Native Salmonid Research and Monitoring Progress Update – 2010

Idaho Tributary Habitat Acquisition and
Fishery Enhancement Program,
Appendix A

Prepared by:

Robert Ryan
Regional Fisheries Biologist
Idaho Department of Fish and Game
Coeur d'Alene, ID

and

Robert Jakubowski
Natural Resources Technician
Avista Corporation
Noxon, MT

Prepared for:

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

April 2011

Native Salmonid Research and Monitoring – 2010 Update

This is an annual update of work completed within the Native Salmonid Research and Monitoring project of the Idaho Tributary Habitat Acquisition and Fishery Enhancement Program, Appendix A of the Clark Fork Settlement Agreement. Completed project components in 2010 included tributary salmonid abundance monitoring in the Grouse Creek, North Fork Grouse Creek, and Rapid Lightning Creek drainages and bull trout redd monitoring on Lake Pend Oreille/Lower Clark Fork River tributaries.

Tributary Salmonid Abundance Monitoring

METHODS

We completed monitoring of Lake Pend Oreille tributaries in an effort to follow general trends in fish abundance, species composition, and distribution on a stream wide scale. In addition, this information in combination with information gathered from other tributaries within the project boundaries of the Clark Fork Settlement Agreement (CFSA) will enable broad scale evaluation of the effects associated with efforts in aquatic habitat protection and restoration accomplished by CFSA activities. We established survey sites on systematic intervals from the mouth of each stream through the upper reaches. Measured stream distances in kilometers were approximated using Garmin Base Camp mapping software (Garmin Ltd. 2009). Upper survey site boundaries were defined as the point where water was no longer found, fish were no longer sampled, or where consistent sampling results suggested further surveys were not necessary due to low expected variation among sample sites (Table 1). We found no directly comparable or repeatable historical electrofishing samples for streams surveyed in 2010. As such, we did not evaluate contemporary abundance trends. Results from 2010 sample efforts were intended to allow some comparison with snorkel survey data collected in the 1980's to be included in a comprehensive report of tributary monitoring efforts following the 2011sample season.

We collected fish using a Smith Root backpack electrofishing unit and pulsed DC settings typically at 50Hz, 2ms, and 800 to 900 volts. Fish were identified, measured (total length; mm) and weighed (g). A subsample of westslope cutthroat trout *Oncorhynchus clarkii lewisi*, rainbow trout *O. mykiss* and cutthroat trout x rainbow trout hybrids were collected for otolith extraction and subsequent age estimation.

To estimate abundance of tributary fish populations we used multi-pass removals (Zippin 1958) in the Grouse Creek, North Fork Grouse Creek and Rapid Lightning Creek drainages in 2010. Abundance estimates only included fish ≥75mm (total length; TL), due to sampling efficiency considerations. Sample sections were typically 100 m in length. We closed sample sections using block nets at the downstream end of each survey section to prevent escapement during downstream electrofishing passes. We completed sequential passes until captures of an individual pass was no more than 20% of the total capture by species of the first pass. Typically, two to three passes were completed. We derived abundance estimates and associated 95% confidence intervals for two and three pass samples using calculations for removal estimates in

closed populations (Hayes et. al 2007). We reported the total catch on the first pass as the population estimate when all the individuals of a particular species were captured on the first pass. In cases where lower confidence bounds were less than the total number of fish captured, the total number of fish captured was reported as the lower bound. We reported density estimates as the number per 100 m^2. We also used sampled fishes to describe population characteristics within sampled streams including age structure, size structure, and species composition.

Multi-pass removals were alternated with single pass removal samples in each drainage. We implemented single pass samples to increase the number of possible sample sites visited in a season, as each single pass required less time than a multi-pass sample. We estimated abundances from single pass samples by generating a multi-pass regression model of abundance based on first pass collections (Meyer and Schill 1999). A single model of abundance based on first pass collections was developed and included sample data from all tributaries and all target species. Capture efficiencies were consistent among all tributaries and species providing support that model predictions were valid across these boundaries.

Table 1. Locations (UTM) of survey sections sampled during 2010 Lake Pend Oreille tributary abundance monitoring efforts. Waypoints represent the approximate lowermost points of each survey section. Sections where water was present are indicated by a yes in the water field. Section length and mean width are listed for each survey section.

STREAM	SECTION(km)	DATE	DATUM	ZONE	E	N	WATER	SECTION DIST(m)	AVG WIDTH(m)
Grouse Creek	6	9/16/10	WGS84	11	541380	5361707	YES	100	8.1
Grouse Creek	8	9/14/10	WGS84	11	543001	5363201	YES	100	7.9
Grouse Creek	10	9/13/10	WGS84	11	544178	5364399	YES	100	7.3
Grouse Creek	12	9/9/10	WGS84	11	544891	5365726	YES	100	12.4
Grouse Creek	14	9/8/10	WGS84	11	546270	5366443	YES	112	5.3
Grouse Creek	16	9/10/10	WGS84	11	547656	5367083	YES	106	7.2
Grouse Creek	18	9/7/10	WGS84	11	549514	5367565	YES	100	5.6
Grouse Creek	20	9/2/10	WGS84	11	551608	5367106	YES	100	7.4
Grouse Creek	22	8/30/10	WGS84	11	553152	5367144	YES	100	4.6
Grouse Creek	24	9/1/10	WGS84	11	554155	5368405	YES	100	7.2
Grouse Creek	26	8/27/10	WGS84	11	556191	5369810	YES	122	5.6
Grouse Creek	28	8/26/10	WGS84	11	557455	5370163	YES	100	3.3
Grouse Creek	30	8/25/10	WGS84	11	558964	5369441	YES	100	2.9
N.F. Grouse Creek	1	8/24/10	WGS84	11	546271	5367174	YES	108	3.9
N.F. Grouse Creek	2	8/24/10	WGS84	11	546555	5368000	YES	100	4.3
N.F. Grouse Creek	3	8/23/10	WGS84	11	546682	5368861	YES	100	4.4
N.F. Grouse Creek	4	8/19/10	WGS84	11	547398	5369373	YES	100	3.7
N.F. Grouse Creek	5	8/23/10	WGS84	11	547802	5370117	YES	100	4.2
N.F. Grouse Creek	6	8/18/10	WGS84	11	547669	5370750	YES	100	4.2
N.F. Grouse Creek	7	8/17/10	WGS84	11	548283	5371761	YES	100	3.9
N.F. Grouse Creek	8	8/16/10	WGS84	11	548905	5372380	YES	100	3.5
N.F. Grouse Creek	9	8/3/10	WGS84	11	549606	5373170	YES	100	3.9
N.F. Grouse Creek	10	8/2/10	WGS84	11	550230	5373465	YES	100	3.6
N.F. Grouse Creek	11	7/21/10	WGS84	11	551188	5373785	YES	100	3.5
N.F. Grouse Creek	12	7/21/10	WGS84	11	551946	5374195	YES	100	3.4
Rapid Lightning Creek	1	7/14/10	WGS84	11	544461	5357345	YES	100	12.1

Table 1 Continued.

STREAM	SECTION(km)	DATE	DATUM	ZONE	E	N	WATER	SECTION DIST(m)	AVG WIDTH(m)
Rapid Lightning Creek	3	7/20/10	WGS84	11	545738	5358397	YES	100	10.9
Rapid Lightning Creek	5	7/20/10	WGS84	11	547452	5358851	YES	100	9.1
Rapid Lightning Creek	7	7/19/10	WGS84	11	549289	5358777	YES	109	7.7
Rapid Lightning Creek	9	7/15/10	WGS84	11	550710	5360224	YES	100	6.5
Rapid Lightning Creek	11	7/14/10	WGS84	11	551788	5361164	YES	100	6.4
Rapid Lightning Creek	13	7/13/10	WGS84	11	553609	5362070	YES	100	4.2
Rapid Lightning Creek	15	7/12/10	WGS84	11	555737	5362487	YES	100	3.8
Rapid Lightning Creek	17	7/8/10	WGS84	11	556930	5363677	YES	101	5.2

RESULTS

We surveyed 41 sections among all sampled tributaries between July 8 and September 16, 2010. Water was present and an electrofishing survey was completed at all sections visited (Table 1). Thirteen sections were surveyed in Grouse Creek over approximately 30 kilometers of the main stem (Figure A-1). Survey sections were placed approximately every two kilometers in Grouse Creek, as sampling every kilometer was prohibitive due to the limited sampling time available. The uppermost survey section (section 30) did not represent the upper limit of fish distribution and the lowermost survey section (section 6) did not represent the lowermost reach of stream, but both appeared to be representative of habitat types for each respective section of the drainage. We sampled a total of 12 sections in North Fork Grouse Creek over approximately 12 kilometers (Figure A-1) and nine sections were surveyed over approximately 18 kilometers in Rapid Lightning Creek (Figure A-2). The uppermost survey section did not represent the uppermost limit of fish distribution in Rapid Lightning Creek. Survey sections were also spaced approximately every 2 kilometers in Rapid Lightning Creek due to its overall length.

We developed a single regression model to estimate abundance based on first pass collections (Figure 1). Capture efficiencies were consistent (0.81 ± 0.06, 95% confidence intervals) among tributaries and species, providing support that our model predictions were valid across these boundaries. Based on the developed linear model, our first pass collections described approximately 98% of the variation in estimated abundance from multi-pass samples.

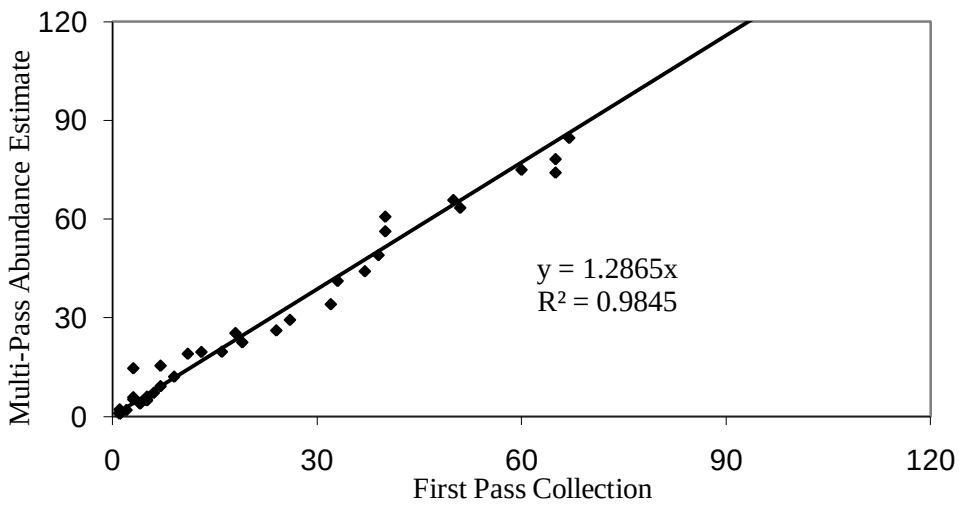

Figure 1. Regression model of estimated multi-pass abundance by first pass collections. Data represented 2010 multi-pass removal efforts in Lake Pend Oreille tributaries including Grouse, North Fork Grouse, and Rapid Lightning creeks.

Grouse Creek

We collected nine fish species and two hybrid crosses among all survey sites on Grouse Creek in 2010 (Table 2) including bull trout *Salvelinus confluentus*, brook trout *Salvelinus fontinalis*, bull trout x brook trout hybrids, longnose dace *Rhinichthys cataractae*, mountain whitefish *Prosopium williamsoni*, northern pikeminnow *Ptychocheilus oregonensis*, rainbow trout, redside shiner *Richardsonius balteatus*, sculpin species *Cottus spp*., westslope cutthroat trout, and rainbow trout x westslope cutthroat trout hybrids. Rainbow trout were the most abundant species found throughout Grouse Creek averaging 8.17 fish/100 m^2 (Table 3) and ranging from 0 to 21 fish/100 m^2. Rainbow trout were detected in all survey sections except section 30. Bull trout densities across survey sites ranged from 0 to 23 fish/100 m^2. Westslope cutthroat trout densities ranged from 0 to 28 fish/100 m^2. Bull trout and westslope cutthroat trout densities averaged among all sites sampled were 3.5 and 3.6 fish/100 m^2, respectively (Table 3). Distribution of bull trout and westslope cutthroat trout was primarily limited to the upper drainage between survey sections 16 and 30, with only one bull trout collected below survey section 16, at survey section six. Mountain whitefish were less abundant with an average density of <1.0 fish/100 m^2 (Table 3) and ranging from 0 to 3fish/100 m^2. Whitefish were only sampled in the lower drainage between survey sections 6 and 16. Brook trout were also detected in low abundance averaging <1.0 fish/100 m^2 across all sites, with a maximum density of 1.0 fish/100 m^2 at section 10. Both bull trout x brook trout and rainbow trout x westslope cutthroat trout hybrids were detected in low abundance (<1.0 fish/100 m^2; Table 3). Hybrids of both types occurred primarily in the upper drainage, from survey section 16 upstream, corresponding to core areas of distribution for bull trout and westslope cutthroat trout. Other non-game fishes including longnose dace, northern pikeminnow, redside shiner, and sculpin were primarily sampled in lower Grouse Creek from survey section 16 downstream. In addition to identified species, small (< 75 mm) unidentified Oncorhynchus species were sampled at eight survey sections. No barriers to migration were observed during survey efforts.

North Fork Grouse Creek

We collected four fish species and one hybrid cross among all survey sites on North Fork Grouse Creek in 2010 (Table 2). Fish species collected included brook trout, rainbow trout, sculpin species, westslope cutthroat trout and rainbow trout x westslope cutthroat trout hybrids. We did not detect any bull trout in this stream. Westslope cutthroat trout were the most abundant species found throughout North Fork Grouse Creek averaging 6 fish/100 m^2 (Table 3) and ranging from 0 to 22 fish/100 m^2. Westslope cutthroat trout were detected only from survey sections 4 to 10 with the highest densities occurring in the uppermost sections. Rainbow trout and brook trout were also abundant with average densities of 5 and 4 fish/100 m^2, respectively (Table 3). Densities of rainbow trout ranged from 0 to 17 fish/100 m^2. Densities of brook trout ranged from 0 to 12 fish/100 m^2. Distribution of both rainbow and brook trout was limited to survey sections seven downstream. Rainbow trout x westslope cutthroat trout hybrids were low in abundance with an average density of < 1.0 fish/100 m^2. Distribution of hybrids was limited from section six downstream. Sculpin were detected only in sections one through eight. In addition to identified species, small (< 75 mm) unidentified Oncorhynchus species were sampled in survey sections one, two, four and six. No fish were sampled in survey sections 11 and 12 suggesting a

fish passage barrier existed upstream of survey section 10. Although, these sections had water in 2010 the absence of fish also may have suggested perennial flow may not occur in all years. The distribution of rainbow and brook trout also suggested a fish passage barrier existed between survey sections seven and eight. No specific survey of barrier locations was conducted and no barriers were documented within either sample location.

Rapid Lightning Creek

We collected nine fish species and one hybrid cross among all survey sites on Rapid Lightning Creek in 2010 (Table 2). Fish species collected included bull trout, black bullhead *Ameiurus melas*, brook trout, long nose dace, largescale sucker *Catostomus macrocheilus*, mountain whitefish, rainbow trout, sculpin species, westslope cutthroat trout, and rainbow trout x westslope cutthroat trout hybrids. Westslope cutthroat trout were one of the most abundant and widely distributed species found throughout Rapid Lightning Creek, averaging 5 fish/100 m^2 (Table 3) among all sites and ranging from 0 to 16 fish/100 m^2. Westslope cutthroat trout were detected in all survey sections except section three. Brook trout were also abundant and well distributed with densities ranging from 0 to 12 fish/100 m^2, and occurring at all survey sections except 17 (uppermost section). Average brook trout density was 3 fish/100 m^2 (Table 3). Bull trout were detected only at survey section three and included only two fish (<1.0 fish/100 m^2). Rainbow trout were found only in the lower drainage in survey sections one, three and five with a maximum density of 5 fish/100 m^2 at survey section one. Rainbow trout x westslope cutthroat trout hybrids were also limited to the lower drainage and only detected at survey sections three and five. Densities at sections three and five were <1.0 and 2.5 fish/100 m^2, respectively. Mountain whitefish were only detected at survey sections one and three with corresponding densities of 1.3 and 1.1 fish/100 m^2, respectively. Other non-game fishes including longnose dace and sculpin were found sporadically throughout Rapid Lightning Creek while single samples of black bullhead and large scale sucker were found only in survey section one. In addition to identified species, small (< 75 mm) unidentified Oncorhynchus species were sampled in survey sections one, three, five, and 13. We believe one migration barrier exists upstream of survey section five based on the distribution of rainbow trout. However, a migration barrier approximately 2.7 km upstream from the confluence with the Pack River was noted in Hoelscher and Bjorn 1989. They also failed to detect rainbow trout upstream of that point approximated by survey section five in our 2010 survey.

Table 2. Tributary monitoring 2010 results by stream, sampled reach, and species. Total catch includes all lengths, while only fish ≥ 75 mm were included in abundance estimates (EST N). In cases of non-declining catch, abundance estimates were minimum estimates defined as the total catch, and no confidence intervals were calculated.

STREAM	SECTION	SPECIES	CAUGHT	MIN TL	MAX TL	EST. N	95% CI -	95% CI +	DENSITY/100m^2
Grouse Creek	16	BBHY	1	139	139	1.00	1.00	1.00	0.13
Grouse Creek	24	BBHY	1	118	118	1.00	1.00	1.00	0.14
Grouse Creek	26	BBHY	2	110	127	2.57	2.00	10.85	0.38
Grouse Creek	6	BLT	1	168	168	1.29	1.00	9.56	0.16
Grouse Creek	16	BLT	1	139	139	0.00*	1.00	0.00	0.00
Grouse Creek	18	BLT	2	128	162	2.57	2.00	10.85	0.46
Grouse Creek	20	BLT	6	63	118	5.00	5.00	5.00	0.68
Grouse Creek	22	BLT	6	51	160	6.43	5.00	14.70	1.40
Grouse Creek	24	BLT	25	80	142	25.37	25.00	26.87	3.53
Grouse Creek	26	BLT	65	55	152	81.05	72.66	89.44	11.97
Grouse Creek	28	BLT	75	60	207	75.00	74.00	77.41	22.56
Grouse Creek	30	BLT	2	99	180	2.57	2.00	10.85	0.89
Grouse Creek	6	BRK	1	222	222	1.29	1.00	9.56	0.16
Grouse Creek	12	BRK	5	76	308	6.43	5.00	14.70	0.52
Grouse Creek	14	BRK	1	242	242	1.29	1.00	9.56	0.22
Grouse Creek	16	BRK	7	104	215	7.20	7.00	8.47	0.95
Grouse Creek	18	BRK	2	215	302	2.57	2.00	10.85	0.46
Grouse Creek	20	BRK	10	68	299	9.22	9.00	10.46	1.25
Grouse Creek	22	BRK	1	115	115	1.29	1.00	9.56	0.28
Grouse Creek	24	BRK	5	105	216	5.22	5.00	6.57	0.73
Grouse Creek	6	LNDC	4	51	82	NA			
Grouse Creek	12	LNDC	1	135	135	NA			
Grouse Creek	14	LNDC	2	93	122	NA			
Grouse Creek	16	LNDC	3	89	107	NA			
Grouse Creek	6	MWF	4	89	98	5.15	4.00	13.41	0.64
Grouse Creek	8	MWF	21	85	101	27.02	21.00	35.26	3.43

Table 2 Continued.

STREAM	SECTION	SPECIES	CAUGHT	MIN TL	MAX TL	EST. N	95% CI -	95% CI +	DENSITY/100m^2
Grouse Creek	10	MWF	8	92	111	10.29	8.00	18.55	1.41
Grouse Creek	14	MWF	1	97	97	1.29	1.00	9.56	0.22
Grouse Creek	16	MWF	1	114	114	1.00	1.00	1.00	0.13
Grouse Creek	6	NPM	4	111	129	NA			
Grouse Creek	6	ONC	4	72	74	NA			
Grouse Creek	8	ONC	1	69	69	NA			
Grouse Creek	10	ONC	1	70	70	NA			
Grouse Creek	16	ONC	6	51	71	NA			
Grouse Creek	18	ONC	1	70	70	NA			
Grouse Creek	20	ONC	4	57	69	NA			
Grouse Creek	22	ONC	4	63	67	NA			
Grouse Creek	26	ONC	2	42	45	NA			
Grouse Creek	6	RBT	18	75	154	23.16	18.00	31.40	2.86
Grouse Creek	8	RBT	28	78	127	36.02	28.00	44.26	4.57
Grouse Creek	10	RBT	41	81	190	52.75	44.47	61.02	7.20
Grouse Creek	12	RBT	37	75	233	47.60	39.34	55.86	3.85
Grouse Creek	14	RBT	34	88	210	43.74	35.49	51.99	7.35
Grouse Creek	16	RBT	81	82	191	84.70	81.00	90.71	11.12
Grouse Creek	18	RBT	80	72	214	101.63	93.11	110.16	18.19
Grouse Creek	20	RBT	153	71	204	155.87	152.00	161.03	21.13
Grouse Creek	22	RBT	48	79	182	61.75	53.45	70.05	13.46
Grouse Creek	24	RBT	55	85	234	56.30	55.00	59.26	7.83
Grouse Creek	26	RBT	22	89	199	28.30	22.00	36.54	4.18
Grouse Creek	28	RBT	7	89	171	14.68	7.00	60.65	4.42
Grouse Creek	6	RSS	3	85	107	NA			
Grouse Creek	14	SCL	2	79	86	NA			
Grouse Creek	16	SCL	1	62	62	NA			
Grouse Creek	18	WCT	6	78	236	7.72	6.00	15.98	1.38
Grouse Creek	20	WCT	5	120	198	5.86	5.00	10.02	0.79

Table 2 Continued.

STREAM	SECTION	SPECIES	CAUGHT	MIN TL	MAX TL	EST. N	95% CI -	95% CI +	DENSITY/100m^2
Grouse Creek	22	WCT	1	204	204	1.29	1.00	9.56	0.28
Grouse Creek	24	WCT	2	111	136	2.18	2.00	3.66	0.30
Grouse Creek	26	WCT	15	88	277	19.30	15.00	27.54	2.85
Grouse Creek	28	WCT	42	71	238	41.22	41.00	42.26	12.40
Grouse Creek	30	WCT	64	68	195	81.05	72.66	89.44	28.19
Grouse Creek	8	WRHY	1	105	105	1.29	1.00	9.56	0.16
Grouse Creek	16	WRHY	1	136	136	1.00	1.00	1.00	0.13
Grouse Creek	20	WRHY	4	97	159	4.00	4.00	4.00	0.54
Grouse Creek	22	WRHY	1	97	97	1.29	1.00	9.56	0.28
Grouse Creek	26	WRHY	2	172	191	2.57	2.00	10.85	0.38
Grouse Creek	28	WRHY	6	93	186	6.02	6.00	6.33	1.81
N.F Grouse Creek	1	BRK	11	95	211	14.15	11.00	22.40	3.35
N.F Grouse Creek	2	BRK	18	88	265	19.09	18.00	22.36	4.40
N.F Grouse Creek	3	BRK	27	86	227	34.74	27.00	42.98	7.89
N.F Grouse Creek	4	BRK	46	63	302	44.16	43.00	47.19	11.90
N.F Grouse Creek	5	BRK	27	60	191	27.02	21.00	35.26	6.47
N.F Grouse Creek	6	BRK	38	60	228	34.13	34.00	34.96	8.22
N.F Grouse Creek	7	BRK	22	81	191	28.30	22.00	36.54	7.21
N.F Grouse Creek	1	ONC	1	37	37	NA			
N.F Grouse Creek	2	ONC	1	46	46	NA			
N.F Grouse Creek	4	ONC	2	40	48	NA			
N.F Grouse Creek	6	ONC	1	39	39	NA			
N.F Grouse Creek	1	RBT	32	85	211	41.17	32.92	49.42	9.74
N.F Grouse Creek	2	RBT	75	72	184	74.14	74.00	74.93	17.09
N.F Grouse Creek	3	RBT	23	82	202	29.59	23.00	37.83	6.72
N.F Grouse Creek	4	RBT	29	77	163	29.39	29.00	30.98	7.92
N.F Grouse Creek	5	RBT	38	76	116	48.89	40.62	57.15	11.71
N.F Grouse Creek	6	RBT	20	67	205	19.69	19.00	22.17	4.75
N.F Grouse Creek	7	RBT	11	65	137	10.29	8.00	18.55	2.62

Table 2 Continued.

STREAM	SECTION	SPECIES	CAUGHT	MIN TL	MAX TL	EST. N	95% CI -	95% CI +	DENSITY/100m^2
N.F Grouse Creek	1	SCL	1	62	62	NA			
N.F Grouse Creek	2	SCL	1	77	77	NA			
N.F Grouse Creek	3	SCL	1	67	67	NA			
N.F Grouse Creek	4	SCL	1	83	83	NA			
N.F Grouse Creek	5	SCL	2	45	71	NA			
N.F Grouse Creek	7	SCL	3	60	94	NA			
N.F Grouse Creek	8	SCL	2	49	50	NA			
N.F Grouse Creek	4	WCT	2	159	268	2.00	2.00	2.00	0.54
N.F Grouse Creek	6	WCT	1	115	115	1.00	1.00	1.00	0.24
N.F Grouse Creek	7	WCT	25	72	133	30.88	24.00	39.12	7.87
N.F Grouse Creek	8	WCT	68	67	200	63.44	61.00	68.18	18.06
N.F Grouse Creek	9	WCT	78	67	204	86.20	77.78	94.61	21.96
N.F Grouse Creek	10	WCT	90	71	209	78.24	76.00	82.52	21.73
N.F Grouse Creek	1	WRHY	2	131	158	2.57	2.00	10.85	0.61
N.F Grouse Creek	3	WRHY	1	108	108	1.29	1.00	9.56	0.29
N.F Grouse Creek	4	WRHY	1	90	90	1.00	1.00	1.00	0.27
N.F Grouse Creek	5	WRHY	2	110	138	2.57	2.00	10.85	0.62
N.F Grouse Creek	6	WRHY	5	83	97	5.00	5.00	5.00	1.20
N.F Grouse Creek	7	WRHY	3	82	85	3.86	3.00	12.13	0.98
Rapid Lightning Creek	3	BLT	2	121	124	2.57	2.00	10.85	0.24
Rapid Lightning Creek	1	BRK	4	60	71	NA			
Rapid Lightning Creek	3	BRK	4	128	134	5.15	4.00	13.41	0.47
Rapid Lightning Creek	5	BRK	4	139	161	4.00	4.00	4.00	0.44
Rapid Lightning Creek	7	BRK	11	49	138	9.01	7.00	17.26	1.07
Rapid Lightning Creek	9	BRK	22	49	224	19.64	19.00	21.85	3.04
Rapid Lightning Creek	11	BRK	34	47	234	41.17	32.92	49.42	6.46
Rapid Lightning Creek	13	BRK	48	67	217	49.06	47.00	53.52	11.65
Rapid Lightning Creek	15	BRK	8	76	181	10.29	8.00	18.55	2.74
Rapid Lightning Creek	1	BBH	1	118	118	NA			

Table 2 Continued.

STREAM	SECTION	SPECIES	CAUGHT	MIN TL	MAX TL	EST. N	95% CI -	95% CI +	DENSITY/100m^2
Rapid Lightning Creek	1	LNDC	14	64	120	NA			
Rapid Lightning Creek	3	LNDC	6	66	127	NA			
Rapid Lightning Creek	3	LSS	1	165	165	NA			
Rapid Lightning Creek	1	MWF	30	57	209	15.46	13.00	22.84	1.27
Rapid Lightning Creek	3	MWF	33	57	170	11.58	9.00	19.83	1.07
Rapid Lightning Creek	1	ONC	3	31	40	NA			
Rapid Lightning Creek	3	ONC	3	31	42	NA			
Rapid Lightning Creek	5	ONC	1	50	50	NA			
Rapid Lightning Creek	13	ONC	2	60	64	NA			
Rapid Lightning Creek	1	RBT	57	85	230	60.75	57.00	66.95	5.01
Rapid Lightning Creek	3	RBT	26	91	161	33.45	26.00	41.69	3.08
Rapid Lightning Creek	5	RBT	2	120	142	0.00*	2.00	0.00	0.00
Rapid Lightning Creek	1	SCL	1	67	67	NA			
Rapid Lightning Creek	9	SCL	1	43	43	NA			
Rapid Lightning Creek	11	SCL	3	63	113	NA			
Rapid Lightning Creek	13	SCL	5	60	92	NA			
Rapid Lightning Creek	1	WCT	1	81	81	0.00*	1.00	0.00	0.00
Rapid Lightning Creek	5	WCT	5	86	243	5.00	5.00	5.00	0.55
Rapid Lightning Creek	7	WCT	17	84	241	21.87	17.00	30.11	2.60
Rapid Lightning Creek	9	WCT	14	72	188	12.13	12.00	12.98	1.88
Rapid Lightning Creek	11	WCT	11	71	227	11.58	9.00	19.83	1.82
Rapid Lightning Creek	13	WCT	30	63	198	26.18	26.00	27.19	6.22
Rapid Lightning Creek	15	WCT	51	70	199	59.18	50.89	67.47	15.78
Rapid Lightning Creek	17	WCT	71	47	196	65.80	65.00	67.93	12.62
Rapid Lightning Creek	3	WRHY	2	134	208	2.57	2.00	10.85	0.24
Rapid Lightning Creek	5	WRHY	22	96	289	22.56	22.00	24.65	2.49

BLT = bull trout
BRK = brook trout
BBH = black bullhead
BBHY = brook trout x bull trout hybrid
LNDC = longnose dace
LSS = largescale sucker
MWF = mountain whitefish
ONC = unidentified Oncorhynchus spp.
RBT = rainbow trout
RSS = redside shiner
SCL = unidentified sculpin spp.
WCT = westslope cutthroat trout
WRHY = westslope cutthroat trout x rainbow trout hybrid

Table 3. Mean estimated density of sampled salmonids among all sample locations from 2010 Lake Pend Oreille tributary monitoring. Density estimates represent only fish ≥ 75 mm.

	SPECIES (Average fish/100 m^2)						
STREAM	BBHY	BLT	BRK	MWF	RBT	WCT	WRHY
Grouse Creek	0.22	3.47	0.35	0.65	8.17	3.55	0.25
N.F. Grouse Creek		0.00	4.12		5.05	5.87	0.33
Rapid Lightning Creek		0.03	3.23	1.17	1.01	5.18	0.30

BBHY = brook trout x bull trout hybrid
BLT = bull trout
BRK = brook trout
MWF = mountain whitefish
RBT = rainbow trout
WCT = westslope cutthroat trout
WRHY = westslope cutthroat trout x rainbow trout hybrid

Bull Trout Redd Monitoring

METHODS

Idaho Department of Fish and Game, Avista, and US Forest Service staff conducted bull trout redd counts on 19 tributaries to Lake Pend Oreille (LPO), as well as the Clark Fork River. In addition, surveys were completed on the Middle Fork East River and Uleda Creek (tributaries to the lower Priest River). We located redds visually by walking along annually monitored sections within each tributary (Table 1). Bull trout 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 where one redd was superimposed over another redd, each distinct depression was counted as one redd.

We used a nonparametric rank-correlation procedure, Kendall's tau b ($\alpha = 0.05$) (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 (PBTAT 1998). 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 that year. In addition, we did not use the 1983 data point for Grouse Creek or the 1986 data points for Rattle and East Fork Lightning creeks because some segments of these streams that may have contained relatively substantial numbers of redds were not counted. We evaluated long-term trends in redd counts as the period between 1983and present, excluding exceptions noted above. We evaluated short-term trends using data collected since 2001.

RESULTS

We completed bull trout redd counts between October 8 and 19, 2010. Redd counts ranged from a low of 0 redds in Twin Creek to a high of 188 redds in Trestle Creek (Table 2). A total of 654 bull trout redds were observed across all sample locations. Index streams surveyed since 1983, accounted for 456 of the total observed redds in 2010. Based on 2010 redd counts, the expanded (3.2 fish per redd) adult bull trout spawning population consisted of at least an estimated 2,093 individuals. We estimated five local populations to have more than 100 adult spawning fish.

We detected significant positive trends in bull trout redd counts in both Porcupine Creek and Johnson Creek over the ten year period from 2001 to 2010 (Table 3). A short- term negative trend was detected in the Clark Fork River. Long-term significant trends were detected on the Clark Fork River (negative), Granite, Gold, and Johnson creeks, and collectively among all streams (all positive). Trend evaluations were largely consistent with the 2009 survey year although a significant positive trend in Johnson Creek was a new finding in 2010 (Ryan and Jakubowski 2011). In addition, a short- term significant decline in Clark Fork River counts had not been detected in the previous year. We detected a significant short- term positive trend for Lightning Creek between 2000 and 2009, but did not in 2010.

Table 1. Survey streams for annual bull trout redd counts in tributaries to Lake Pend Oreille, Idaho.

STREAM	SECTION DESCRIPTION (approximate length (km))
Char Cr	Mouth to falls (1.2)
Clark Fork River	Spawning channel (N/A)
E. Fk. Lightning Cr[a]	Savage to Thunder Creek (5.0)
Gold Cr[a]	Mouth to 0.2 km upstream of W. Gold confluence (2.4)
Granite Cr	Mouth to road 278 crossing (6.4)
Grouse Cr[a]	Flume Creek to end of road 280 (2.4 km beyond gate) (6.5)
Johnson Cr[a]	Mouth to falls (1.5)
Lightning Cr	Rattle to Quartz (3.2)
Morris Cr	Mouth to trail 132 crossing (N/A)
N. Gold Cr[a]	Mouth to falls (1.2)
Pack R	Road 231 bridge near McCormick Cr to Falls located 0.4 km downstream of W. Branch (2.8)
Porcupine Cr	Mouth to S.Fk. (3.2)
Rattle Cr	Mouth to falls by upper bridge (5.7)
Savage Cr	Mouth to trail 61 crossing (2.0)
Strong Cr	Mouth to diversion barrier (N/A)
Sullivan Springs	Mouth upstream 0.4 km (0.4)
Trestle Cr[a]	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)
Twin Cr	Mouth to River Road (1.5)
Wellington Cr	Mouth to falls (0.5)

[a] Denotes “index” stream

Table 2. 2010 Bull trout redd counts from tributaries of Lake Pend Oreille, Clark Fork River, and Pend Oreille River, Idaho.

STREAM	Avg 1983-2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Clark Fork R.	8	6	7	8	1	0	3	2	0	1	0
Lightning Cr.	11	7	8	8	9	22	9	3	10	11[b]	0
East Fork Cr.	51	36	58	38	77	50	51	34	38	85	26
Savage Cr.	7	4	15	7	15	7	25	0[b]	8	5	6
Char Cr.	11	2	8	7	14	15	20	1	5[e]	1[e]	4[e]
Porcupine Cr.	11	0	0	5	10	14	8	8	8	15	11
Wellington Cr.	9	7	7	8	7	6	29	9	10	4[b]	7
Rattle Cr.	16	67	33	37	34	34	21	2	24	62[b]	43
Johnson Cr.	18	34	31	0	32	45	28	32	40	47	57
Twin Cr.	10	1	8	3	6	7	11	0	4	0	0
Morris Cr.	1	0	7	1	1	3	16	0	6	6	9
Strong Cr.	2	--	0	--	0	--	--	--	7	6	2
Trestle Cr. [a]	244	335	333	361	102[b]	174	395	145	183	279	188
Pack R.	22	28	22	24	31	53	44	16	11	4	0
Grouse Cr.	38	18	42	45	28	77	55	38	31	51	27
Granite Cr.	33	7	57	101	149	132	166	104	52	106[c]	75[c]
Sullivan Springs Cr.	16	8	15	12	14	15	28	17	7[c]	2[c]	9[c]
North Gold Cr.	30	16	24	21	56	34	30	28	17	28[c]	28[c]
Gold Cr.	112	127	203	126	167	200	235	179	73	107[c]	130[c]
W. Gold Cr.	NA	--	--	--	--	--	4	0	7	5	4
M.F. East R.	NA	4[d]	8[d]	21	20	48	71	34	36	25	22
Uleda Cr.	NA	3[d]	4[d]	3	7	4	7	2	7[b]	16	6
N.F. East R.	NA	--	--	--	1	0	0	--	0	--	0
Total 6 index streams	489	566	691	591	462	580	794	456	382	597	456
Total of all streams	605	710	890	836	781	940	1256	654	584	866	654

[a] Additional apprx. 0.5 km reach immediately upstream of index reach on Trestle Creek added in 2001
[b] Impaired observation conditions (ice, high water, ect)
[c] Abundant early spawning kokanee made identification of bull trout redds in lower reaches difficult
[d] Partial Count
[e] Barrier excluded bull trout from accessing typical spawning habitat

Table 3. Correlations between year and redd count (trends) for bull trout populations monitored from 1983 to 2010 in tributaries to Lake Pend Oreille, Idaho. The total number of years actually included for each evaluation is described by valid years. Tau b represents the direction and magnitude of observed trend.

	PERIOD 2001 to 2010		PERIOD 1983 to 2010	
STREAM	YEARS	TAU-b	YEARS	TAU-b
Clark Fork River	10	-0.54[a]	19	-0.50[a]
Lightning Creek	10	0.16	23	-0.08
East Fork Lightning Creek	10	-0.09	25	-0.10
Savage Creek	10	-0.11	22	0.04
Char Creek	10	-0.13	23	-0.12
Porcupine Creek	10	0.58[a]	23	0.04
Wellington Creek	10	0.02	23	-0.09
Rattle Creek	10	-0.13	22	0.17
Johnson Creek	10	0.49[a]	27	0.32[a]
Twin Creek	10	-0.28	23	-0.24
Morris Creek	10	0.37	12	0.39
Strong Creek	5	0.32	6	0.21
Trestle Creek	10	-0.11	27	0.05
Pack River	10	-0.47	23	-0.24
Grouse Creek	10	0.02	26	-0.03
Granite Creek	10	0.16	23	0.46[a]
Sullivan Springs	10	-0.09	23	0.02
North Gold Creek	10	0.09	28	-0.16
Gold Creek	10	-0.16	28	0.29[a]
West Gold Creek	5	0.11	5	0.11
Middle Fork East River	10	0.38	10	0.38
Uleda Creek	10	0.38	10	0.38
North Fork East River	5	-0.63	5	-0.63
Index Streams	10	-0.27	27	0.08
All Streams	10	-0.20	27	0.29[a]

[a] Denotes significance at $\alpha \leq 0.05$

REFERENCES

Hayes, D. B., J. R. Bence, T. J. Kwak, and B. E. Thompson. 2007. Abundance, biomass, and production *in* Analysis and interpretation of freshwater fisheries data, C. S. Guy and M. L. Brown, editors. American Fisheries Society,Bethesda, Maryland.

Hoelscher, B. and T.C. Bjornn. 1989. Habitat, densities, and potential production of trout and char in Pend Oreille Lake Tributaries. Idaho Department of Fish and Game, Job Completion Report, Project F-71-R-12, Boise.

Ryan, R. and R. Jakubowski. 2011. Native Salmonid Research and Monitoring Progress Update, 2009. Report to Avista Corporation, Spokane, Washington.

Panhandle Bull Trout Technical Advisory Team. 1998. Lake Pend Oreille key watershed bull trout problem assessment. Idaho Department of Environmental Quality, Boise.

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

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

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

Appendix A. Lake Pend Oreille Tributary Monitoring Location Maps

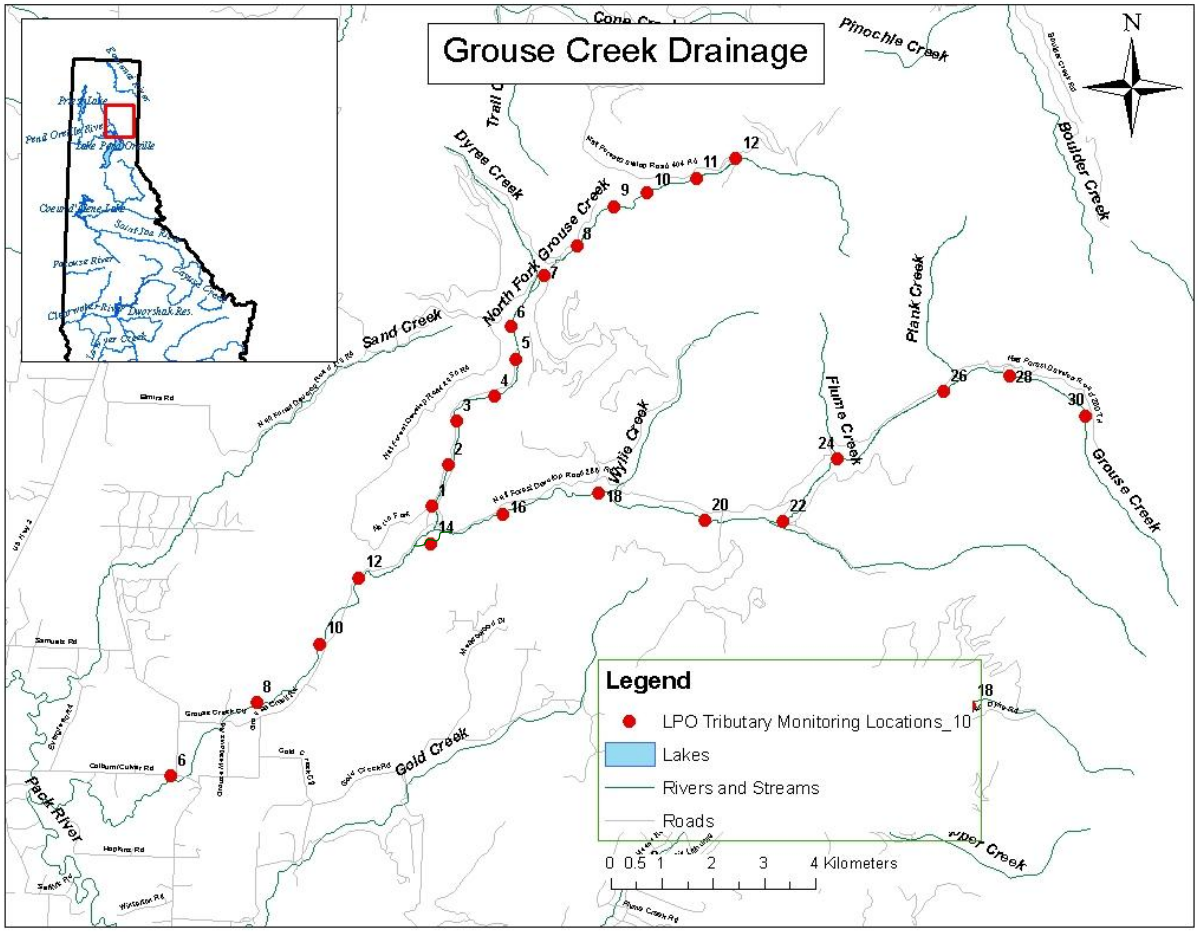

Figure A-1. 2010 tributary monitoring locations on Grouse Creek and North Fork Grouse Creek, Idaho.

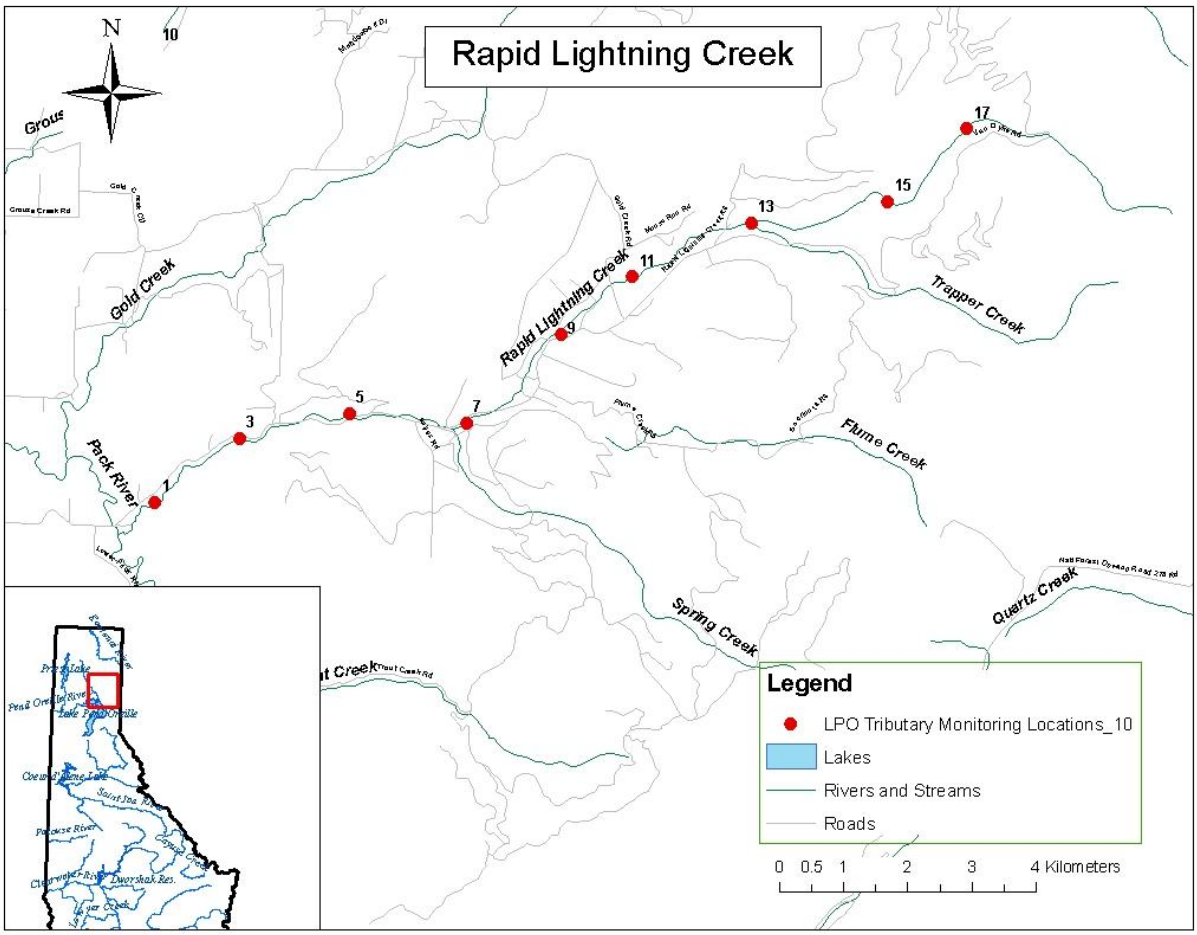

Figure A-2. 2010 tributary monitoring locations on Rapid Lightning Creek, Idaho.