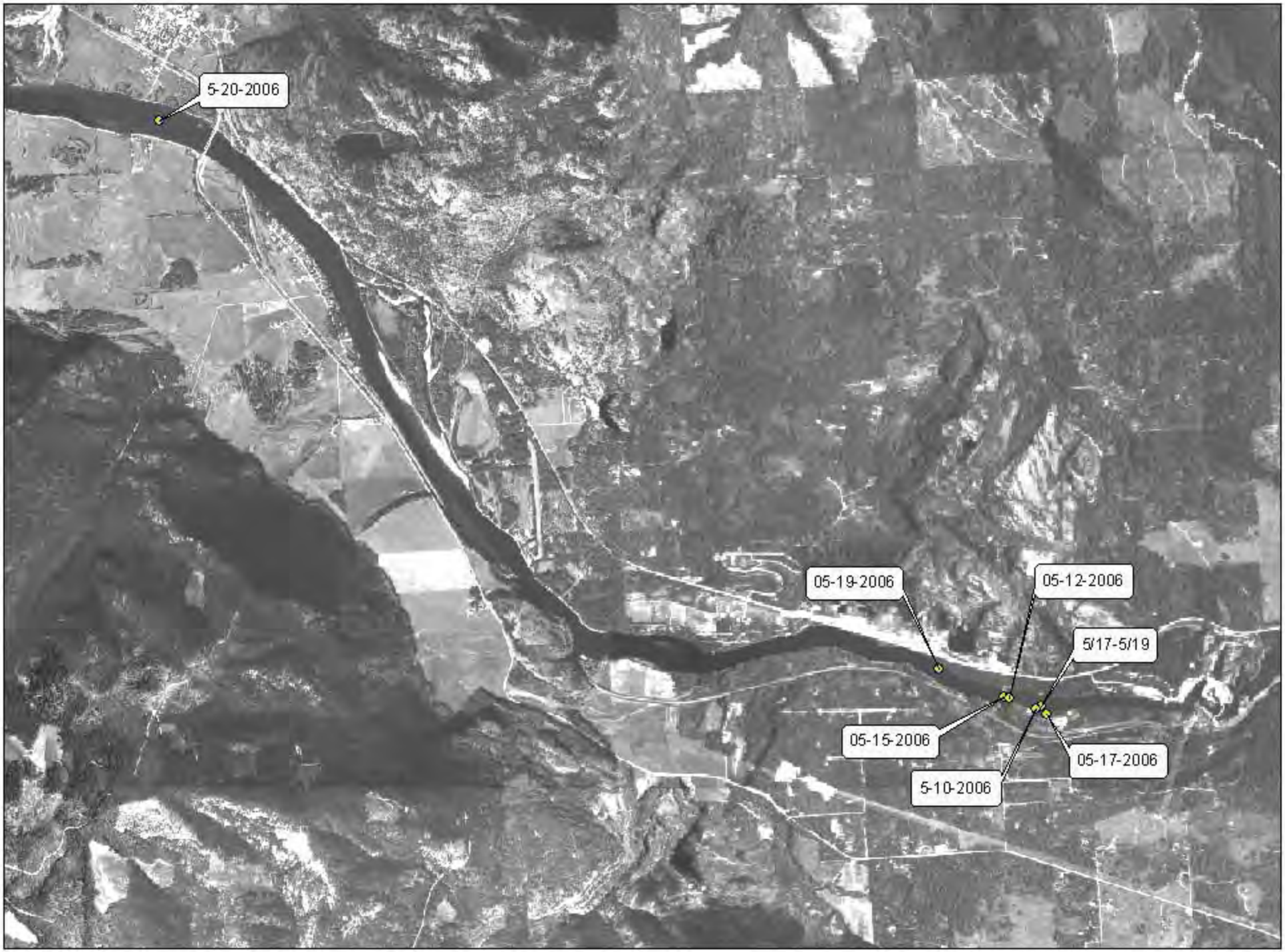

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