

2022 Pend Oreille Basin Bull Trout Redd Monitoring Annual Project Update

Idaho Tributary Habitat Acquisition and Enhancement Program

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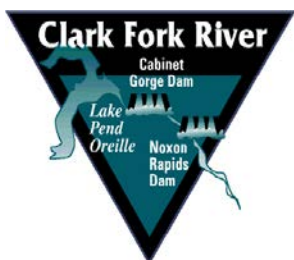


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ABSTRACT

Redd counts are used as an index of abundance to gauge the relative strength of adult Bull Trout *Salvelinus confluentus* escapement in Lake Pend Oreille basin tributaries. Counts are conducted annually during the month of October in 23 tributaries and are performed by two individuals who physically walk each stream and tally observed redds in a single pass. Surveys were completed between October 6 and 20, 2022. A total of 459 Bull Trout redds (all considered migratory) were counted among all surveyed streams in 2022. For all streams combined, counts were 23% below the previous 10-year average. Mild fall weather in 2022 was conducive to counting redds.

INTRODUCTION

Redd 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 (Al-Chokhachy et al. 2005). Redd counts require less effort to conduct than other traditional monitoring methods, such as fish trapping, yet provide information on adult Bull Trout abundance at the watershed and/or population level. However, redd counts are not without their limitations, as the technique has been shown to be prone to observer variability (Dunham et al. 2001). In addition, annual variation in flows, water clarity, spawner timing, and survey conditions (e.g., rain or lighting conditions) all can influence individual stream counts (Dunham et al. 2001). As a result, caution should be used when interpreting redd count results, particularly from one year to the next.

METHODS

With assistance from other agencies, Avista and Idaho Department of Fish and Game staff conducted annual Bull Trout redd counts on 23 tributaries to Lake Pend Oreille (LPO) and the lower Clark Fork River in 2022. In addition, U.S. Fish and Wildlife Service employees completed surveys on the Middle Fork East River and Uleda Creek (tributaries to the lower Priest River). Redds were located visually by walking standardized sections within each tributary (Tables 1 and 2). Bull Trout redds were defined as areas of clean gravels at least 0.3 x 0.6 m in size with gravels at least 76 mm in diameter having been moved by the fish and with a mound of loose gravel down-current from a depression (Pratt 1984). In areas where one redd was superimposed over another, each distinct depression was counted as an individual redd. Global Positioning Satellite (GPS) coordinates were collected at each redd location (Figure 1). Novice observers were paired with more experienced counters in lieu of a formal training session, which had the added benefit of increased safety. Counters were considered “experienced” if they had participated in LPO redd count surveys for at least one year under the direction of another experienced counter.

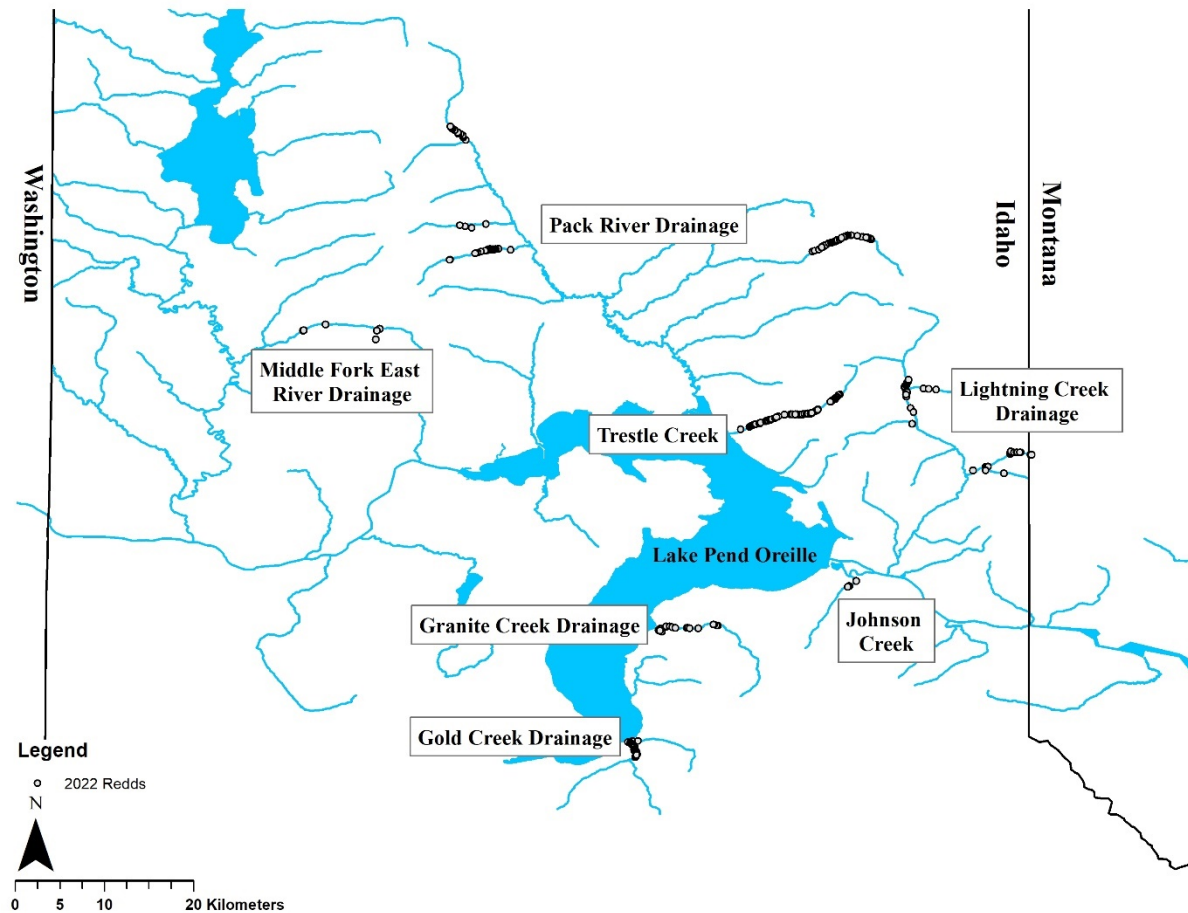


FIGURE 1. Map of streams surveyed and 2022 Bull Trout redd locations recorded using handheld GPS units in the Pend Oreille drainage, Idaho.

TABLE 1. Survey streams for annual Bull Trout redd counts in tributaries to the lower Priest River, LPO, and the lower Clark Fork River, Idaho.

Stream	Section Description (approximate length in km)
Caribou Cr.	Between Caribou Creek road crossings at 1 km and 7 km (6.0 km)
Char Cr.	Mouth to barrier (0.2 km)
East Fork Lightning Cr.	Savage to Thunder Creek (5.0 km)
Granite Cr.	Mouth to Road 278 crossing (6.4 km)
Grouse Cr.	Flume Creek to 2.4 km beyond gate at end of Road 280 (6.5 km)
Hellroaring Cr.	Mouth to falls (2.4 km)
Johnson Cr.	Mouth to falls (1.5 km)
Lightning Cr.	Rattle Creek mouth to falls (3.2 km)
Middle Fork East R.	Idaho Department of Lands (IDL) Road 1012 crossing to IDL Road 10 crossing (9.2 km)
Morris Cr.	Mouth to Trail 132 crossing (2.5 km)
North Gold Cr.	Mouth to falls (1.2 km)
Pack River	Road 231 bridge near McCormick Cr. to falls located 0.4 km downstream of W. Branch (2.8 km)
Porcupine Cr.	Mouth to S. Fork (3.2 km)
Rattle Cr.	Mouth to falls by upper bridge (5.7 km)
Savage Cr.	Mouth to Trail 61 crossing (2.0 km)
South Gold Cr.	Mouth to 0.2 km upstream of W. Gold confluence (2.4 km)
Strong Cr.	Lower Reach: Mouth upstream 1 km to top of hillside slide (1.0 km)
Strong Cr.	Upper Reach: Forest Service boundary upstream 1 km (1.0 km)
Sullivan Springs	Mouth upstream 0.4 km (0.4 km)
Trestle Cr.	1.6 km upstream of mouth to approximately 1.0 km upstream of road 275 switchback, at the confluence with first southeast bank un-named tributary (11.1 km)
Uleda Cr.	Mouth to IDL Road 101 crossing (2.0 km)
Wellington Cr.	Mouth to falls (0.5 km)
West Gold Cr.	Lakeview Rd. bridge to confluence with S. Gold Cr. (0.7 km)

TABLE 2. Latitude and longitude (WGS 84) of the downstream and upstream boundaries of the annual Bull Trout redd count survey reaches in tributaries to the lower Priest River, Lake Pend Oreille, and the lower Clark Fork River, Idaho.

Stream	Downstream		Upstream	
	Latitude	Longitude	Latitude	Longitude
Caribou Cr.	48.4716	-116.5648	48.4579	-116.6408
Char Cr.	48.2620	-116.0682	48.2726	-116.0646
East Fork Lightning Cr.	48.2475	-116.0980	48.2621	-116.0395
Granite Cr.	48.0852	-116.4249	48.0845	-116.3550
Grouse Cr.	48.4667	-116.2675	48.4780	-116.2060
Hellroaring Cr.	48.4946	-116.5689	48.4938	-116.6003
Johnson Cr.	48.1365	-116.2247	48.1286	-116.2319
Lightning Cr.	48.3266	-116.1725	48.3525	-116.1766
Middle Fork East R.	48.3797	-116.7923	48.3883	-116.6822
Morris Cr.	48.2236	-116.1174	48.2126	-116.0896
North Gold Cr.	47.9734	-116.4525	47.9725	-116.4395
Pack River	48.5768	-116.6119	48.5991	-116.6368
Porcupine Cr.	48.2676	-116.1237	48.2538	-116.1570
Rattle Cr.	48.3266	-116.1725	48.3204	-116.1138
Savage Cr.	48.2475	-116.0980	48.2427	-116.0725
South Gold Cr.	47.9709	-116.4543	47.9536	-116.4523
Strong Cr. (Lower Reach)	48.2408	-116.3010	48.2449	-116.2950
Strong Cr. (Upper Reach)	48.2519	-116.2881	48.2554	-116.2853
Sullivan Springs	48.0839	-116.4219	48.0823	-116.4175
Trestle Cr.	48.2893	-116.3312	48.3298	-116.2340
Uleda Cr.	48.3876	-116.7075	48.3702	-116.7045
Wellington Cr.	48.2908	-116.1628	48.2935	-116.1695
West Gold Cr.	47.9536	-116.4523	47.9518	-116.4605

RESULTS AND DISCUSSION

Redd counts were conducted October 6–20, 2022. A total of 459 Bull Trout redds (all considered migratory) were counted among all surveyed streams (Table 3; Appendix A). This was 19 more than the total counted during 2021, but still 23% below the 10-year average. Most stream counts were below past averages; however, this was partially offset by an uptick in redds counted in Grouse and Lightning creeks, which had their highest counts since 2011 and 1985, respectively (Table 4, Figures 2–11; Appendix A). Favorable weather and stream flows made for ideal surveying conditions in all locations (Table 5). Specific coordinates of redds are displayed visually in Appendix B and are listed in Appendix C.

Redd count data are inherently variable due to changing survey conditions, spawning timing, stream morphology, and variability among surveyors. Attempts have been made to standardize sampling by surveying during the same time each year and providing consistent training for surveyors, but annual variability will always exist. For example, several redds were reported in McCormick Creek during a 2019 watershed survey, but when officially surveyed in 2020 through 2022 no redds were observed. These results suggest that hydrologically formed features were mistakenly identified as redds, and we recommend discontinuing this count. A recurring finding in numerous watershed assessments in the lower Clark Fork River-LPO area is that these watersheds are inherently dynamic and are geomorphically unstable (CES 1998; Golder Associates 2003, 2006; RDG 2009; PWA 2004). Therefore, it is not surprising that redd counts in specific watersheds and tributaries fluctuate with the habitat conditions, both short- and long-term. It is important to remember that these data are collected to provide general long-term trends, and it is appropriate to interpret these data cautiously, particularly over short time periods. Despite the sources of variation and shortcomings, redd counts are a reliable long-term monitoring tool for Bull Trout and remain a widely used technique for monitoring adult population trends (Kovach et al. 2018).

TABLE 3. Bull Trout redd counts by year from all tributaries to Lake Pend Oreille, the lower Clark Fork River, and the lower Priest River, Idaho 1984–2022.

Year	Total of all streams	Year	Total of all streams
1984	881	2004	781
1985	930	2005	940
1986	412	2006	1,256
1987	555	2007	654
1988	478	2008	584
1989	543	2009	866
1990	503	2010	654
1991	423	2011	815
1992	447	2012	652
1993	656	2013	781
1994	631	2014	717
1995	320	2015	553
1996	610	2016	359
1997	527	2017	782
1998	726	2018	702
1999	705	2019	500
2000	732	2020	496
2001	710	2021	440
2002	890	2022	459
2003	836	2002–2021 Avg	712
		2012–2021 Avg	596

TABLE 4. Bull Trout redd counts by year from all surveyed tributaries in the Lake Pend Oreille basin, Idaho 2012–2022. Blank cells indicate that no redd count occurred. Data prior to 2012 are listed in Appendix A.

Stream	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2012-2021
												Avg
Lightning Cr.	1	1	4	11		3	8	13	3	8	28	6
Cr.	11	26	22	17	19	80	87	35	10	34	20	34
Savage Cr.		5	6	5	1	19	15	3	6	3	3	7
Char Cr.	0	4	2	0	0	0	4	2	2	1	7	2
Porcupine Cr.	2	4	15	0	14	10	29	13	14	11	0	11
Wellington Cr.	5	5	11	8	3	5	15	7	6	2	4	7
Rattle Cr.	59	8	63	5	5	20	32	47	12	12	6	26
Morris Cr.	0	3	14	0	3	32	18	0	0	4	0	7
Johnson Cr.	54	50	21	5	5	10	14	5	7	27	12	20
Strong Cr.	3	47	17	0	10	4	8	0	18	1	0	11
Trestle Cr.	187	133	159	117	91	75	73	90	97	171	102	119
Granite Cr.	68	217	115	68	48	96	150	86	116	19	25	98
Sullivan Springs	4	11	4	0	4	14	18	11	12	8	13	9
North Gold Cr.	3	28	25	41	22	54	0	15	19	25	5	23
Gold Cr.	110	106	88	69	71	169	70	96	84	48	86	91
W. Gold Cr.	8	29	10	3	0	3	0	0	1	0	0	5
M.F. East R.	28	25	51	51	50	23	27	9	25	8	5	30
Uleda Cr.	24	14	26	11	2	1	0	1	3	1	2	8
Pack R.	7	6	1	35	5	57	30	8	2	9	17	16
Grouse Cr.	69	12	54	48		32	23	25	26	29	82	35
Caribou Cr.	6	47	9	57	4	51	70	11	6	8	34	27
Hellroaring Cr.	3			2	2	24	11	23	0	11	8	10
McCormick Cr.									0	0	0	0
Total of all stream	652	781	717	553	359	782	702	500	469	440	459	602

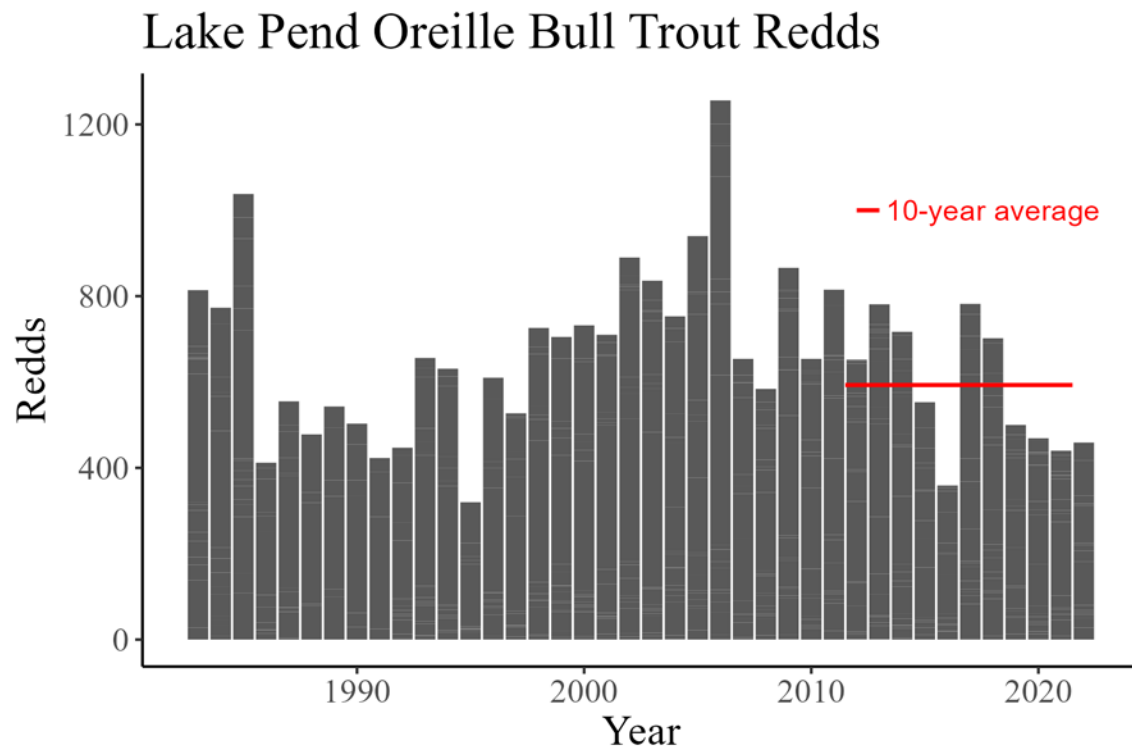


FIGURE 2. Total number of Bull Trout redds counted in all surveyed streams in the Pend Oreille drainage 1983–2022. The horizontal red line represents the prior 10-year average (2012–2021).

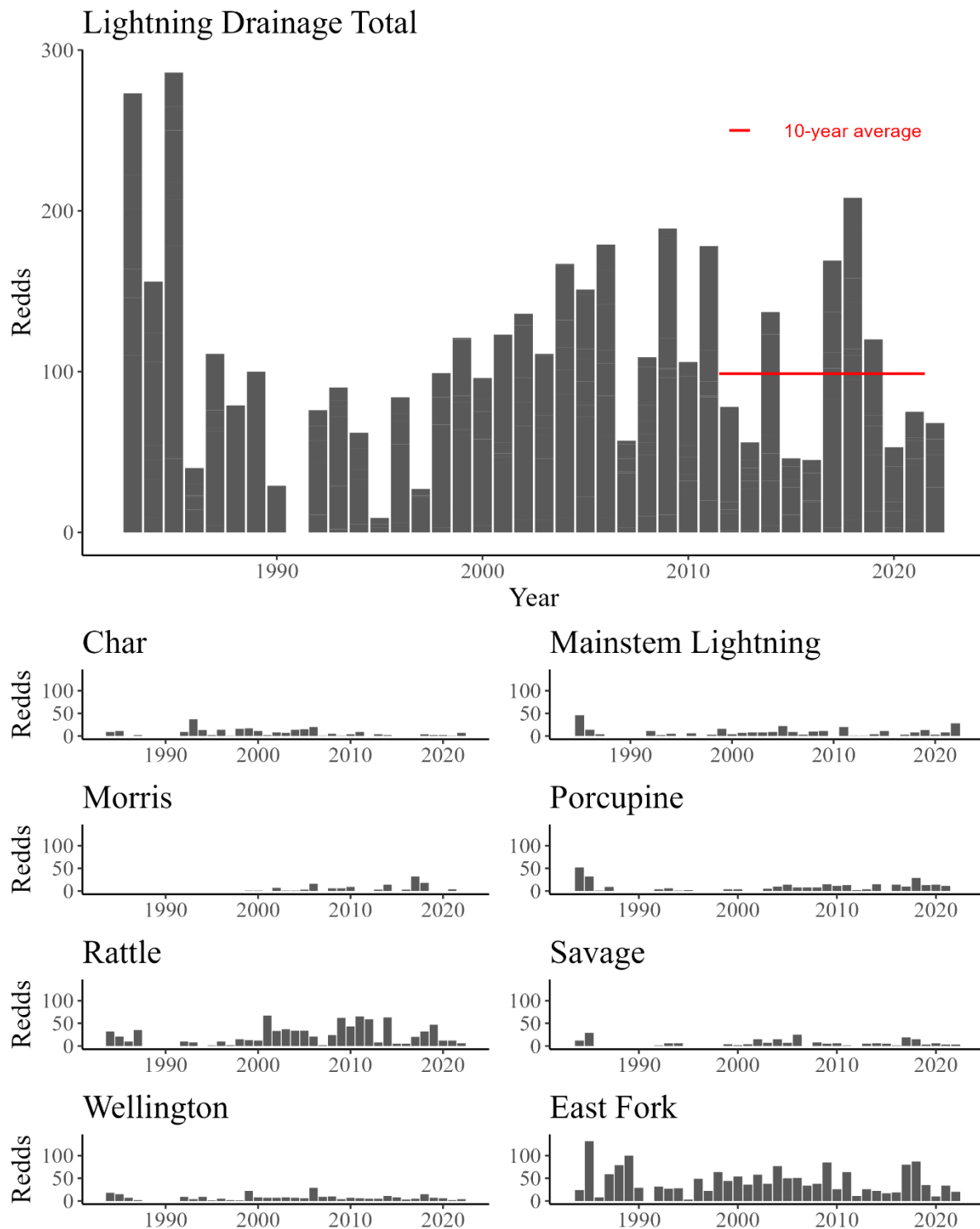


FIGURE 3. Number of Bull Trout redds counted in the Lightning Creek drainage 1983–2022. The horizontal red line represents the prior 10-year average (2012–2021).

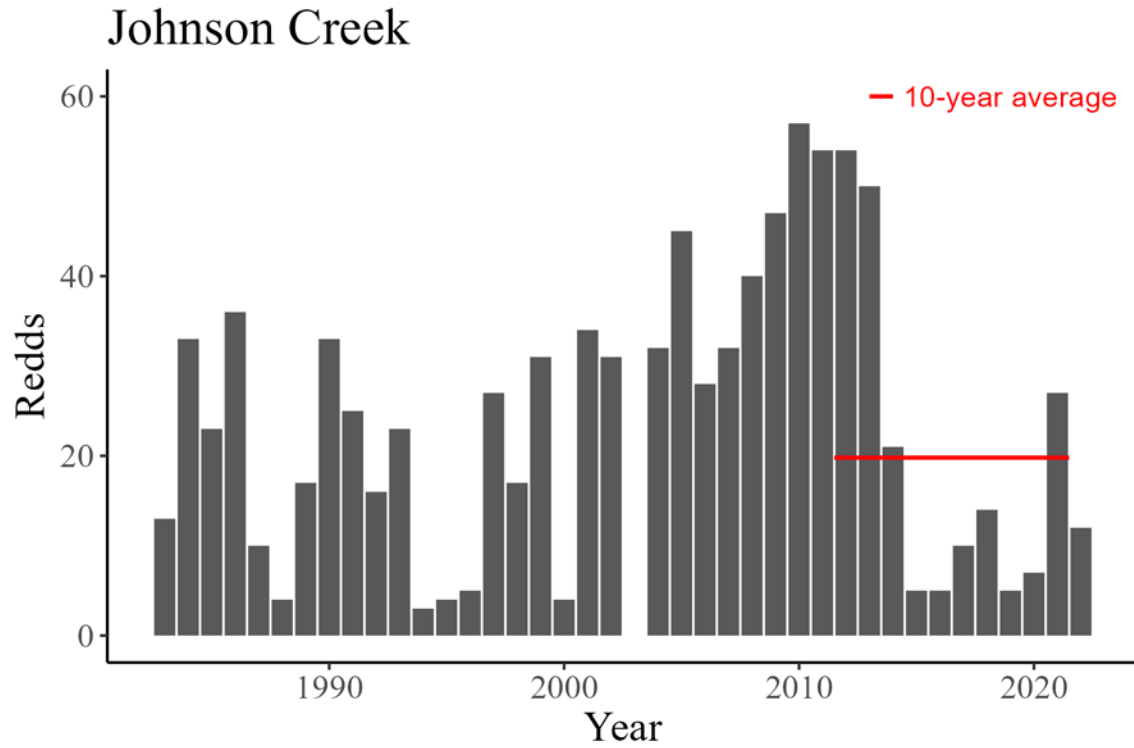


FIGURE 4. Number of Bull Trout redds counted in Johnson Creek 1983–2022. The horizontal red line represents the prior 10-year average (2012–2021).

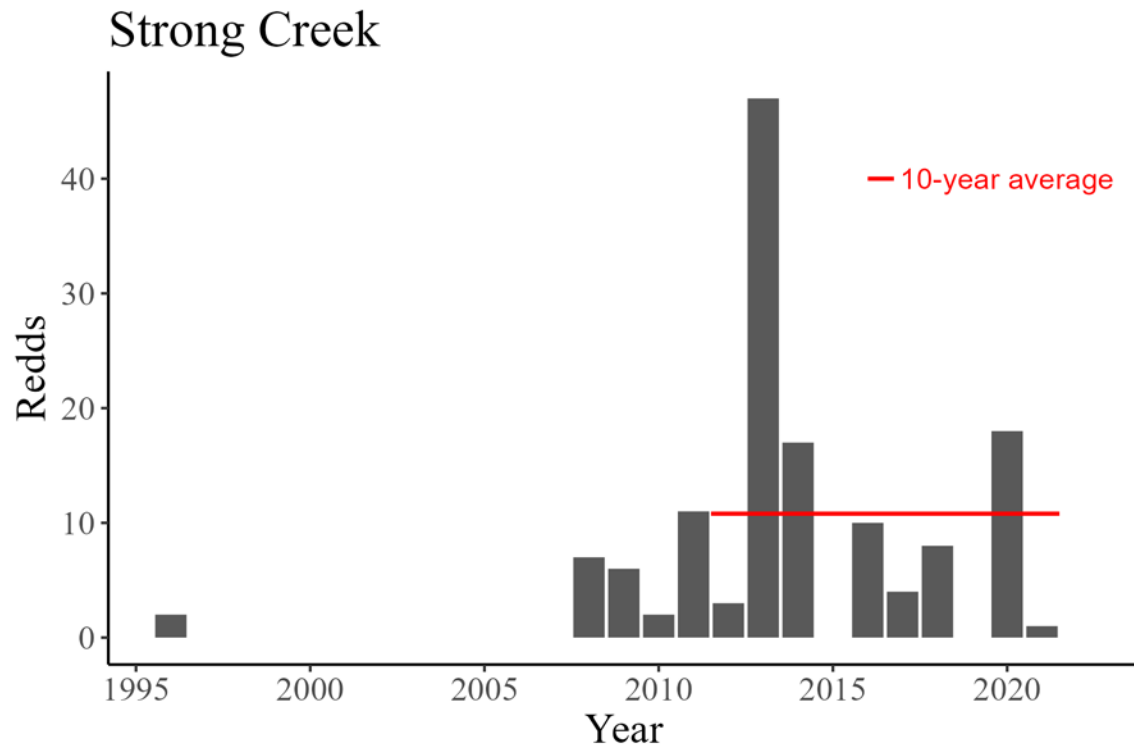


FIGURE 5. Number of Bull Trout redds counted in Strong Creek 1996–2022. The horizontal red line represents the prior 10-year average (2012–2021).

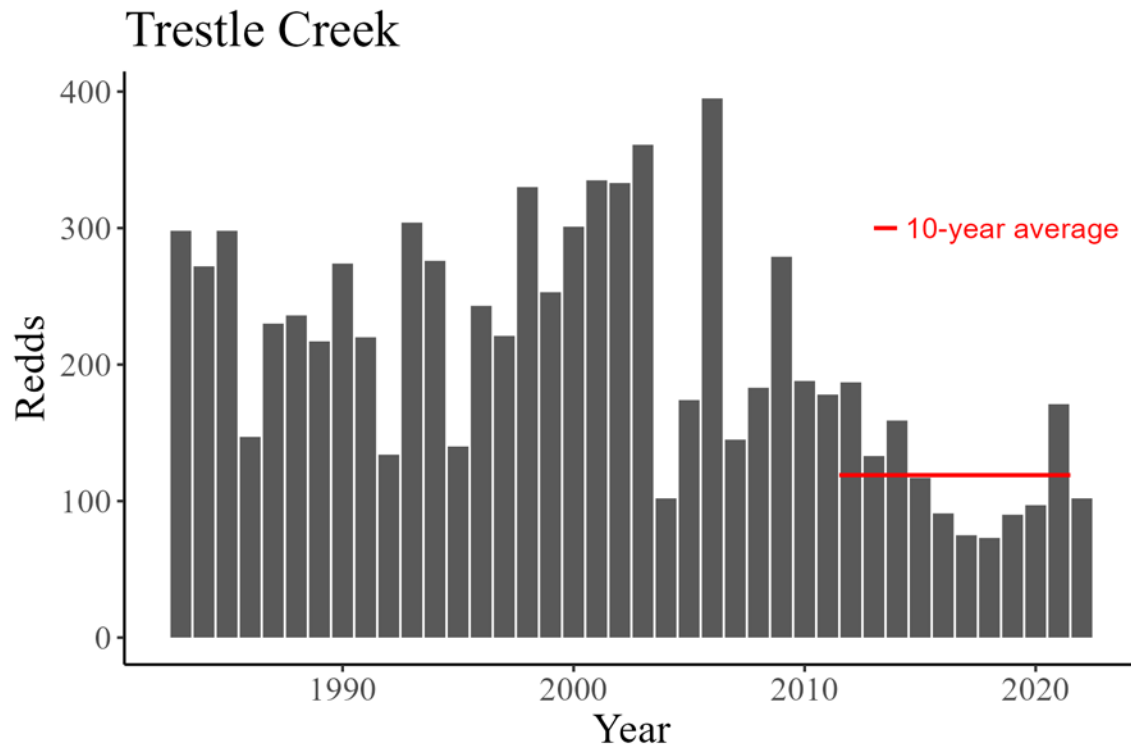


FIGURE 6. Number of Bull Trout redds counted in Trestle Creek from 1983–2022. The horizontal red line represents the prior 10-year average (2012–2021).

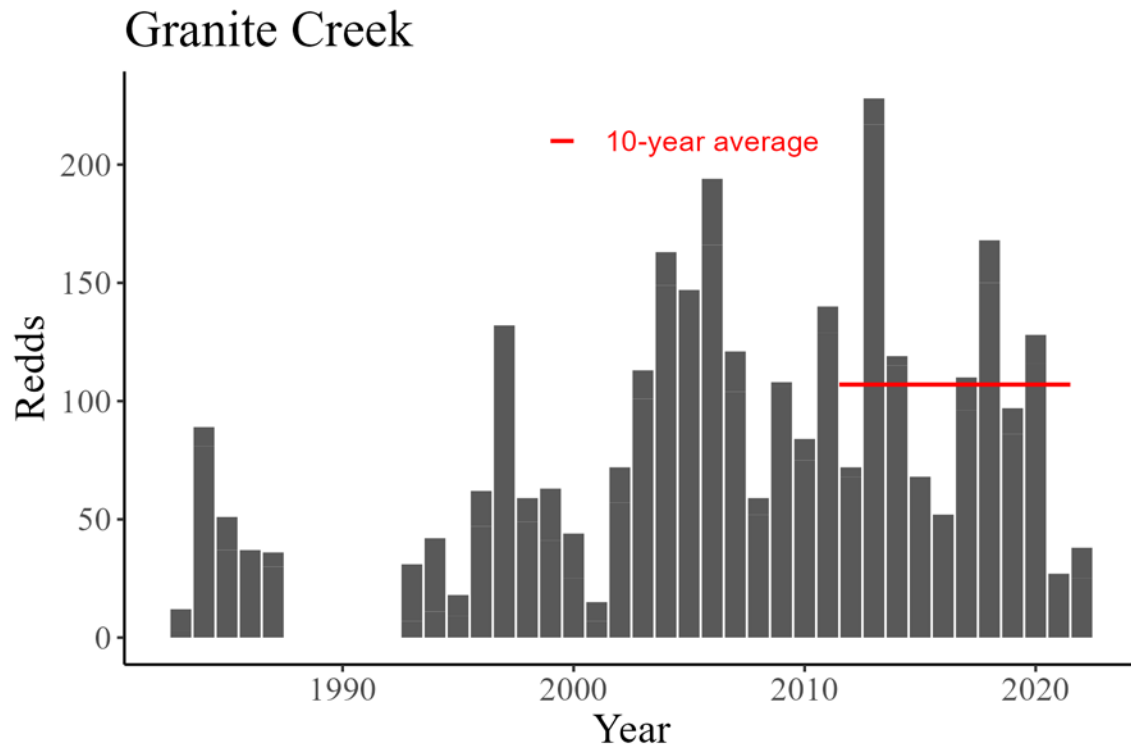


FIGURE 7. Number of Bull Trout redds counted in the Granite Creek drainage 1983–2022. The horizontal red line represents the prior 10-year average (2012–2021).

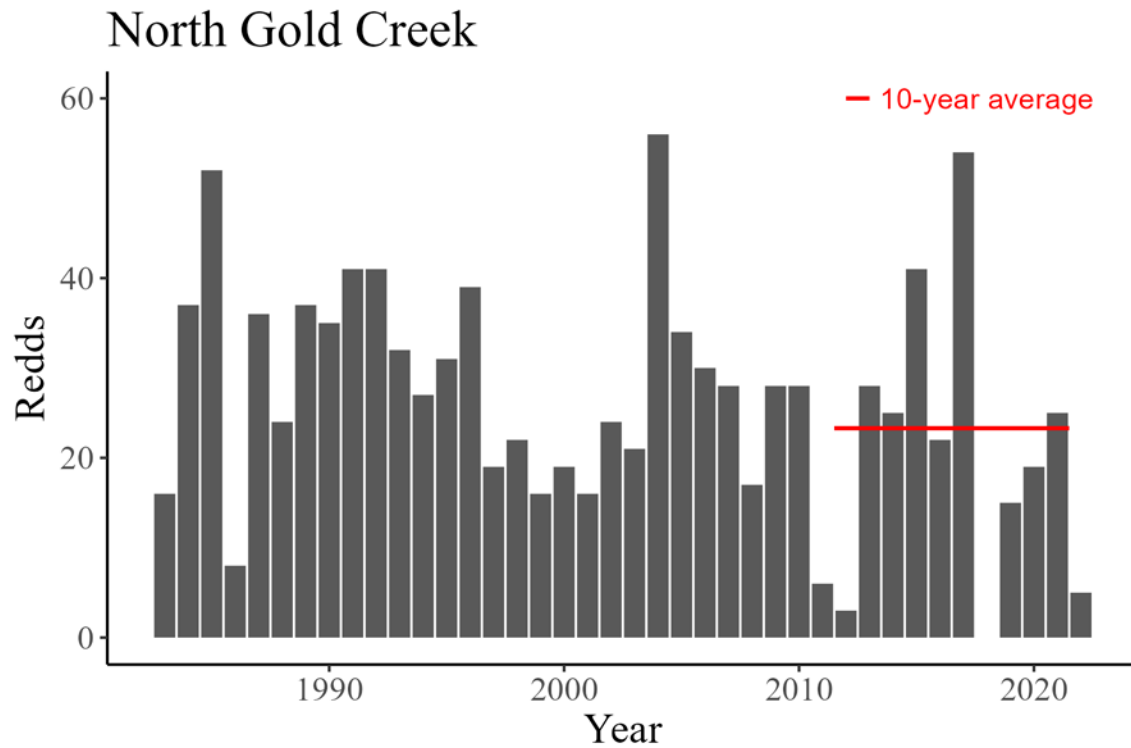


FIGURE 8. Number of Bull Trout redds counted in North Gold Creek 1983–2022. The horizontal red line represents the prior 10-year average (2012–2021).

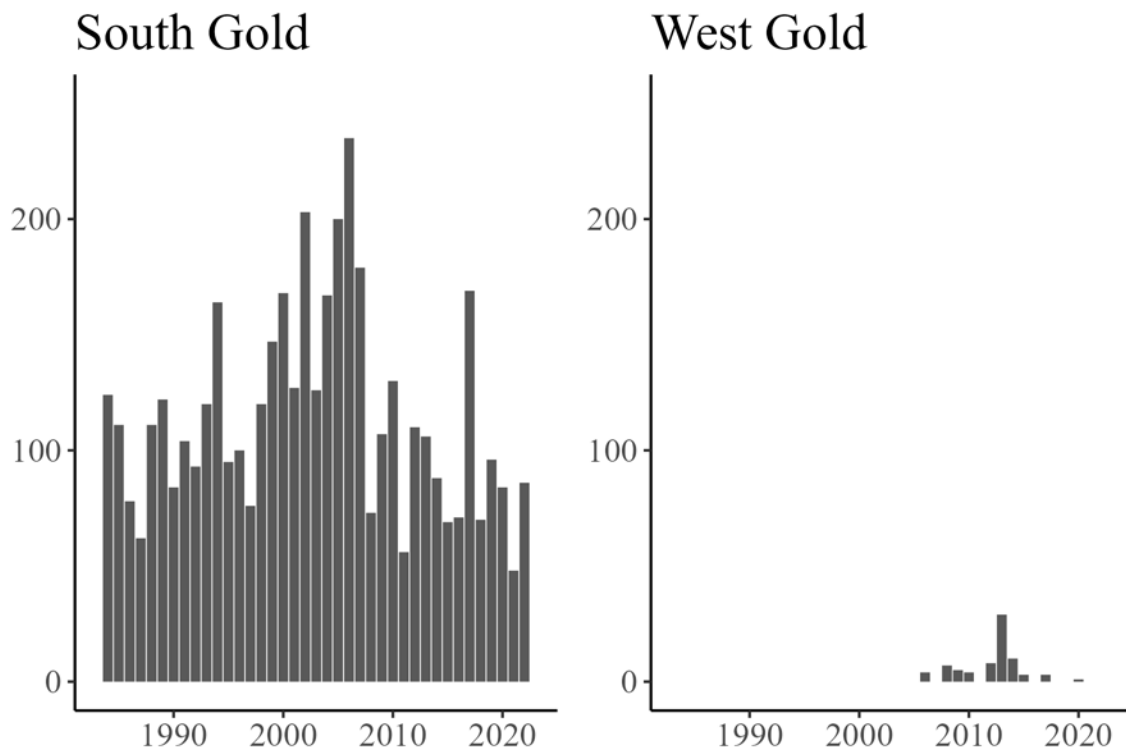
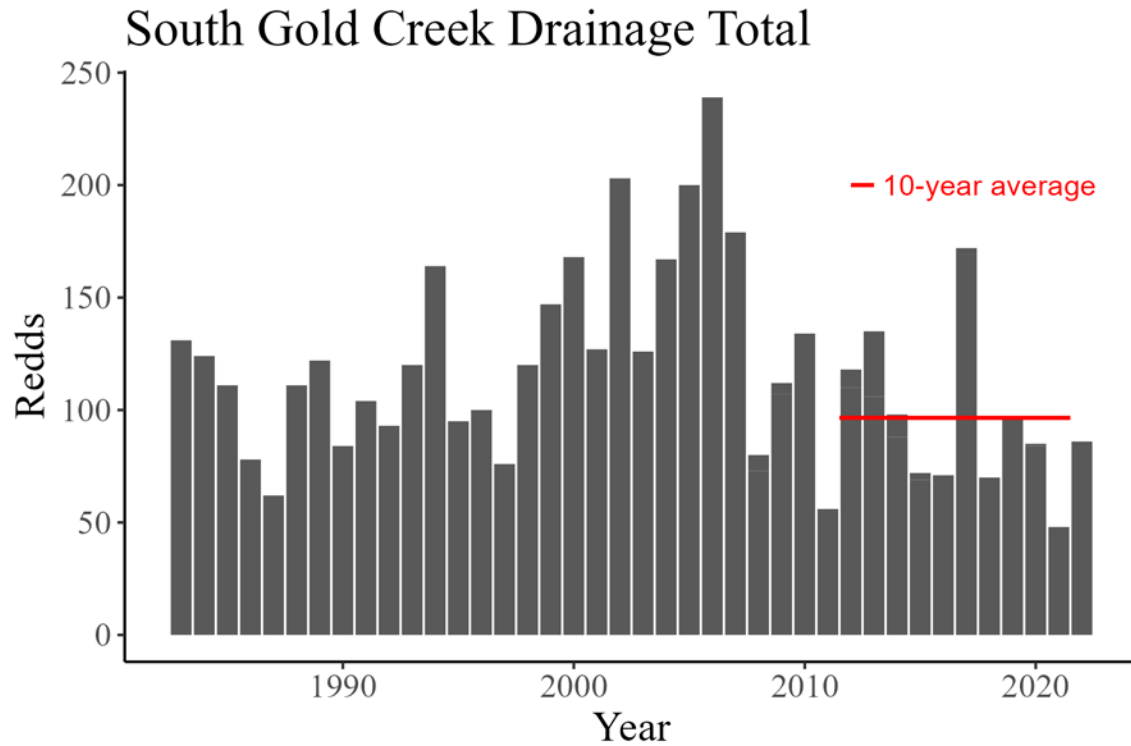


FIGURE 9. Number of Bull Trout redds counted in the South Gold Creek drainage 1983–2022. The horizontal red line represents the prior 10-year average (2012–2021).

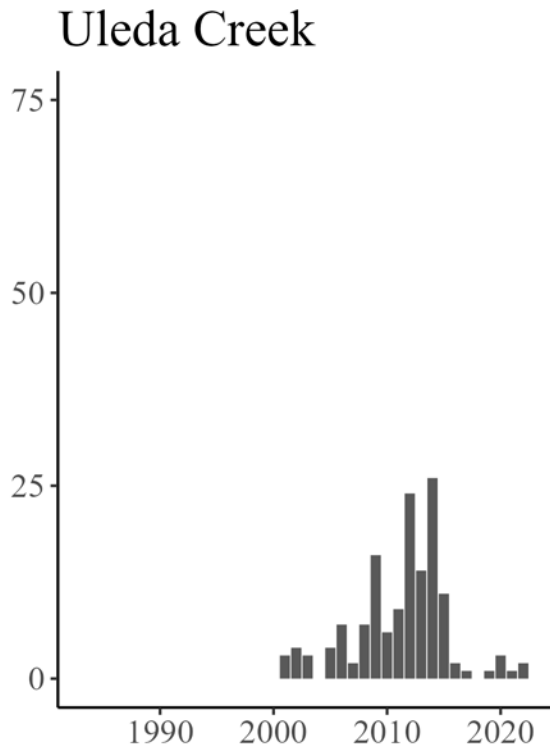
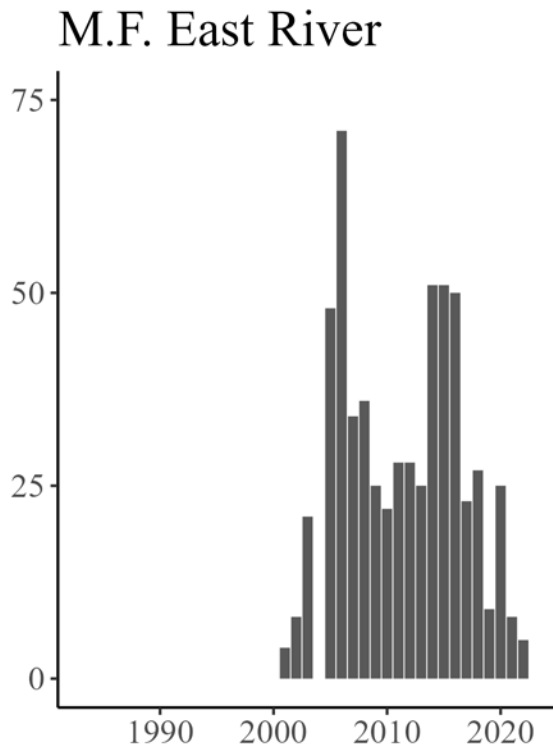
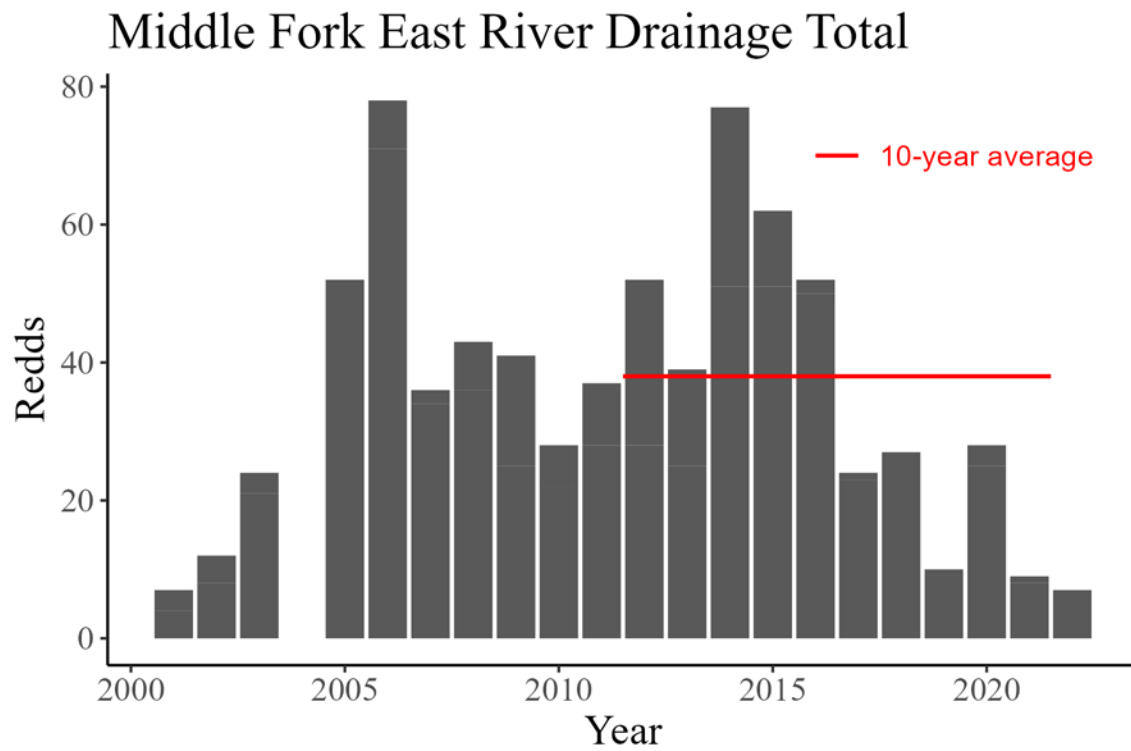


FIGURE 10. Number of Bull Trout redds counted in the Middle Fork East River drainage 2000–2022. The horizontal red line represents the prior 10-year average (2012–2021).

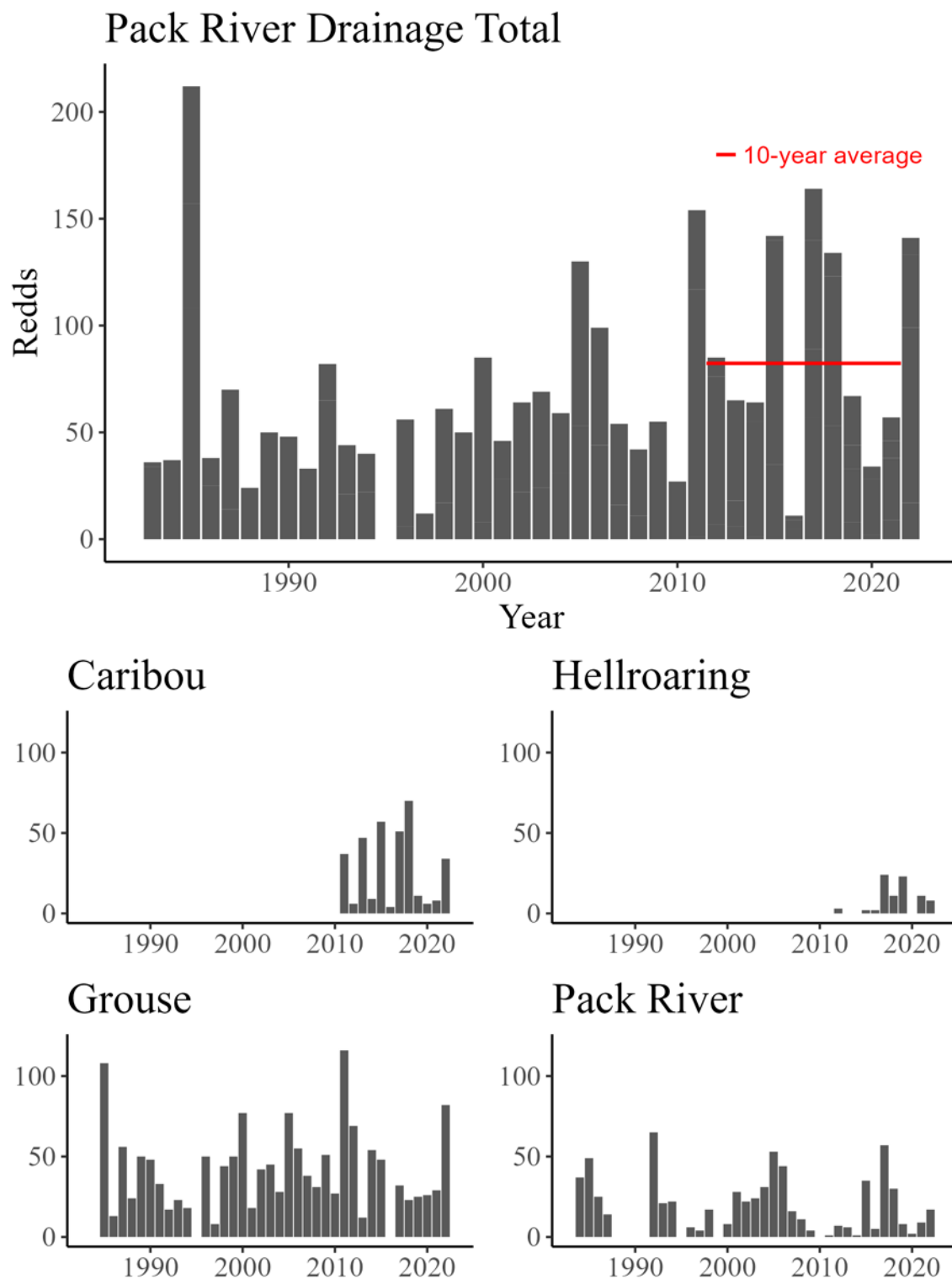


FIGURE 11. Number of Bull Trout redds counted in the Pack River drainage 1983–2022. The horizontal red line represents the prior 10-year average (2012–2021).

Tributaries within the LPO basin often experience large rainfall events during the winter when snowpack has already been established (rain-on-snow events). This can result in catastrophic flooding and widespread bedload movement throughout the watershed, and likely causes negative effects on incubating Bull Trout eggs (Rieman and McIntyre 1996). A recent and historic rain-on-snow event in December of 2015 restructured the Pack River and Lightning Creek drainages to the extent where much of each creek was unrecognizable. A majority of the in-stream large woody debris was mobilized, and new channels were formed. Early maturing fish from the 2015 year-class would have begun returning to spawn in 2020, and high mortality at the egg stage during the flood event may help explain the low numbers of redds observed in these drainages during the 2020 counts. However, this year (2022), is seven years after the event, when a subset of individuals from the 2016 and 2017 year-classes would have matured and begun to return to spawn. As a result, the increase seen in 2022 is likely driven by the return of fish from those year-classes. It is also possible that restructuring of the streams during the flood event may have improved spawning and juvenile rearing habitat, and increased recruitment.

Exploratory redd counts were conducted in Lightning Creek during 2022 in a 3 km reach from the mouth of Rattle Creek downstream to the Wellington Road bridge. This reach lies below the annual monitoring section; however, a total of 12 redds were counted during this survey and we recommend adding this reach to future surveys. These redds were not included in the 2022 count.

Smaller rainfall events are also possible during the time when redd counts are being conducted, and likely has influence on the effectiveness of positively identifying a redd. In a recent study by Arndt and Parsons (2021), redd count visibility was negatively impacted by significant hydrograph peaks just prior to and during a survey. In 2022, all creeks exhibited good survey conditions (Table 5).

TABLE 5. Dates surveyed and environmental conditions and water clarity rating (Poor, Moderate, Good) during the 2022 redd count on each creek.

Stream	Dates Surveyed	Counting Conditions
Caribou Cr.	10/13/22	Good
Char Cr.	10/11/22	Good
East Fork Lightning Cr.	10/11/22	Good
Granite Cr.	10/19/22	Good
Grouse Cr.	10/13/22	Good
Hellroaring Cr.	10/13/22	Good
Johnson Cr.	10/17/22	Good
Lightning Cr.	10/11/22	Good
Middle Fork East R.	10/18–19/22	Good
Morris Cr.	12/12/22	Good
North Gold Cr.	10/20/22	Good
Pack River	10/13/22	Good
Porcupine Cr.	10/10/22	Good
Rattle Cr.	10/11/22	Good
Savage Cr.	10/11/22	Good
South Gold Cr.	10/20/22	Good
Strong Cr.	10/12/22	Good
Sullivan Springs	10/13/22	Good
Trestle Cr.	10/6/22	Good
Uleda Cr.	10/20/22	Good
Wellington Cr.	10/11/22	Good
West Gold Cr.	10/20/22	Good

The act of physically walking each of these streams provides a rudimentary annual evaluation of current fish habitat conditions. For example, in recent years we noticed that in South Gold Creek a dry reach low in the watershed presents a barrier to Bull Trout migration in late summer (Jakubowski and Bouwens 2018). A recurring dry reach also occurs in Strong Creek and may represent a barrier to migration, especially in drought years such as 2022. Excess bedload from upstream has accumulated at the mouth causing stream flows to become subsurface during drought conditions, and likely explains the lack of redds in 2022. Landowner access for the middle third of the redd count section on Strong Creek has also been restricted and has not been counted since 2016. Similar conditions exist in Rattle Creek, where dry reaches have been observed for several years. This potential for reduced access to spawning habitats may have influenced redd count numbers for 2022 in several survey streams. During the 2022 spring runoff period, a fish passage barrier in Char Creek first noted in 2008 (Jakubowski and Ryan 2009), located approximately 150 m upstream from the confluence with East Fork Lightning Creek, was blown out, allowing further upstream

access. A total of four redds were counted above the former barrier location, with one redd counted below. However, the upstream redds were all located below a new barrier that appears to have formed, just 170 m above the previous site. No redds were found above this new barrier. A fish passage barrier may also be developing in Wellington Creek. In 2018, we noticed that a large amount of bedload had accumulated behind a large fallen tree near its confluence with Lightning Creek. This forced a substantial portion of streamflow to filter sub-surface through the bedload, while the remainder carved out small channels through the riparian zone around the blockage. During the time of the survey in 2019, fish passage was completely blocked and would have required Bull Trout to ascend the stream during higher spring flows to access spawning reaches. The same conditions have continued through 2022, and it appears this situation may continue to worsen. Similar to Char Creek, migration may be completely blocked in the near future. A migration barrier utilized to guide kokanee into a spawning weir has existed near the mouth of Granite Creek since redd counts began, however this may also serve as a partial barrier to Bull Trout in severe drought years like observed in 2021 and 2022. Low numbers of redds were observed again this year, though they were located both above and below this barrier.

Habitat restoration may benefit spawning Bull Trout in tributaries where barriers to migration exist. For example, a longstanding barrier located immediately upstream of the mouth of Johnson Creek was removed in the fall of 2019 and summer of 2020. During post-restoration redd surveys in 2020–2022, all redds that were observed were located above the previous barrier, indicating the project was a success. A collaborative restoration project on Trestle Creek also appears to be providing increased benefit to spawning Bull Trout. This project included placing large wood in numerous locations to redirect current away from steep roadside edges and to slow velocities by providing stream channel roughness. During the 2022 redd count, numerous redds were found within the added wood throughout the restoration reach. Prior to the restoration work, few if any redds were typically found in this section of Trestle Creek, presumably due to the high velocities and lack of concealing cover. It is also hoped that the project will enhance juvenile Bull and Westslope Cutthroat trout rearing habitat as well.

Trends in tributary-specific contribution to the Bull Trout metapopulation in LPO appear to be developing. A major driver to this observed decline likely stems from the reduction in counts in Trestle Creek, which does not support as many redds as it did historically. However, contemporary counts may be stabilizing at this reduced number, and the stream still accounts for a relatively high number of redds per year. Granite and South Gold creeks have become much more important as Bull Trout spawning streams since the redd data collection began, and with the exception of 2021 and 2022, now account for similar redd numbers to Trestle Creek. The Pack River and Lightning Creek drainages continue to exhibit wide variability in annual redd counts, and further research may be beneficial to determine specific drivers of these differences. Annual redd count surveys now incorporate all streams where Bull Trout are known to spawn within the Idaho portion of the LPO basin and can be considered a comprehensive index of the spawning population.

RECOMMENDATIONS

- 1) Continue to perform standardized redd count surveys in LPO tributaries on an annual basis.
- 2) Consider adding the 3 km reach of Lightning Creek between Rattle Creek and the Wellington Road bridge to the annual redd count survey.
- 3) Document the prevalence of stream intermittency to investigate the likelihood of fish being precluded from entering natal tributaries.
- 4) Investigate the potential for variability in redd counts depending on environmental conditions.
- 5) Further investigate the potential migration barrier in lower South Gold Creek.
- 6) Further investigate the developing blockage near the mouth of Wellington Creek.
- 7) Investigate the potential for a seasonal migration barrier in Granite Creek.

ACKNOWLEDGEMENTS

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APPENDIX A

Table A-1. Bull Trout redd counts by year from all surveyed tributaries in the Lake Pend Oreille basin, Idaho 1984–2011.

Stream	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Clark Fork R.									2	8	17	18	3	7	8	5	5	6	7	8	1	0	3	2	0	1	0	0
Lightning Cr.	9	46	14	4					11	2	5	0	6	0	3	16	4	7	8	8	9	22	9	3	10	11	0	20
East Fork*	24	132	8	59	79	100	29		32	27	28	3	49	22	64	44	54	36	58	38	77	50	51	34	38	85	26	64
Savage Cr.	12	29		0					1	6	6	0	0	0	0	4	2	4	15	7	15	7	25	0	8	5	6	1
Char Cr.	9	11	0	2					9	37	13	2	14	1	16	17	11	2	8	7	14	15	20	1	5	1	4	9
Porcupine Cr.	52	32	1	9					4	6	1	2	0	0	0	4	4	0	0	5	10	14	8	8	8	15	11	13
Wellington Cr.	18	15	7	2					9	4	9	1	5	2	1	22	8	7	7	8	7	6	29	9	10	4	7	6
Rattle Cr.	32	21	10	35					10	8	0	1	10	2	15	13	12	67	33	37	34	34	21	2	24	62	43	65
Morris Cr.		--	--	--												1	1	0	7	1	1	3	16	0	6	6	9	0
Lightning Drainage Total	156	286	40	111	79	100	29	0	76	90	62	9	84	27	99	121	96	123	136	111	167	151	179	57	109	189	106	178
Johnson Cr.*	33	23	36	10	4	17	33	25	16	23	3	4	5	27	17	31	4	34	31	0	32	45	28	32	40	47	57	54
Twin Cr.	25	5	28	0					3	4	0	5	16	6	10	19	10	1	8	3	6	7	11	0	4	0	0	1
Strong Creek													2						0		0				7	6	2	11
Trestle Cr.*	272	298	147	230	236	217	274	220	134	304	276	140	243	221	330	253	301	335	333	361	102	174	395	145	183	279	188	178
Granite Cr.	81	37	37	30					0	7	11	9	47	90	49	41	25	7	57	101	149	132	166	104	52	106	75	129
Sullivan Springs	8	14		6					0	24	31	9	15	42	10	22	19	8	15	12	14	15	28	17	7	2	9	11
Granite Drainage Total	89	51	37	36	0	0	0	0	0	31	42	18	62	132	59	63	44	15	72	113	163	147	194	121	59	108	84	140
North Gold Cr.*	37	52	8	36	24	37	35	41	41	32	27	31	39	19	22	16	19	16	24	21	56	34	30	28	17	28	28	6
Gold Cr.*	124	111	78	62	111	122	84	104	93	120	164	95	100	76	120	147	168	127	203	126	167	200	235	179	73	107	130	56
W. Gold																							4	0	7	5	4	0
Gold Drainage Total	124	111	78	62	111	122	84	104	93	120	164	95	100	76	120	147	168	127	203	126	167	200	239	179	80	112	134	56
M.F. East River																		4	8	21	20	48	71	34	36	25	22	28
Uleda Creek																		3	4	3	7	4	7	2	7	16	6	9
MFER Total																		7	12	24	27	52	78	36	43	41	28	37
N.F. East River																					1	0	0		0		0	
Pack River	37	49	25	14					65	21	22	0	6	4	17	0	8	28	22	24	31	53	44	16	11	4	0	1
Grouse Cr.*	108	55	13	56	24	50	48	33	17	23	18	0	50	8	44	50	77	18	42	45	28	77	55	38	31	51	27	116
Caribou																												37
Hellroaring																												
McCormick																												
Pack Drainage Total	145	104	38	70	24	50	48	33	82	44	40	0	56	12	61	50	85	46	64	69	59	130	99	54	42	55	27	154
Total 6 index streams *	598	671	290	453	478	543	503	423	333	529	516	273	486	373	597	541	623	566	691	591	462	580	794	456	382	597	456	474
Total of all streams	881	930	412	555	478	543	503	423	447	656	631	320	610	527	726	705	732	710	890	836	781	940	1256	654	584	866	654	815

APPENDIX B

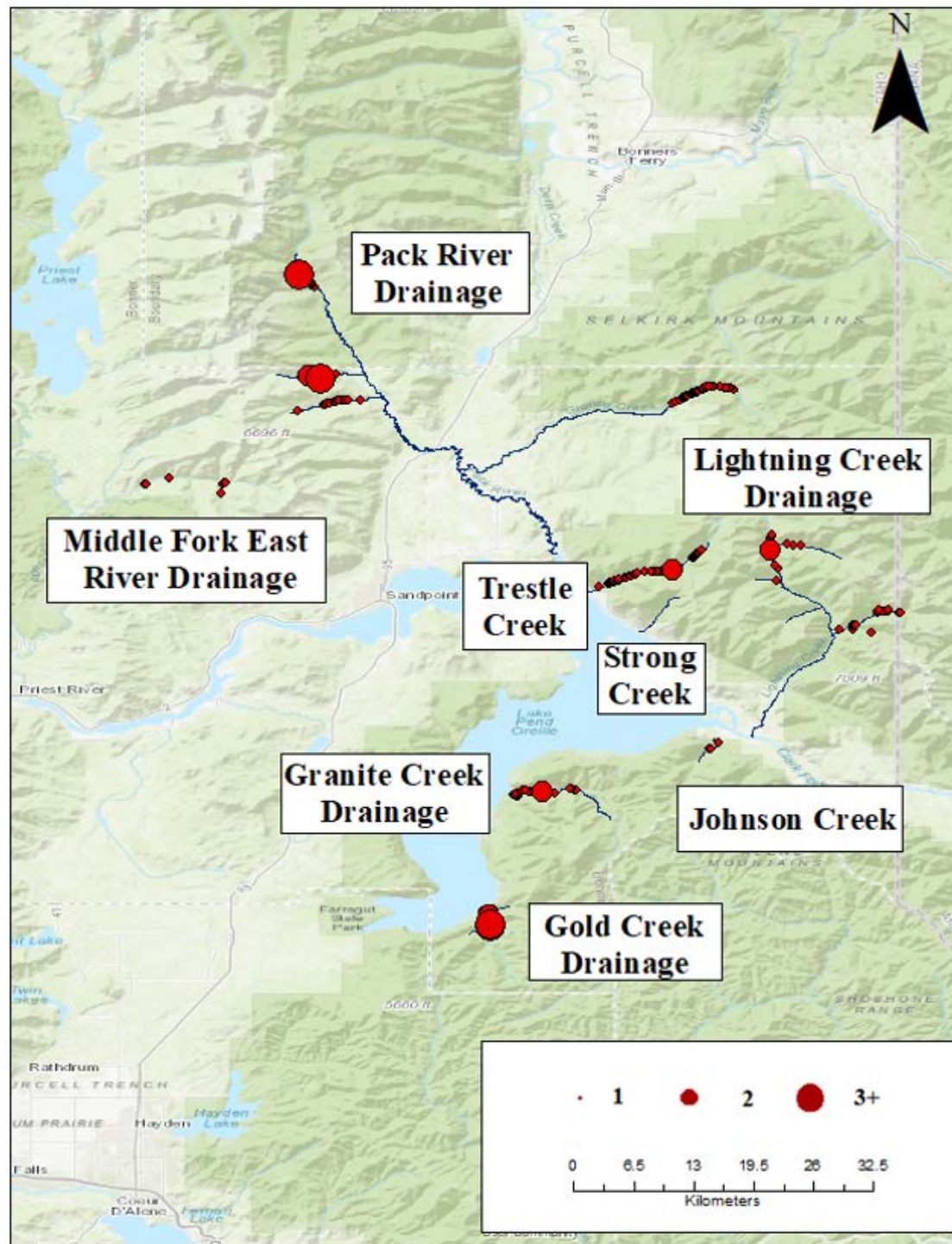


Figure B-1. Map of the Lake Pend Oreille basin outlining all drainages and sub-drainages surveyed for Bull Trout redds in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).

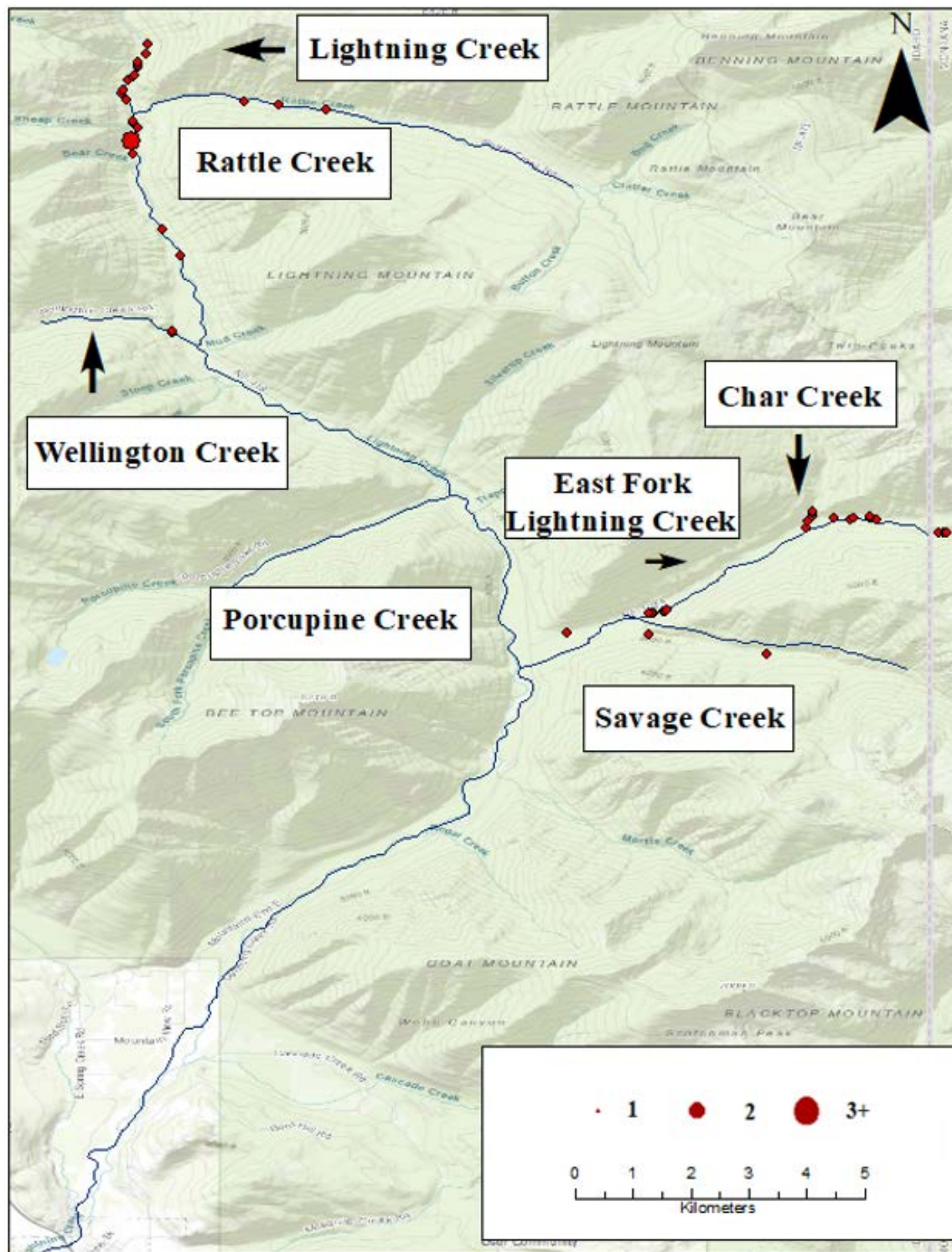


Figure B-2. Distribution map of Bull Trout redds observed in the Lightning Creek drainage in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).



Figure B-3. Distribution map of Bull Trout redds observed in Johnson Creek in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).

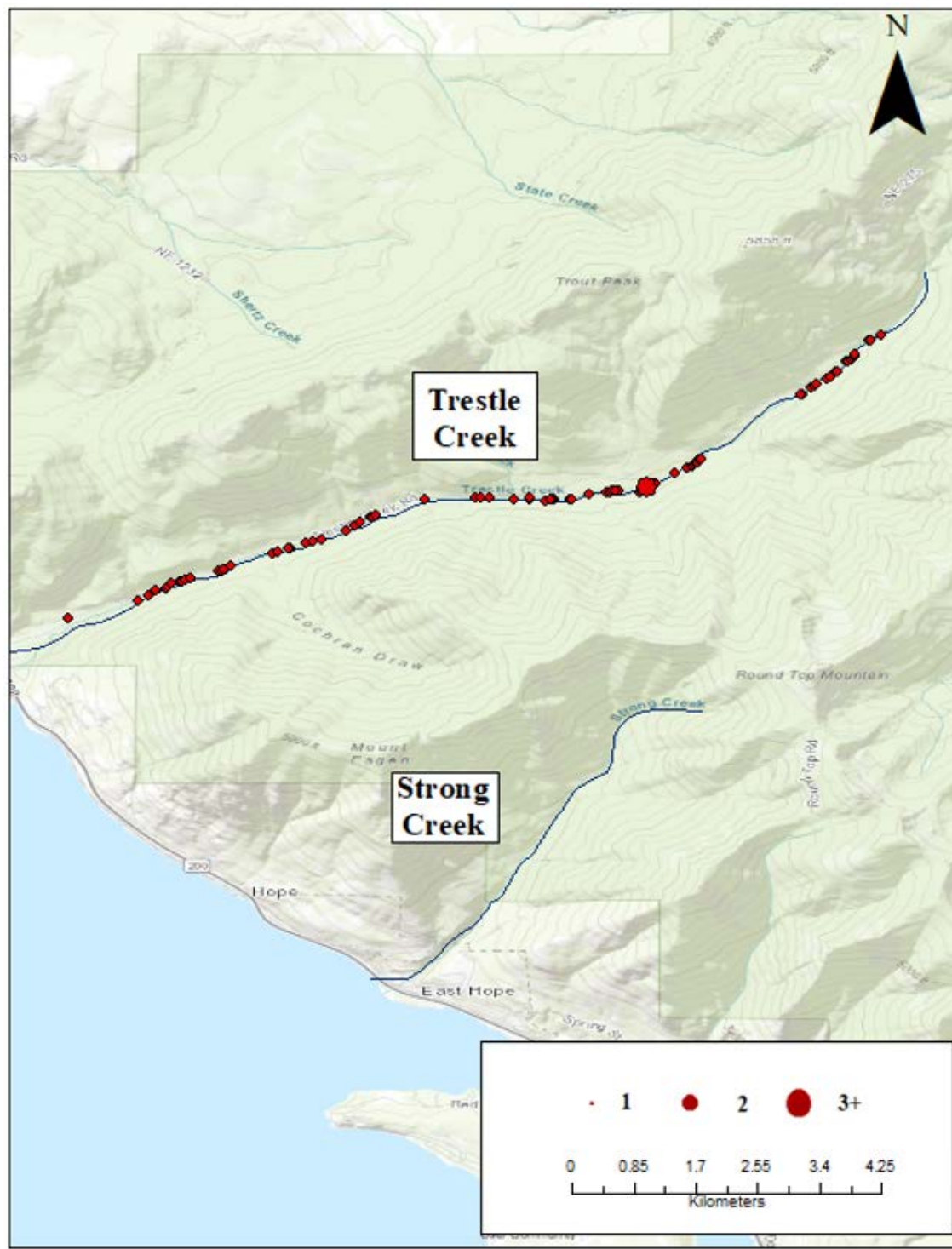


Figure B-4. Distribution map of Bull Trout redds observed in Trestle and Strong creeks in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).



Figure B-5. Distribution map of Bull Trout redds observed in the Granite Creek drainage in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).

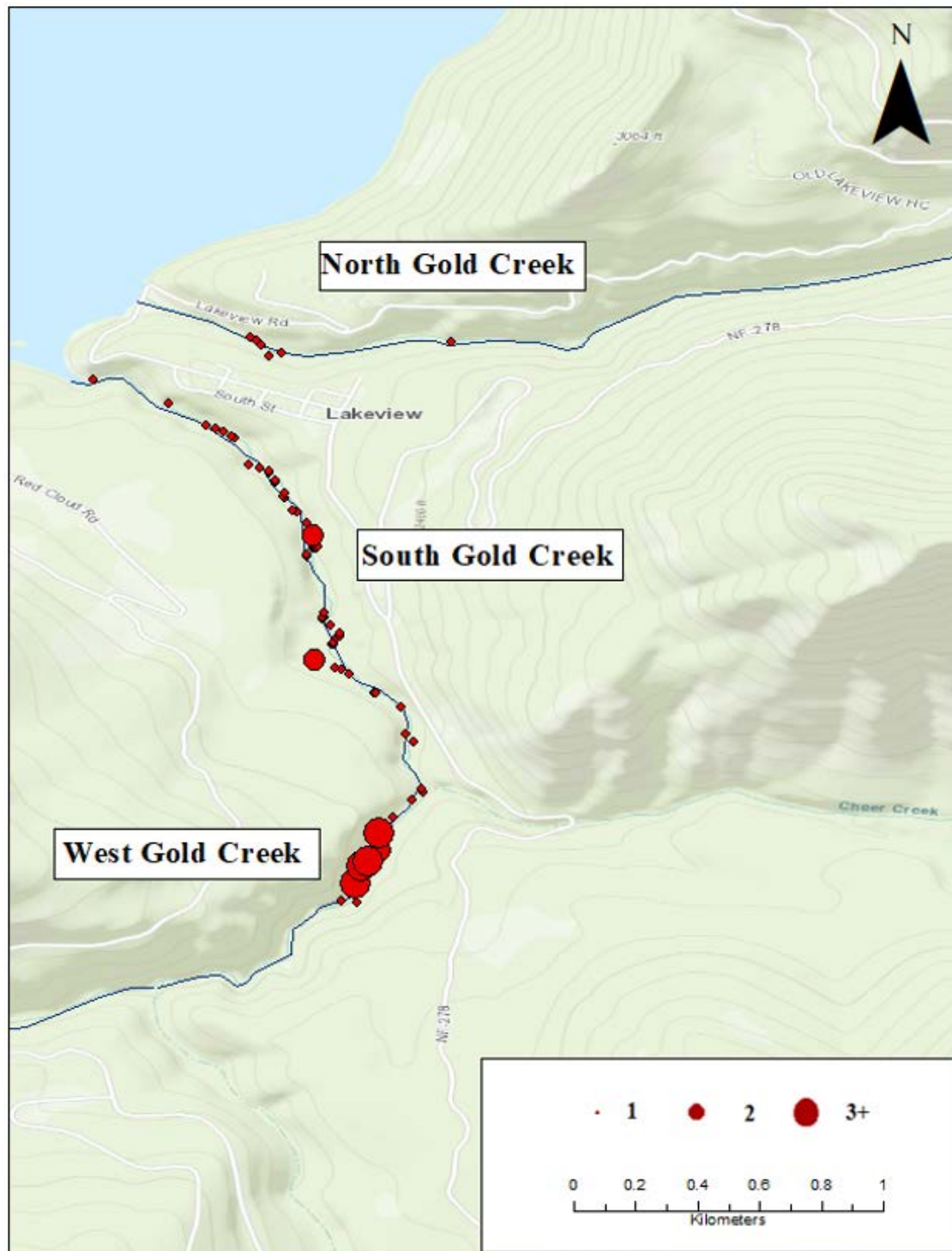


Figure B-6. Distribution map of Bull Trout redds observed in the Gold Creek drainage in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).

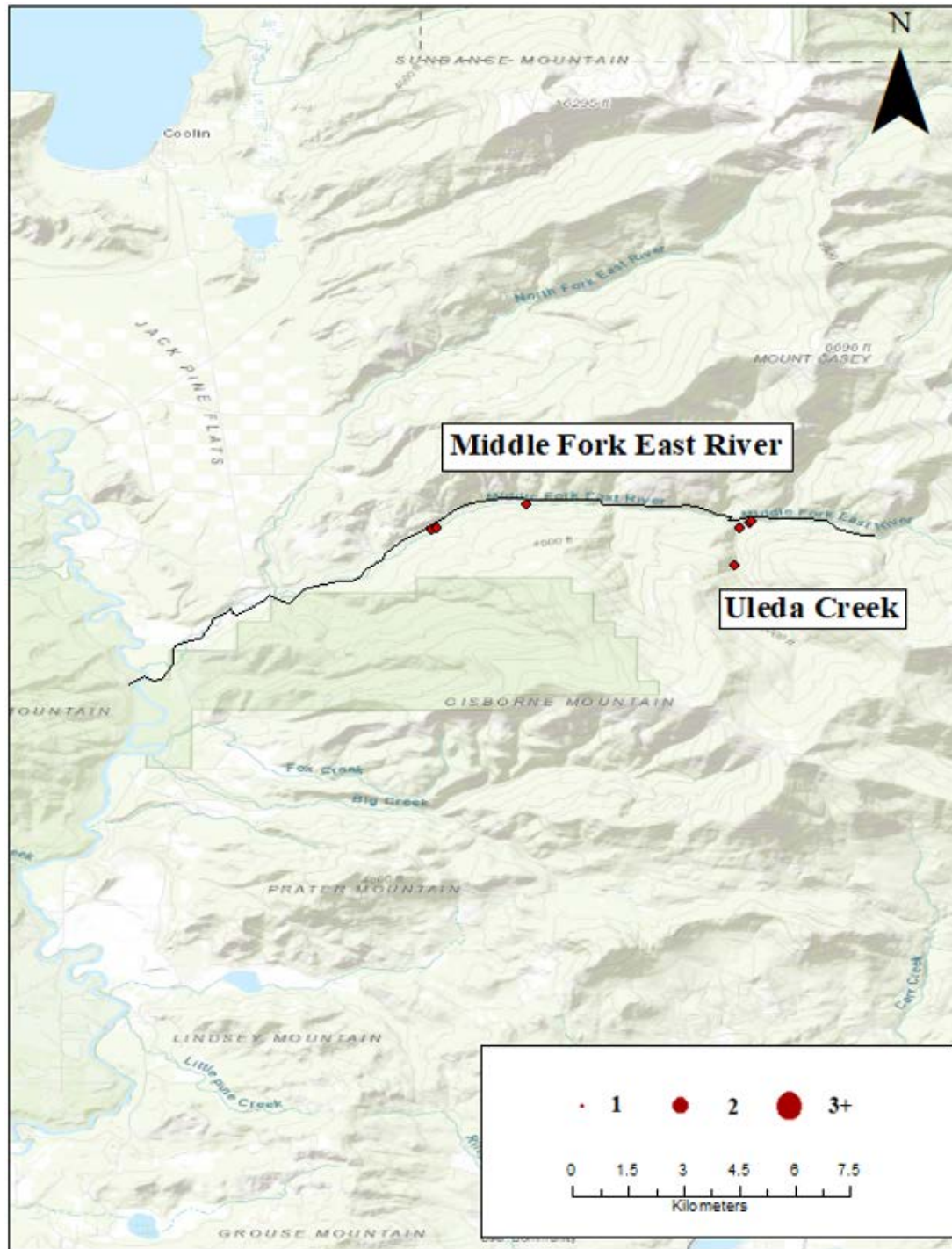


Figure B-7. Distribution map of Bull Trout redds observed in the Middle Fork East River drainage in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).

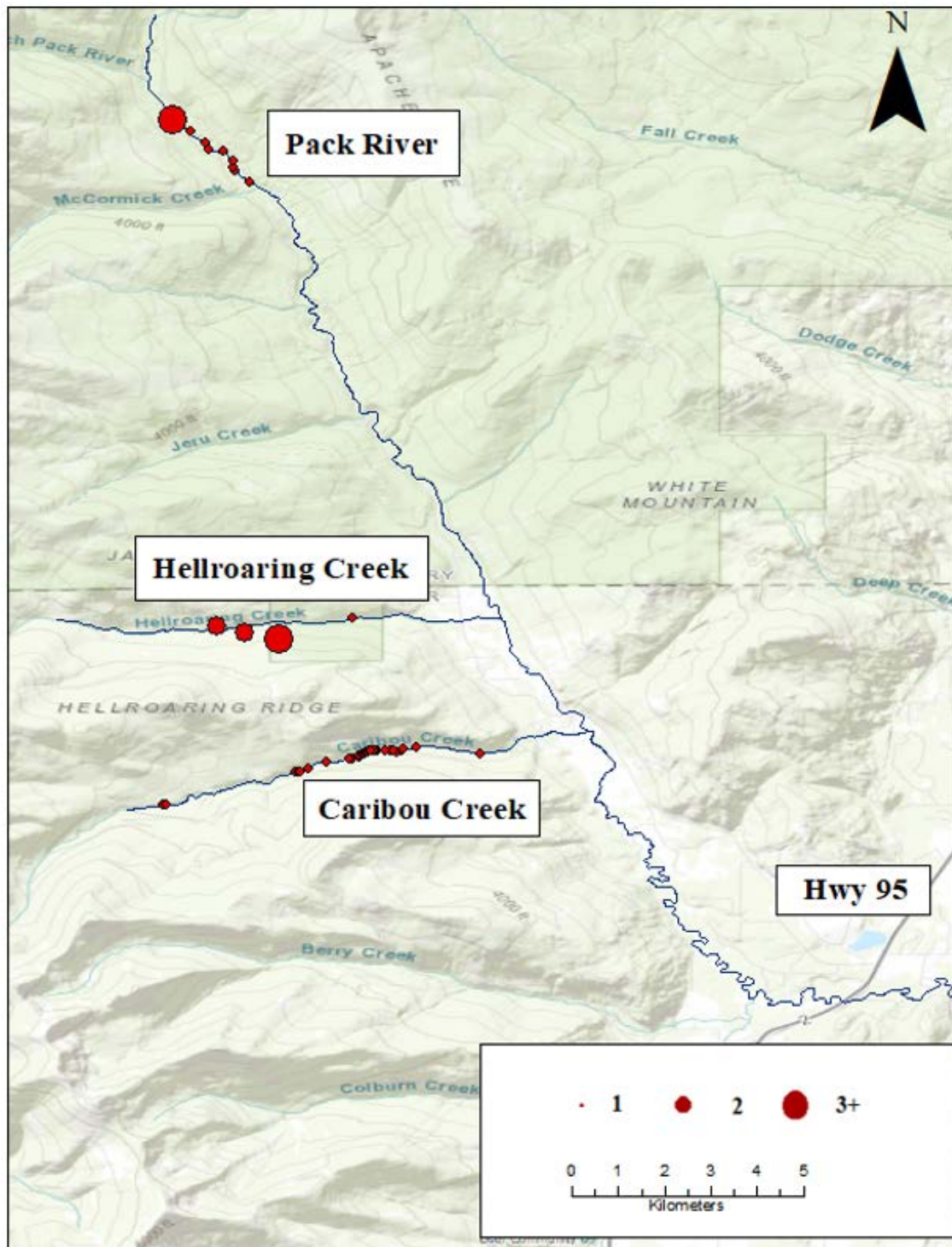


Figure B-8. Distribution map of Bull Trout redds observed in the Pack River drainage in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).

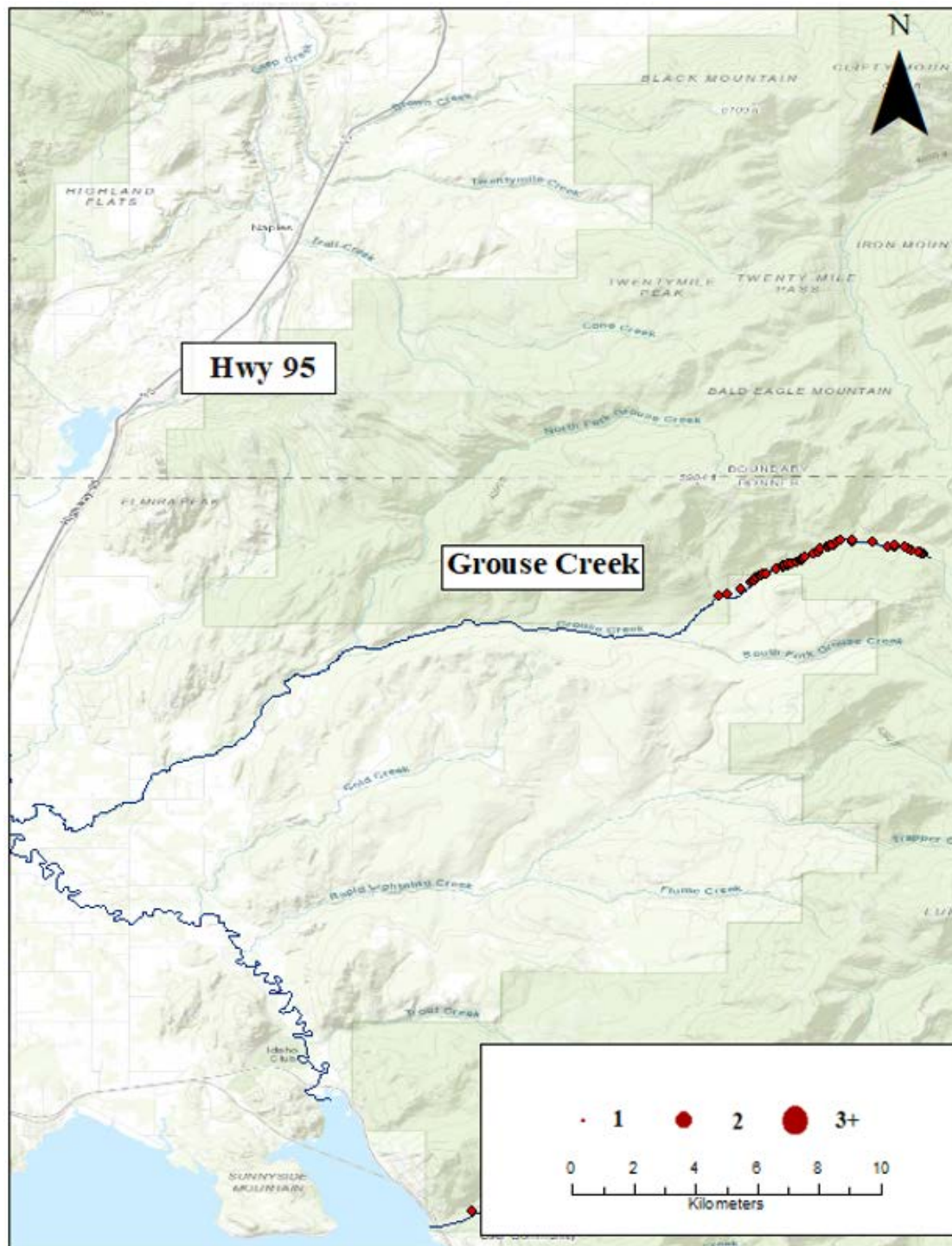


Figure B-9. Distribution map of Bull Trout redds observed in Grouse Creek, a tributary in the Pack River drainage in 2022. Number of redds at each location is described by incrementally larger shapes (see legend).

APPENDIX C

Table C-1. Survey stream, Latitude and Longitude (WGS 84) of Bull Trout redd locations recorded using handheld GPS devices during the 2022 annual Bull Trout redd counts on 23 tributaries to Lake Pend Oreille, lower Priest River and the lower Clark Fork River, Idaho.

Stream	Latitude	Longitude
Gold Creek	47.95890	-116.44476
Gold Creek	47.97113	-116.45403
Gold Creek	47.97043	-116.45184
Gold Creek	47.97041	-116.45184
Gold Creek	47.96979	-116.45072
Gold Creek	47.96971	-116.45046
Gold Creek	47.96960	-116.45023
Gold Creek	47.96949	-116.45003
Gold Creek	47.96943	-116.44993
Gold Creek	47.96942	-116.44993
Gold Creek	47.96866	-116.44950
Gold Creek	47.96864	-116.44950
Gold Creek	47.96858	-116.44918
Gold Creek	47.96847	-116.44890
Gold Creek	47.96841	-116.44891
Gold Creek	47.96821	-116.44875
Gold Creek	47.96817	-116.44873
Gold Creek	47.96783	-116.44848
Gold Creek	47.96775	-116.44850
Gold Creek	47.96771	-116.44846
Gold Creek	47.96731	-116.44823
Gold Creek	47.96727	-116.44811
Gold Creek	47.96728	-116.44809
Gold Creek	47.96694	-116.44782
Gold Creek	47.96677	-116.44772
Gold Creek	47.96660	-116.44762
Gold Creek	47.96629	-116.44748
Gold Creek	47.96625	-116.44755
Gold Creek	47.96624	-116.44759
Gold Creek	47.96624	-116.44760
Gold Creek	47.96624	-116.44765
Gold Creek	47.96604	-116.44781
Gold Creek	47.96600	-116.44783
Gold Creek	47.96437	-116.44734
Gold Creek	47.96421	-116.44736
Gold Creek	47.96420	-116.44733

Table B-1. continued.

Stream	Latitude	Longitude
Gold Creek	47.96416	-116.44735
Gold Creek	47.96399	-116.44712
Gold Creek	47.96378	-116.44687
Gold Creek	47.96378	-116.44685
Gold Creek	47.96368	-116.44686
Gold Creek	47.96368	-116.44686
Gold Creek	47.96361	-116.44693
Gold Creek	47.96350	-116.44704
Gold Creek	47.96347	-116.44704
Gold Creek	47.96347	-116.44704
Gold Creek	47.96346	-116.44705
Gold Creek	47.96345	-116.44707
Gold Creek	47.96316	-116.44752
Gold Creek	47.96315	-116.44754
Gold Creek	47.96314	-116.44757
Gold Creek	47.96310	-116.44757
Gold Creek	47.96298	-116.44757
Gold Creek	47.96289	-116.44752
Gold Creek	47.96288	-116.44752
Gold Creek	47.96287	-116.44751
Gold Creek	47.96287	-116.44751
Gold Creek	47.96287	-116.44750
Gold Creek	47.96289	-116.44749
Gold Creek	47.96274	-116.44702
Gold Creek	47.96274	-116.44701
Gold Creek	47.96271	-116.44684
Gold Creek	47.96257	-116.44657
Gold Creek	47.96201	-116.44587
Gold Creek	47.96201	-116.44583
Gold Creek	47.96162	-116.44510
Gold Creek	47.96084	-116.44495
Gold Creek	47.96059	-116.44473
Gold Creek	47.95926	-116.44449
Gold Creek	47.95914	-116.44443
Gold Creek	47.95598	-116.44681
Gold Creek	47.95598	-116.44638
Gold Creek	47.95650	-116.44643
Gold Creek	47.95650	-116.44643
Gold Creek	47.95650	-116.44643

Table B-1. continued.

Stream	Latitude	Longitude
Gold Creek	47.95699	-116.44624
Gold Creek	47.95699	-116.44624
Gold Creek	47.95699	-116.44624
Gold Creek	47.95716	-116.44606
Gold Creek	47.95716	-116.44606
Gold Creek	47.95716	-116.44606
Gold Creek	47.95747	-116.44567
Gold Creek	47.95747	-116.44567
Gold Creek	47.95769	-116.44572
Gold Creek	47.95797	-116.44571
Gold Creek	47.95797	-116.44571
Gold Creek	47.95797	-116.44571
Gold Creek	47.95844	-116.44530
North Gold Creek	47.97234	-116.44946
North Gold Creek	47.97226	-116.44930
North Gold Creek	47.97212	-116.44914
North Gold Creek	47.97181	-116.44892
North Gold Creek	47.97188	-116.44853
North Gold Creek	47.97223	-116.44360
Granite Creek	48.08424	-116.42174
Granite Creek	48.08450	-116.42136
Granite Creek	48.08500	-116.42112
Granite Creek	48.08572	-116.42111
Granite Creek	48.08755	-116.41577
Granite Creek	48.08763	-116.41571
Granite Creek	48.08771	-116.41545
Granite Creek	48.08794	-116.41523
Granite Creek	48.08801	-116.41166
Granite Creek	48.08753	-116.40904
Granite Creek	48.08749	-116.40901
Granite Creek	48.08648	-116.40633
Granite Creek	48.08671	-116.39461
Granite Creek	48.08664	-116.39462
Granite Creek	48.08656	-116.39328
Granite Creek	48.08623	-116.39147
Granite Creek	48.08434	-116.42311
Granite Creek	48.08435	-116.42309
Granite Creek	48.08418	-116.42272
Granite Creek	48.08415	-116.42250

Table B-1. continued.

Stream	Latitude	Longitude
Granite Creek	48.08891	-116.36272
Granite Creek	48.08889	-116.36440
Granite Creek	48.08991	-116.36645
Granite Creek	48.08999	-116.36770
Granite Creek	48.08614	-116.38320
Sullivan Springs	48.08363	-116.42089
Sullivan Springs	48.08321	-116.42056
Sullivan Springs	48.08319	-116.42057
Sullivan Springs	48.08314	-116.42052
Sullivan Springs	48.08304	-116.42035
Sullivan Springs	48.08303	-116.42037
Sullivan Springs	48.08300	-116.42032
Sullivan Springs	48.08288	-116.42012
Sullivan Springs	48.08289	-116.42010
Sullivan Springs	48.08264	-116.41969
Sullivan Springs	48.08262	-116.41961
Sullivan Springs	48.08408	-116.42212
Sullivan Springs	48.08395	-116.42174
Johnson Creek	48.13415	-116.22356
Johnson Creek	48.12874	-116.23066
Johnson Creek	48.12888	-116.23089
Johnson Creek	48.12884	-116.23097
Johnson Creek	48.12865	-116.23123
Johnson Creek	48.12836	-116.23143
Johnson Creek	48.12836	-116.23143
Johnson Creek	48.12834	-116.23149
Johnson Creek	48.12823	-116.23192
Char Creek	48.26229	-116.06831
Char Creek	48.26326	-116.06803
Char Creek	48.26402	-116.06733
Char Creek	48.26437	-116.06735
Char Creek	48.26442	-116.06739
Char Creek	48.26462	-116.06735
East Fork Lightning Creek	48.24583	-116.10556
East Fork Lightning Creek	48.24585	-116.10558
East Fork Lightning Creek	48.24899	-116.09275
East Fork Lightning Creek	48.24889	-116.09223
East Fork Lightning Creek	48.24886	-116.09207
East Fork Lightning Creek	48.24885	-116.09199

Table B-1. continued.

Stream	Latitude	Longitude
East Fork Lightning Creek	48.24919	-116.09052
East Fork Lightning Creek	48.24919	-116.09052
East Fork Lightning Creek	48.24928	-116.09037
East Fork Lightning Creek	48.24928	-116.09039
East Fork Lightning Creek	48.24942	-116.09011
East Fork Lightning Creek	48.26355	-116.05733
East Fork Lightning Creek	48.26141	-116.04774
East Fork Lightning Creek	48.26139	-116.04708
East Fork Lightning Creek	48.26142	-116.04672
East Fork Lightning Creek	48.26144	-116.04647
East Fork Lightning Creek	48.26363	-116.06403
East Fork Lightning Creek	48.26353	-116.06153
East Fork Lightning Creek	48.26363	-116.06088
East Fork Lightning Creek	48.26384	-116.05846
East Fork Lightning Creek	48.26382	-116.05845
Lightning Creek	48.32850	-116.17396
Lightning Creek	48.32861	-116.17412
Lightning Creek	48.32961	-116.17469
Lightning Creek	48.33025	-116.17459
Lightning Creek	48.33159	-116.17364
Lightning Creek	48.33207	-116.17301
Lightning Creek	48.33233	-116.17278
Lightning Creek	48.33233	-116.17275
Lightning Creek	48.33371	-116.17229
Lightning Creek	48.33379	-116.17225
Lightning Creek	48.33381	-116.17222
Lightning Creek	48.33383	-116.17226
Lightning Creek	48.33438	-116.17232
Lightning Creek	48.33438	-116.17231
Lightning Creek	48.33584	-116.17095
Lightning Creek	48.33723	-116.17077
Lightning Creek	48.32537	-116.17294
Lightning Creek	48.32028	-116.17295
Lightning Creek	48.30839	-116.16849
Lightning Creek	48.30454	-116.16556
Lightning Creek	48.32536	-116.17302
Lightning Creek	48.32532	-116.17301
Lightning Creek	48.32534	-116.17298
Lightning Creek	48.32536	-116.17297

Table B-1. continued.

Stream	Latitude	Longitude
Lightning Creek	48.32510	-116.17292
Lightning Creek	48.32427	-116.17219
Lightning Creek	48.32226	-116.17324
Lightning Creek	48.32226	-116.17324
Rattle Creek	48.32835	-116.15574
Rattle Creek	48.32782	-116.15046
Rattle Creek	48.32721	-116.14296
Rattle Creek	48.32720	-116.14295
Savage Creek	48.24574	-116.09285
Savage Creek	48.24264	-116.07456
Savage Creek	48.24264	-116.07456
Wellington Creek	48.29256	-116.16681
Wellington Creek	48.29258	-116.16688
Wellington Creek	48.29262	-116.16689
Wellington Creek	48.29266	-116.16687
Middle Fork East River	48.38674	-116.78223
Middle Fork East River	48.38712	-116.78117
Middle Fork East River	48.39300	-116.75941
Middle Fork East River	48.38850	-116.70492
Middle Fork East River	48.38851	-116.70447
Uleda Creek	48.38687	-116.70755
Uleda Creek	48.37790	-116.70859
Caribou Creek	48.46835	-116.57231
Caribou Creek	48.46938	-116.58485
Caribou Creek	48.46905	-116.58735
Caribou Creek	48.46907	-116.58746
Caribou Creek	48.46901	-116.58783
Caribou Creek	48.46864	-116.58866
Caribou Creek	48.46878	-116.58945
Caribou Creek	48.46872	-116.59005
Caribou Creek	48.46882	-116.59105
Caribou Creek	48.46889	-116.59244
Caribou Creek	48.46892	-116.59283
Caribou Creek	48.46895	-116.59316
Caribou Creek	48.46895	-116.59328
Caribou Creek	48.46895	-116.59332
Caribou Creek	48.46896	-116.59369
Caribou Creek	48.46885	-116.59419
Caribou Creek	48.46856	-116.59433

Table B-1. continued.

Stream	Latitude	Longitude
Caribou Creek	48.46842	-116.59465
Caribou Creek	48.46836	-116.59495
Caribou Creek	48.46832	-116.59501
Caribou Creek	48.46820	-116.59542
Caribou Creek	48.46776	-116.59585
Caribou Creek	48.46773	-116.59589
Caribou Creek	48.46728	-116.59725
Caribou Creek	48.46737	-116.59734
Caribou Creek	48.46741	-116.59793
Caribou Creek	48.46650	-116.60230
Caribou Creek	48.46549	-116.60583
Caribou Creek	48.46485	-116.60742
Caribou Creek	48.46473	-116.60783
Caribou Creek	48.46471	-116.60825
Caribou Creek	48.46472	-116.60845
Caribou Creek	48.45831	-116.63366
Caribou Creek	48.45822	-116.63408
Grouse Creek	48.46651	-116.26764
Grouse Creek	48.47125	-116.25758
Grouse Creek	48.47133	-116.25740
Grouse Creek	48.47134	-116.25740
Grouse Creek	48.47138	-116.25737
Grouse Creek	48.47138	-116.25737
Grouse Creek	48.47212	-116.25689
Grouse Creek	48.47212	-116.25689
Grouse Creek	48.47240	-116.25574
Grouse Creek	48.47253	-116.25541
Grouse Creek	48.47276	-116.25512
Grouse Creek	48.46718	-116.26533
Grouse Creek	48.47294	-116.25494
Grouse Creek	48.47329	-116.25405
Grouse Creek	48.47484	-116.25111
Grouse Creek	48.47484	-116.25111
Grouse Creek	48.47531	-116.24900
Grouse Creek	48.47546	-116.24873
Grouse Creek	48.47546	-116.24873
Grouse Creek	48.47545	-116.24875
Grouse Creek	48.47546	-116.24879
Grouse Creek	48.47549	-116.24877

Table B-1. continued.

Stream	Latitude	Longitude
Grouse Creek	48.46873	-116.26125
Grouse Creek	48.47558	-116.24854
Grouse Creek	48.47563	-116.24836
Grouse Creek	48.47561	-116.24775
Grouse Creek	48.47572	-116.24759
Grouse Creek	48.47590	-116.24727
Grouse Creek	48.47612	-116.24651
Grouse Creek	48.47611	-116.24651
Grouse Creek	48.47615	-116.24651
Grouse Creek	48.47670	-116.24496
Grouse Creek	48.47713	-116.24410
Grouse Creek	48.47072	-116.25838
Grouse Creek	48.47719	-116.24395
Grouse Creek	48.47724	-116.24373
Grouse Creek	48.47728	-116.24376
Grouse Creek	48.47728	-116.24373
Grouse Creek	48.47739	-116.24357
Grouse Creek	48.47749	-116.24309
Grouse Creek	48.47747	-116.24305
Grouse Creek	48.47773	-116.24285
Grouse Creek	48.47806	-116.24261
Grouse Creek	48.47819	-116.24255
Grouse Creek	48.47074	-116.25840
Grouse Creek	48.47880	-116.23999
Grouse Creek	48.47896	-116.20804
Grouse Creek	48.48126	-116.21616
Grouse Creek	48.48122	-116.21651
Grouse Creek	48.48120	-116.21814
Grouse Creek	48.48229	-116.22266
Grouse Creek	48.48265	-116.22861
Grouse Creek	48.48265	-116.22861
Grouse Creek	48.48288	-116.22893
Grouse Creek	48.48288	-116.23217
Grouse Creek	48.48246	-116.23319
Grouse Creek	48.48168	-116.23413
Grouse Creek	48.47906	-116.20832
Grouse Creek	48.48167	-116.23419
Grouse Creek	48.48163	-116.23436
Grouse Creek	48.48174	-116.23485

Table B-1. continued.

Stream	Latitude	Longitude
Grouse Creek	48.48166	-116.23497
Grouse Creek	48.48119	-116.23576
Grouse Creek	48.48110	-116.23591
Grouse Creek	48.48110	-116.23589
Grouse Creek	48.48110	-116.23591
Grouse Creek	48.48108	-116.23594
Grouse Creek	48.48108	-116.23594
Grouse Creek	48.47962	-116.23859
Grouse Creek	48.47966	-116.23861
Grouse Creek	48.47081	-116.25831
Grouse Creek	48.47084	-116.25829
Grouse Creek	48.47089	-116.25818
Grouse Creek	48.47093	-116.25797
Grouse Creek	48.47916	-116.20842
Grouse Creek	48.48032	-116.23816
Grouse Creek	48.47936	-116.20886
Grouse Creek	48.47946	-116.20913
Grouse Creek	48.47961	-116.20943
Grouse Creek	48.48024	-116.21130
Grouse Creek	48.48066	-116.21236
Grouse Creek	48.48098	-116.21336
Hellroaring Creek	48.49042	-116.61164
Hellroaring Creek	48.49042	-116.61164
Hellroaring Creek	48.49042	-116.61164
Hellroaring Creek	48.49042	-116.61164
Hellroaring Creek	48.49191	-116.61834
Hellroaring Creek	48.49191	-116.61834
Hellroaring Creek	48.49453	-116.59720
Hellroaring Creek	48.49306	-116.62355
Hellroaring Creek	48.49306	-116.62355
Pack River	48.57935	-116.61741
Pack River	48.58139	-116.62005
Pack River	48.58209	-116.62047
Pack River	48.58352	-116.62039
Pack River	48.58532	-116.62252
Pack River	48.58556	-116.62517
Pack River	48.58702	-116.62578
Pack River	48.58903	-116.62870
Pack River	48.59042	-116.63097

Table B-1. continued.

Stream	Latitude	Longitude
Pack River	48.59062	-116.63155
Pack River	48.59083	-116.63175
Pack River	48.59138	-116.63218
Pack River	48.59138	-116.63218
Pack River	48.59138	-116.63218
Pack River	48.59196	-116.63265
Pack River	48.59246	-116.63312
Pack River	48.59282	-116.63339
Trestle Creek	48.28957	-116.33142
Trestle Creek	48.29021	-116.33003
Trestle Creek	48.29990	-116.30251
Trestle Creek	48.30215	-116.28312
Trestle Creek	48.30212	-116.28310
Trestle Creek	48.30185	-116.28104
Trestle Creek	48.30203	-116.28045
Trestle Creek	48.30198	-116.28023
Trestle Creek	48.30192	-116.27994
Trestle Creek	48.30192	-116.27994
Trestle Creek	48.30202	-116.27799
Trestle Creek	48.30210	-116.27793
Trestle Creek	48.30210	-116.27788
Trestle Creek	48.29980	-116.30259
Trestle Creek	48.30270	-116.27571
Trestle Creek	48.30282	-116.27356
Trestle Creek	48.30300	-116.27318
Trestle Creek	48.30306	-116.27283
Trestle Creek	48.30305	-116.27269
Trestle Creek	48.30307	-116.27242
Trestle Creek	48.30307	-116.27242
Trestle Creek	48.30305	-116.27206
Trestle Creek	48.30300	-116.26946
Trestle Creek	48.30314	-116.26921
Trestle Creek	48.30000	-116.30213
Trestle Creek	48.30327	-116.26905
Trestle Creek	48.30342	-116.26877
Trestle Creek	48.30357	-116.26855
Trestle Creek	48.30358	-116.26850
Trestle Creek	48.30358	-116.26850
Trestle Creek	48.30358	-116.26849

Table B-1. continued.

Stream	Latitude	Longitude
Trestle Creek	48.30383	-116.26788
Trestle Creek	48.30405	-116.26739
Trestle Creek	48.30405	-116.26739
Trestle Creek	48.30201	-116.29591
Trestle Creek	48.30523	-116.26510
Trestle Creek	48.29079	-116.32921
Trestle Creek	48.29111	-116.32800
Trestle Creek	48.29129	-116.32777
Trestle Creek	48.29163	-116.32733
Trestle Creek	48.29195	-116.32622
Trestle Creek	48.29197	-116.32610
Trestle Creek	48.29210	-116.32548
Trestle Creek	48.29226	-116.32499
Trestle Creek	48.29241	-116.32498
Trestle Creek	48.29310	-116.32145
Trestle Creek	48.29325	-116.32097
Trestle Creek	48.29332	-116.32087
Trestle Creek	48.29381	-116.31999
Trestle Creek	48.29390	-116.31998
Trestle Creek	48.29535	-116.31482
Trestle Creek	48.29556	-116.31412
Trestle Creek	48.29593	-116.31293
Trestle Creek	48.29590	-116.31256
Trestle Creek	48.29667	-116.31064
Trestle Creek	48.29686	-116.30981
Trestle Creek	48.29710	-116.30869
Trestle Creek	48.29815	-116.30566
Trestle Creek	48.29887	-116.30452
Trestle Creek	48.29919	-116.30395
Trestle Creek	48.28731	-116.33995
Trestle Creek	48.32228	-116.23966
Trestle Creek	48.32167	-116.24092
Trestle Creek	48.32158	-116.24116
Trestle Creek	48.31994	-116.24276
Trestle Creek	48.31983	-116.24287
Trestle Creek	48.31946	-116.24307
Trestle Creek	48.31946	-116.24308
Trestle Creek	48.31938	-116.24325
Trestle Creek	48.31938	-116.24324

Table B-1. continued.

Stream	Latitude	Longitude
Trestle Creek	48.31911	-116.24374
Trestle Creek	48.31908	-116.24396
Trestle Creek	48.30523	-116.26506
Trestle Creek	48.30586	-116.26350
Trestle Creek	48.30603	-116.26285
Trestle Creek	48.30629	-116.26274
Trestle Creek	48.30646	-116.26255
Trestle Creek	48.30646	-116.26255
Trestle Creek	48.30647	-116.26255
Trestle Creek	48.30659	-116.26226
Trestle Creek	48.30215	-116.28971
Trestle Creek	48.30660	-116.26225
Trestle Creek	48.30660	-116.26225
Trestle Creek	48.30692	-116.26202
Trestle Creek	48.30696	-116.26197
Trestle Creek	48.30219	-116.28917
Trestle Creek	48.30216	-116.28803
Trestle Creek	48.30207	-116.28507
Trestle Creek	48.30212	-116.28499
Trestle Creek	48.30358	-116.26849
Trestle Creek	48.31783	-116.24510
Trestle Creek	48.31772	-116.24535
Trestle Creek	48.31721	-116.24585
Trestle Creek	48.31694	-116.24635
Trestle Creek	48.31630	-116.24762
Trestle Creek	48.31623	-116.24766
Trestle Creek	48.31616	-116.24787
Trestle Creek	48.31616	-116.24786
Trestle Creek	48.31587	-116.24818
Trestle Creek	48.31488	-116.24945
Trestle Creek	48.31488	-116.24955
Trestle Creek	48.30659	-116.26226