

Pend Oreille Basin Bull Trout Redd Monitoring 2023 Annual Project Update

Idaho Tributary Habitat Acquisition and Fishery Enhancement Program,
Appendix A

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TABLE OF CONTENTS

LIST OF TABLES	ii
ABSTRACT	iii
INTRODUCTION.....	1
METHODS.....	1
RESULTS AND DISCUSSION.....	5
RECOMMENDATIONS	20
ACKNOWLEDGEMENTS	20
LITERATURE CITED.....	21
Appendix A	23
Appendix B.....	25
Appendix C.....	34

LIST OF FIGURES

Figure 1. Map of streams surveyed and 2023 Bull Trout redd locations recorded using handheld GPS units in the Pend Oreille drainage, Idaho..... 2

Figure 2. Total number of Bull Trout redds counted in all surveyed streams in the Pend Oreille drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022)..... 9

Figure 3. Number of Bull Trout redds counted in the Lightning Creek drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022)..... 10

Figure 6. Number of Bull Trout redds counted in Trestle Creek from 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022)..... 13

Figure 7. Number of Bull Trout redds counted in the Granite Creek drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022)..... 14

Figure 8. Number of Bull Trout redds counted in North Gold Creek 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022)..... 15

Figure 9. Number of Bull Trout redds counted in the South Gold Creek drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022)..... 16

Figure 10. Number of Bull Trout redds counted in the Middle Fork East River drainage 2000–2023. The horizontal red line represents the prior 10-year average (2013–2022).17

Figure 11. Number of Bull Trout redds counted in the Pack River drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022)..... 18

LIST OF TABLES

Table 1. Survey streams for annual Bull Trout redd counts in tributaries to the lower Priest River, Lake Pend Oreille, and the lower Clark Fork River, Idaho. Strong Creek was altered from a 3.0 km reach to two 1.0 km reaches (upper and lower) in 2017. 3

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. 4

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 1984–2023. 6

Table 4. Bull Trout redd counts by year from all surveyed tributaries in the Lake Pend Oreille basin, Idaho 2013–2023. Blank cells indicate that no redd count occurred. Data prior to 2013 are listed in Appendix A. 7

Table 5. Dates surveyed and environmental conditions and water clarity rating (Poor [rain with murky water], Moderate [overcast with clear water], Good [clear day with clear water]) during the 2023 redd count on each creek..... 8

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 22 tributaries and are performed by teams of two individuals who physically walk each stream and tally observed redds in a single pass. Surveys were completed between October 1 and 19, 2023. A record low total of 281 Bull Trout redds were counted among all surveyed streams in 2023. For all streams combined, counts were 51% below the previous 10-year average. Mild fall weather in 2023 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 the U.S. Fish and Wildlife Service, the Army Corps of Engineers, U.S. Forest Service, and the Idaho Department of Lands, Avista and Idaho Department of Fish and Game staff conducted annual Bull Trout redd counts on 22 tributaries to Lake Pend Oreille (LPO) and the lower Clark Fork River in 2023. In addition, U.S. Fish and Wildlife Service employees completed surveys in the Middle Fork East River drainage (i.e., 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 gravel at least 0.3 x 0.6 m in size with gravel 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.

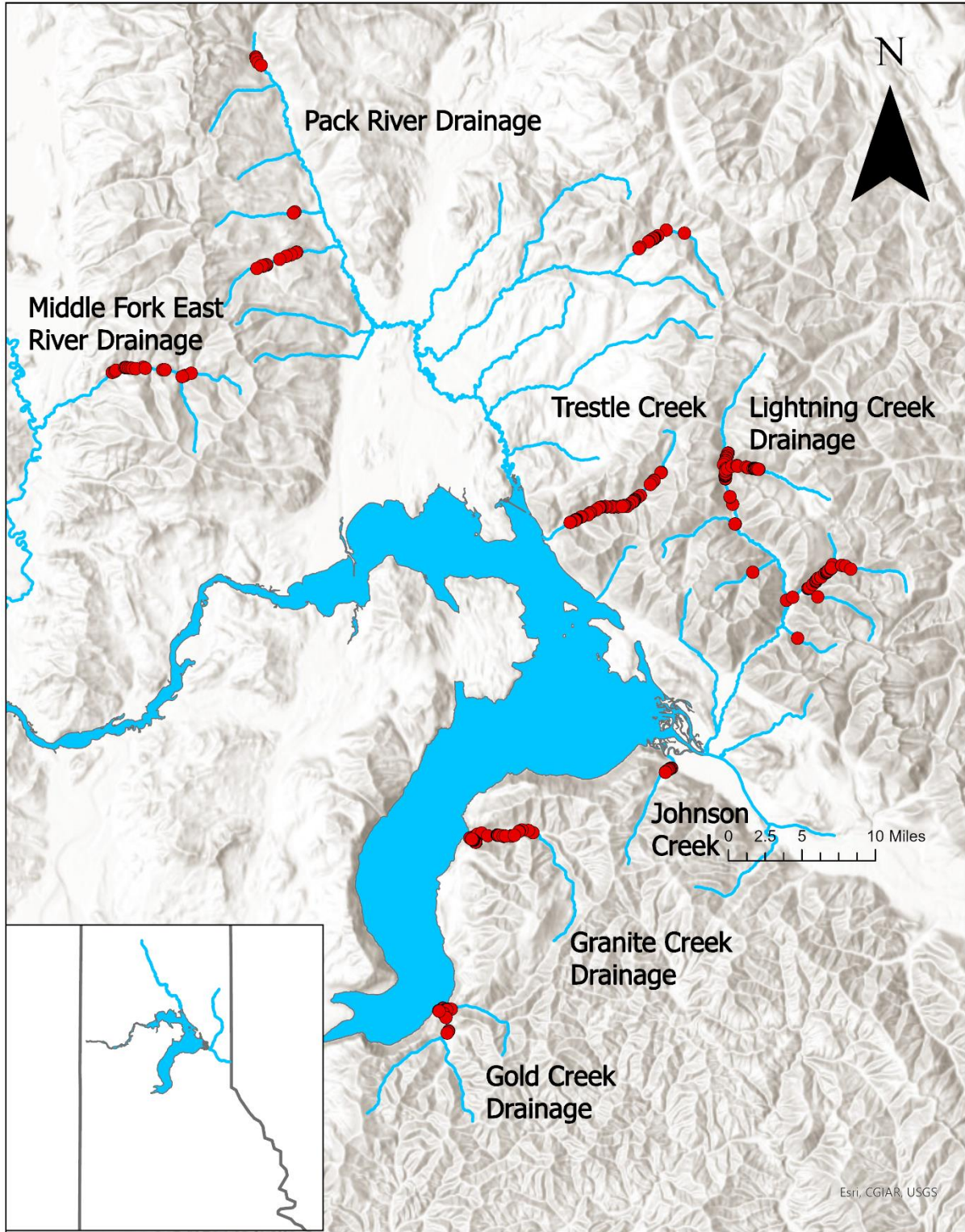


Figure 1. Map of streams surveyed and 2023 Bull Trout redd locations recorded using handheld GPS units in the Pend Oreille drainage, Idaho.

Table 1. Survey streams for annual Bull Trout redd counts in tributaries to the lower Priest River, Lake Pend Oreille, and the lower Clark Fork River, Idaho. Strong Creek was altered from a 3.0 km reach to two 1.0 km reaches (upper and lower) in 2017.

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 1–19, 2023. A record low total of 281 Bull Trout redds comment above were counted among all surveyed streams (Table 3; Appendix A). This was 178 less than the total counted during 2022, and 51% below the 10-year average. Overall, 18 of the 22 individual stream segments were below their 10- and 20-year averages, whereas only four stream segments were equal to or slightly higher than either their respective 10- or 20-year averages. For example, Char Creek was the highest count respective to its long-term average with five redds above its 20-year average. (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.

While most stream segment counts were low, most of the decline in total redds counted among all segments can be attributed to Trestle Creek, Gold Creek, and Grouse Creek. When compared to 2022, Trestle Creek and Gold Creek redds declined by 49% and 83% respectively, whereas the Pack River drainage saw a decrease of 74%, including a reduction of 83% in Grouse Creek alone. These three streams combined saw a decrease of 189 redds compared to 2022. This is greater than the overall decrease of redds in 2023 due to the offset of a few streams (i.e., East Fork Lightning Creek, Middle Fork East River) redd counts being higher than 2022.

Redd count data are inherently variable due to changing survey conditions, spawn timing, stream morphology, and variability among surveyors. For example, varying rainfall events are possible during the time when redd counts are being conducted, and likely has influence on the effectiveness of positively identifying redds. 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. However, in 2023 all surveyed creeks exhibited good survey conditions (Table 5).

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, most redds counted in Grouse Creek during 2022 were located within a short multi-channel section containing ideal spawning substrate. However, during the 2023 survey all but one channel of the multi-channel section were dry due to low water conditions. A recurring finding in numerous watershed assessments in the lower Clark Fork River-LPO area is that these watersheds are inherently dynamic and are characterized by unstable geomorphology (CES 1998; Golder Associates 2003, 2006; RDG 2009; PWA 2004).

Additionally, 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). There have been repeated observations of large accumulations of suitable spawning material that has been mobilized during high flow events and deposited along the stream margins where it becomes inaccessible to spawning Bull Trout during normal fall stream

flows (R. Jakabowski and K. A. Bouwens, personal observation). Therefore, it is not surprising that redd counts in specific watersheds and tributaries fluctuate with the habitat conditions. 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 1984–2023.

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	2023	281
		2003–2022 Avg	690
		2013–2022 Avg	576

Table 4. Bull Trout redd counts by year from all surveyed tributaries in the Lake Pend Oreille basin, Idaho 2013–2023. Blank cells indicate that no redd count occurred. Data prior to 2013 are listed in Appendix A.

Stream	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2013-2022 Avg
	Lightning Cr.	1	4	11		3	8	13	3	8	28	12
East Fork Lightning Cr.	26	22	17	19	80	87	35	10	34	20	32	35
Savage Cr.	5	6	5	1	19	15	3	6	3	3	1	7
Char Cr.	4	2	0	0	0	4	2	2	1	7	7	2
Porcupine Cr.	4	15	0	14	10	29	13	14	11	0	5	11
Wellington Cr.	5	11	8	3	5	15	7	6	2	4	4	7
Rattle Cr.	8	63	5	5	20	32	47	12	12	6	17	21
Morris Cr.	3	14	0	3	32	18	0	0	4	0	1	7
Johnson Cr.	50	21	5	5	10	14	5	7	27	12	9	16
Strong Cr.	47	17	0	10	4	8	0	18	1	0	0	11
Trestle Cr.	133	159	117	91	75	73	90	97	171	102	52	111
Granite Cr.	217	115	68	48	96	150	86	116	19	25	33	94
Sullivan Springs	11	4	0	4	14	18	11	12	8	13	10	10
North Gold Cr.	28	25	41	22	54	0	15	19	25	5	25	23
Gold Cr.	106	88	69	71	169	70	96	84	48	86	15	89
W. Gold Cr.	29	10	3	0	3	0	0	1	0	0	0	5
M.F. East R.	25	51	51	50	23	27	9	25	8	5	20	27
Uleda Cr.	14	26	11	2	1	0	1	3	1	2	1	6
Pack R.	6	1	35	5	57	30	8	2	9	17	6	17
Grouse Cr.	12	54	48		32	23	25	26	29	82	14	37
Caribou Cr.	47	9	57	4	51	70	11	6	8	34	12	30
Hellroaring Cr.			2	2	24	11	23	0	11	8	5	10
McCormick Cr.								0	0	0	0	0
Total of all streams	781	717	553	359	782	702	500	469	440	459	281	576

Table 5. Dates surveyed and environmental conditions and water clarity rating (Poor [rain with murky water], Moderate [overcast with clear water], Good [clear day with clear water]) during the 2023 redd count on each creek.

Stream	Dates Surveyed	Counting Conditions
Caribou Cr.	10/13/23	Good
Char Cr.	10/10/23	Good
East Fork Lightning Cr.	10/10/23	Good
Granite Cr.	10/18/23	Good
Grouse Cr.	10/13/23	Good
Hellroaring Cr.	10/13/23	Good
Johnson Cr.	10/17/23	Good
Lightning Cr.	10/10/23	Good
Middle Fork East R.	10/1/23	Good
Morris Cr.	10/11/23	Good
North Gold Cr.	10/19/23	Good
Pack River	10/13/23	Good
Porcupine Cr.	10/10/23	Good
Rattle Cr.	10/10/23	Good
Savage Cr.	10/10/23	Good
South Gold Cr.	10/19/23	Good
Strong Cr.	10/11/23	Good
Sullivan Springs	10/18/23	Good
Trestle Cr.	10/9/23	Good
Uleda Cr.	10/1/23	Good
Wellington Cr.	10/11/23	Good
West Gold Cr.	10/19/23	Good

Lake Pend Oreille Bull Trout Redds

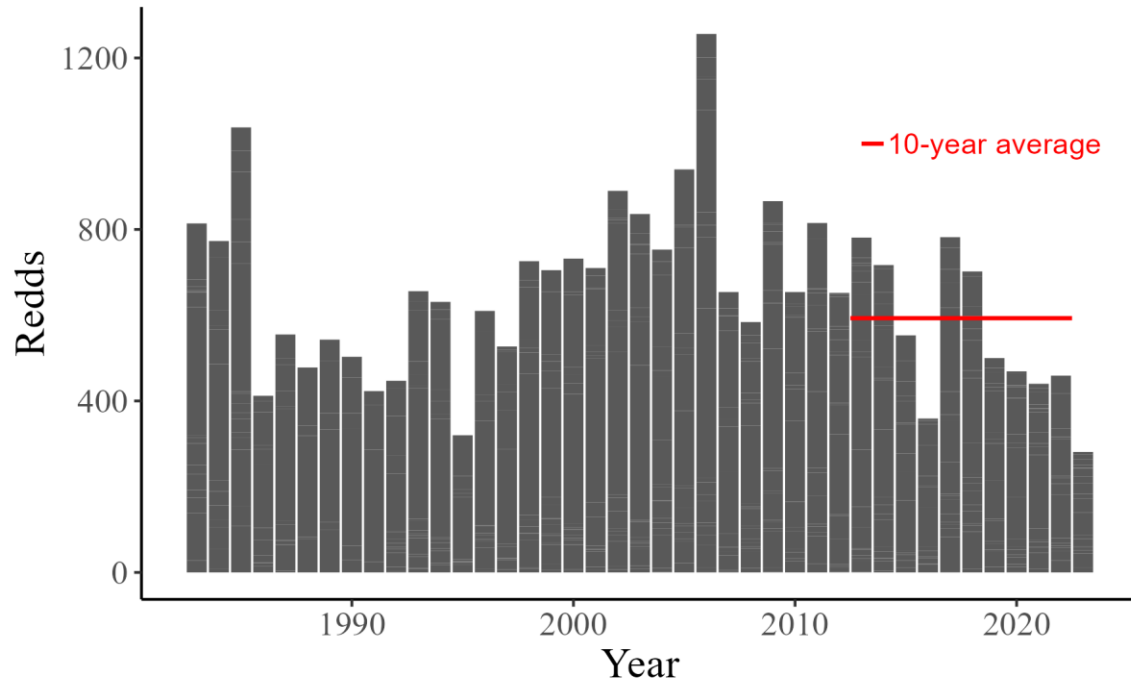


Figure 2. Total number of Bull Trout redds counted in all surveyed streams in the Pend Oreille drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022).

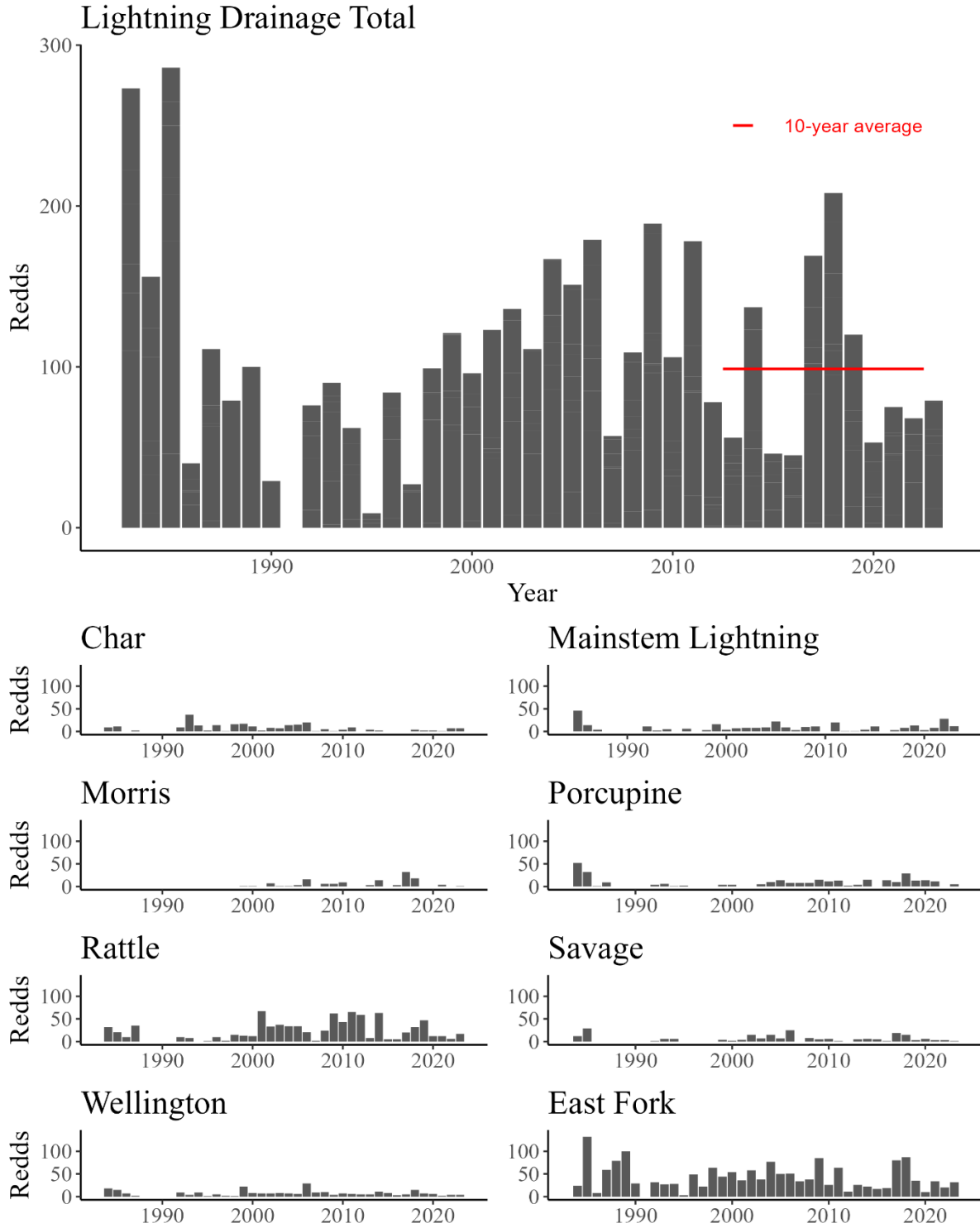


Figure 3. Number of Bull Trout redds counted in the Lightning Creek drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022).

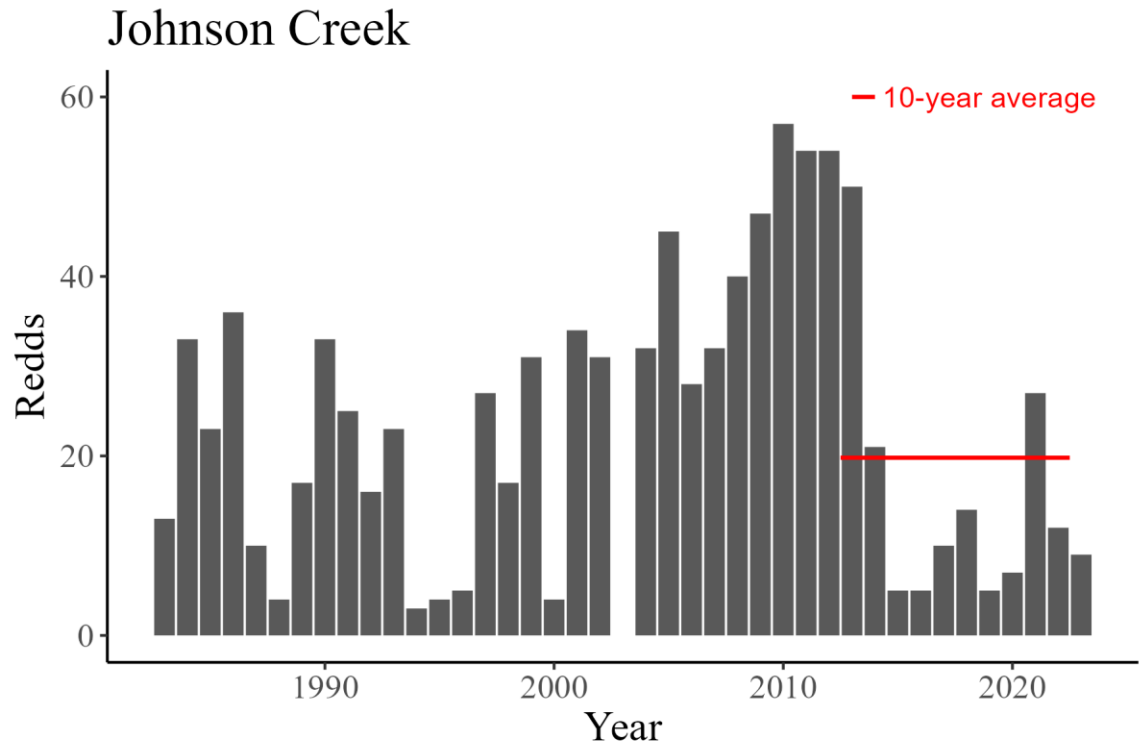


Figure 4. Number of Bull Trout redds counted in Johnson Creek 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022).

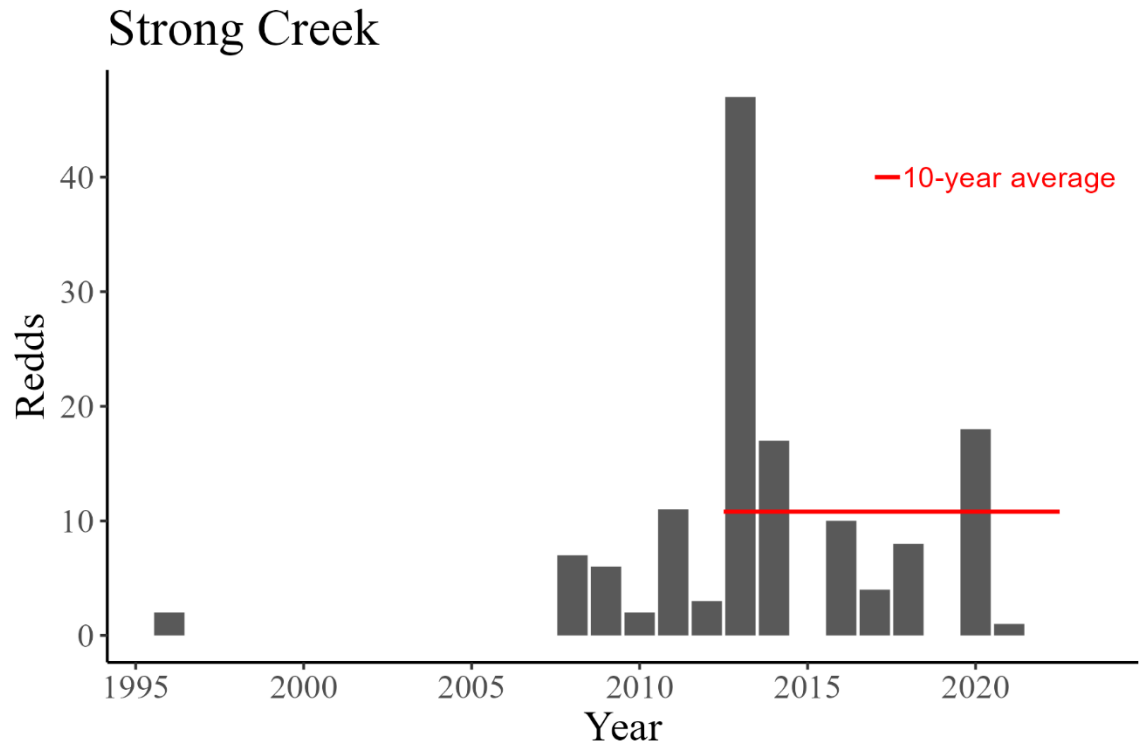


Figure 5. Number of Bull Trout redds counted in Strong Creek 1996–2023. The horizontal red line represents the prior 10-year average (2013–2022).

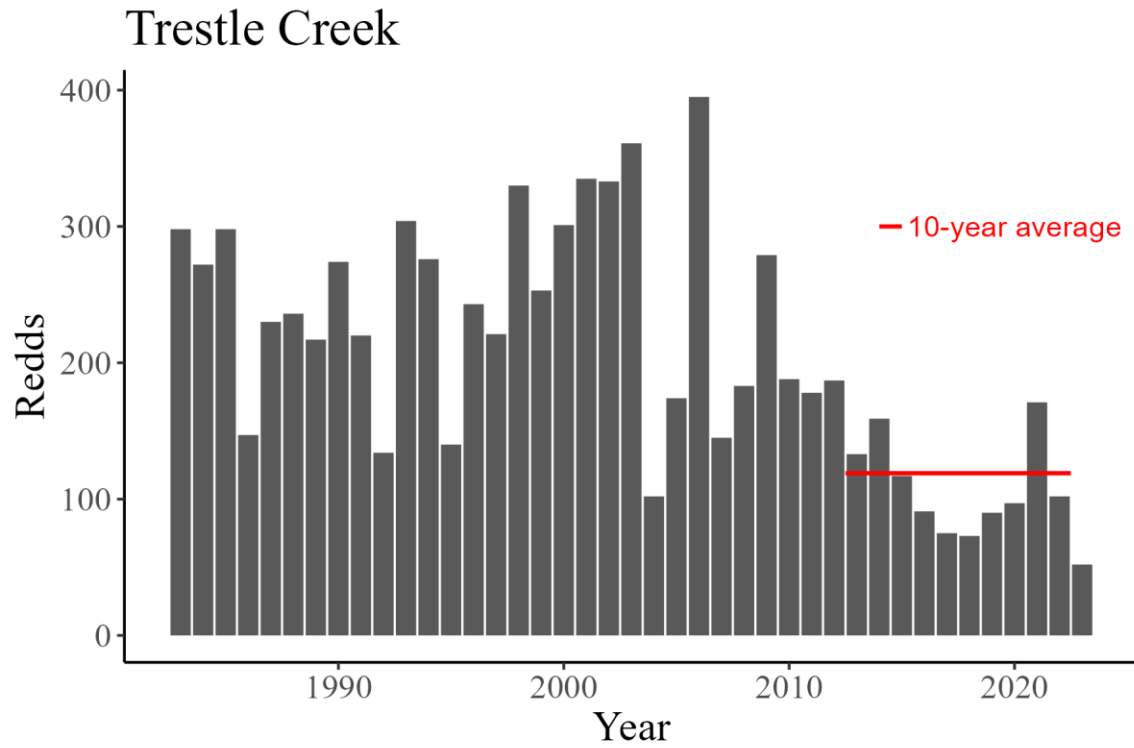


Figure 6. Number of Bull Trout redds counted in Trestle Creek from 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022).

Granite Creek

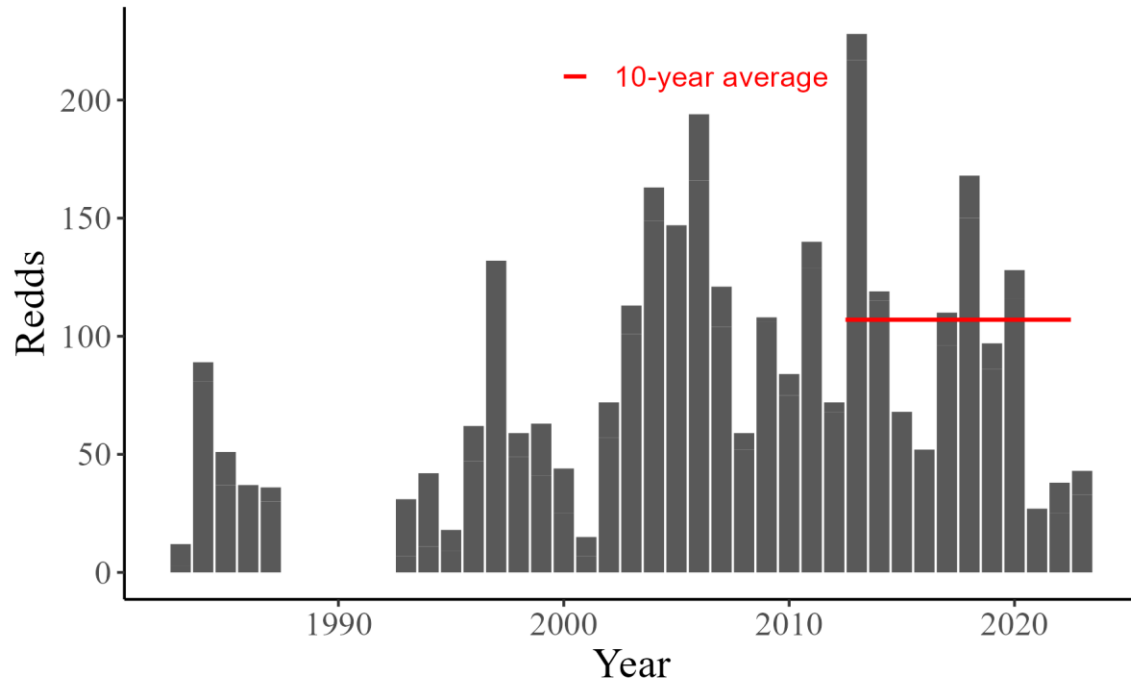


Figure 7. Number of Bull Trout redds counted in the Granite Creek drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022).

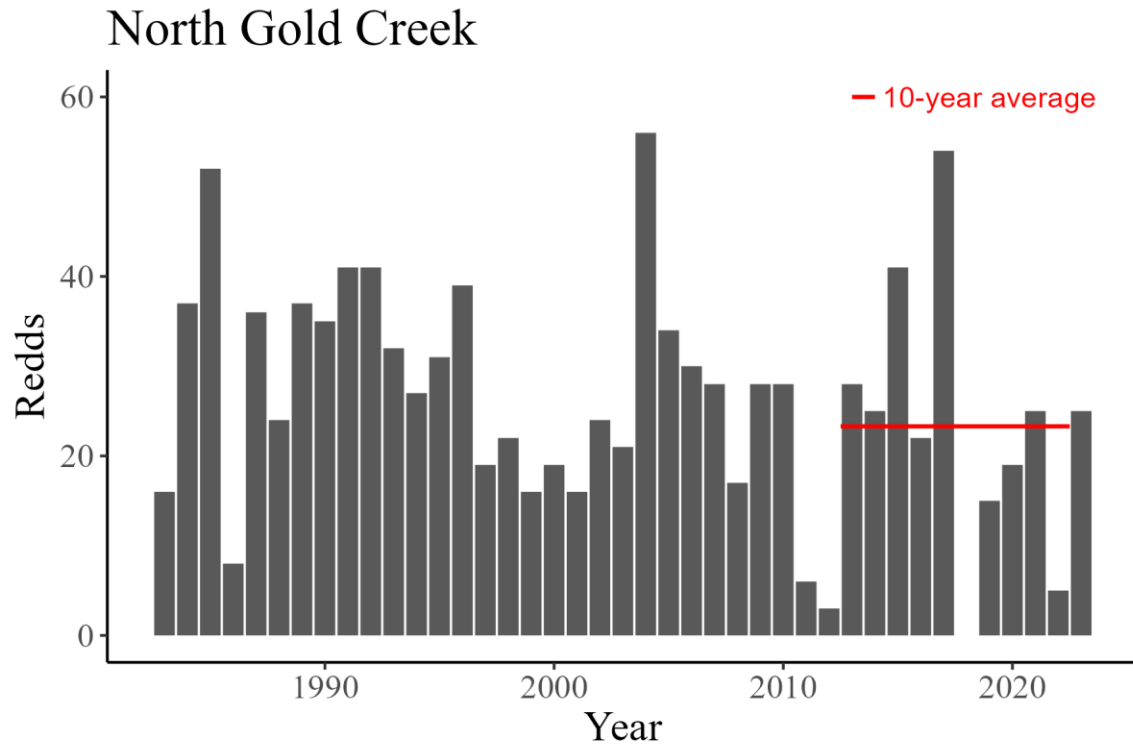


Figure 8. Number of Bull Trout redds counted in North Gold Creek 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022).

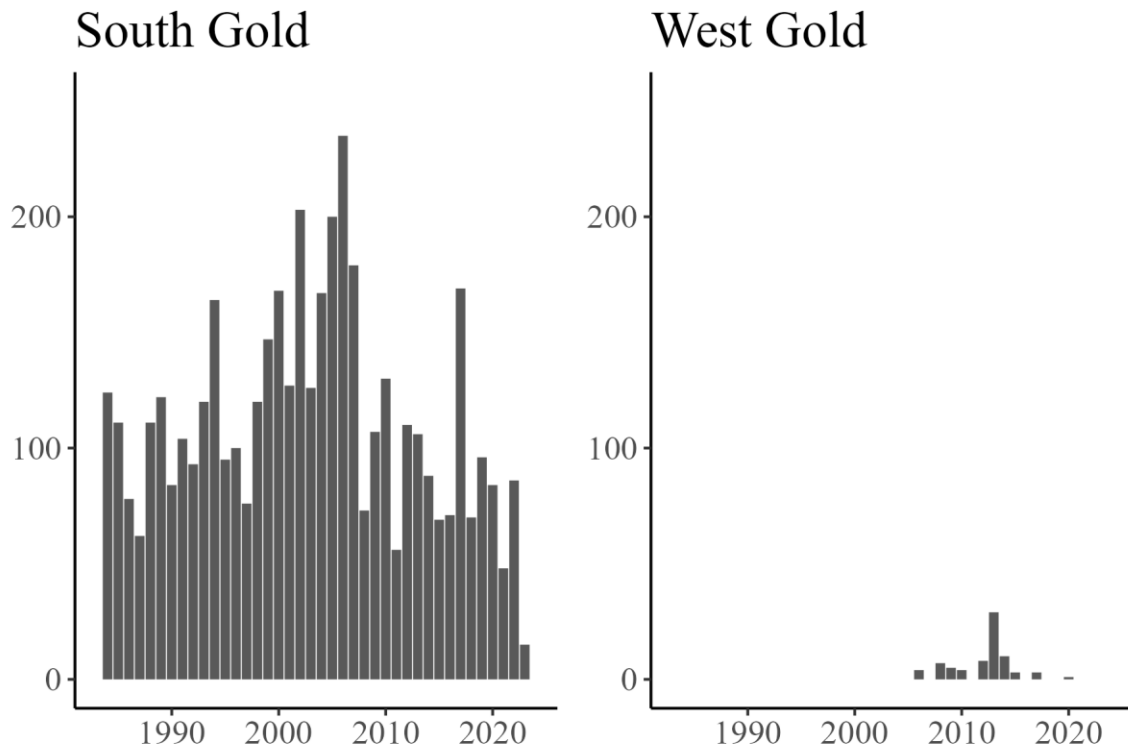
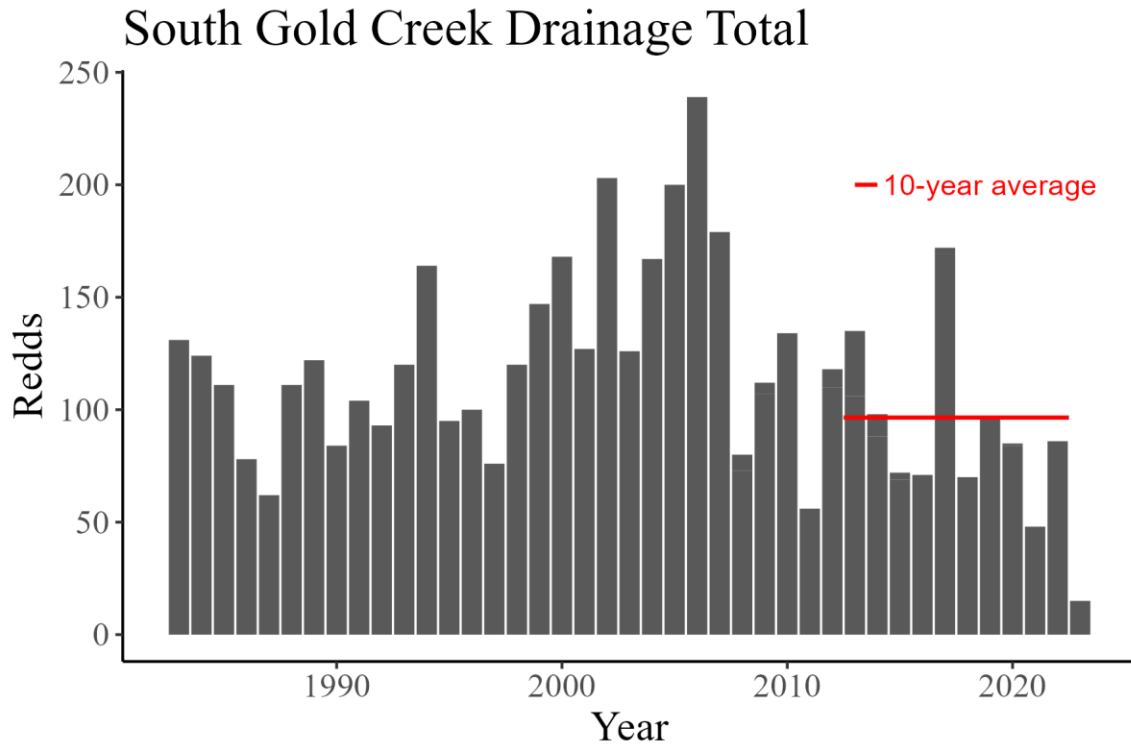


Figure 9. Number of Bull Trout redds counted in the South Gold Creek drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022).

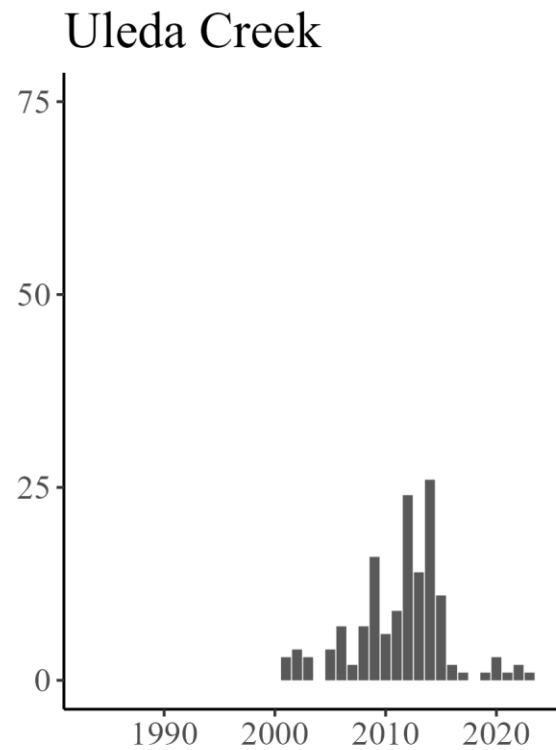
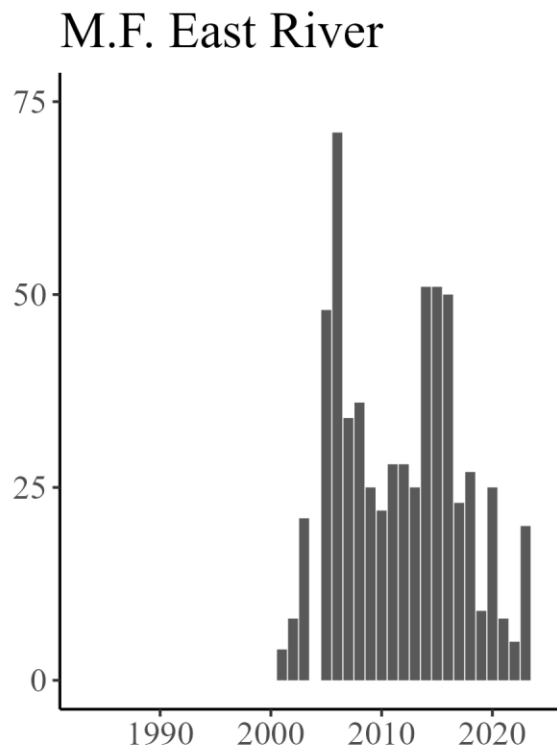
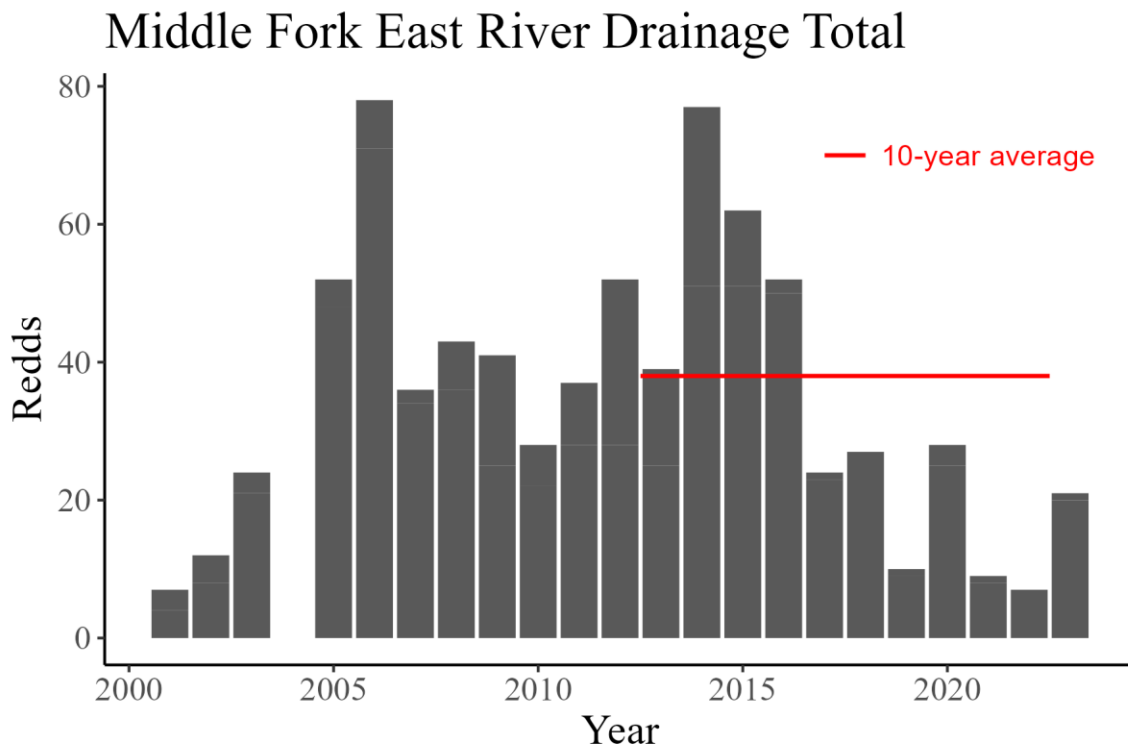


Figure 10. Number of Bull Trout redds counted in the Middle Fork East River drainage 2000–2023. The horizontal red line represents the prior 10-year average (2013–2022).

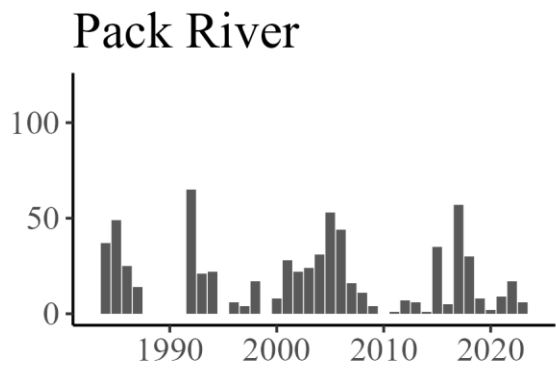
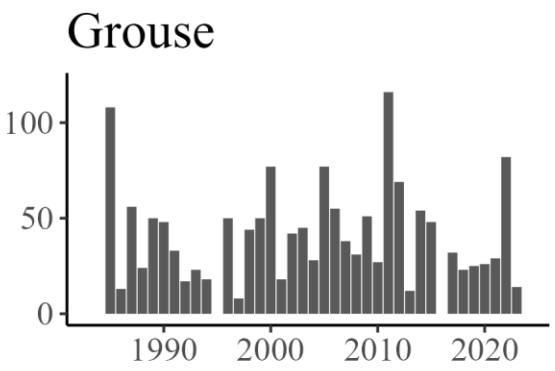
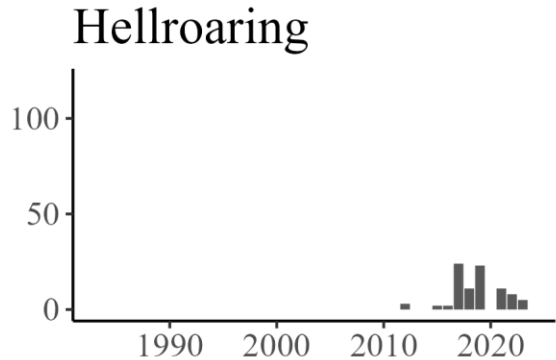
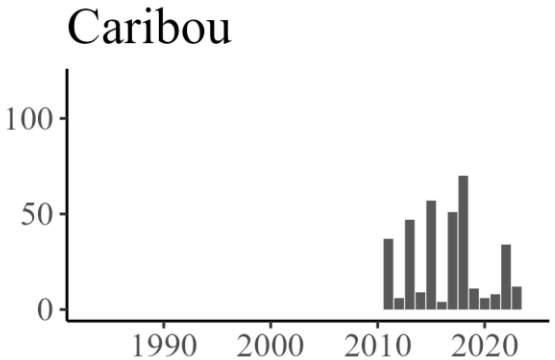
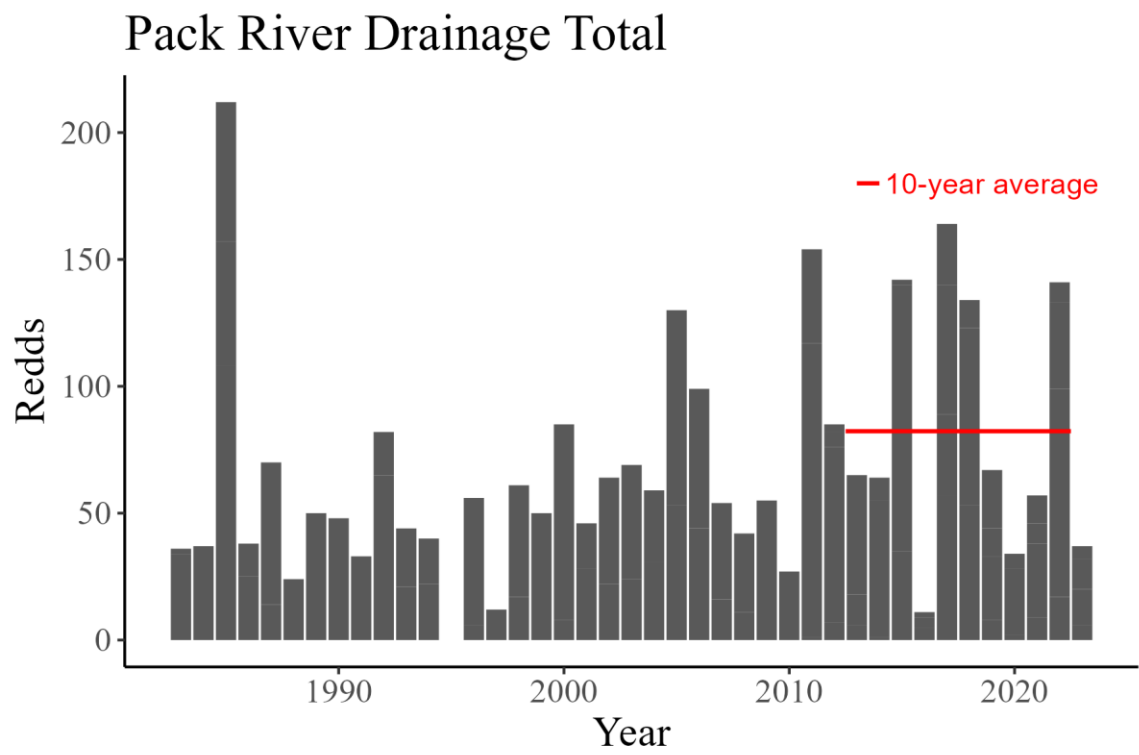


Figure 11. Number of Bull Trout redds counted in the Pack River drainage 1983–2023. The horizontal red line represents the prior 10-year average (2013–2022).

Exploratory redd counts were conducted in Lightning Creek during 2022 and 2023 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 and 20 redds respectively, were counted during this survey and we recommend continued monitoring of this reach in future surveys.

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 2023. 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 2023. 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. A developing fish passage barrier formed by accumulated bedload behind a fallen tree near the mouth of Wellington Creek, first observed in 2018, also continued into 2023, and will likely worsen over time. This potential for reduced access to spawning habitats may have influenced redd count numbers for 2023 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 in 2023. An artificial partial 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 low-water years such as 2022 and 2023. In recent years this barrier has been temporarily modified to divert water to a single “jump-shoot” to permit Bull Trout passage. Low numbers of redds were observed again in Granite Creek this year, though they were located predominately above this potential 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 2020–2023, 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 and 2023 redd counts, numerous redds were found in areas of gravel retained by 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. Preliminary work, including ground and aerial drone surveys and the marking of trees has begun in advance of a large restoration project in Rattle Creek.

The intent of this work is to fall large wood into the creek in numerous locations to reduce velocities, thereby limiting excess bedload transport and further expansion or creation of dry reaches, while also creating pool habitats and overhead cover. The overall desire is to create depositional habitat to collect suitable spawning substrate at the tail-out and margins of newly formed pools to increase the availability of spawning habitat.

Overall, Redd counts continued to decrease in 2023 and are below the 10- and 20-year average for the majority of stream sections. Respective to 2023 this may be due to decreased stream flows. For example, flows for Lightning Creek and the Pack River were among the lowest observed in the last 10 years and this is indicative of trends observed in all of the streams surveyed. Low water conditions may have decreased the availability of adequate spawning habitat, reduced the likelihood of adequate stream connectivity to allow upstream passage of spawning Bull Trout, and decreased the quantity and size of adult holding pools. All of these factors may have resulted in the lower number of redds counted in 2023.

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.

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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 1985–2012.

Stream	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	2012
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.	46	14	4					11	2	5	0	6	0	3	16	4	7	8	8	9	22	9	3	10	11	0	20	1
East Fork*	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	11
Savage Cr.	29		0					1	6	6	0	0	0	0	4	2	4	15	7	15	7	25	0	8	5	6	1	
Char Cr.	11	0	2					9	37	13	2	14	1	16	17	11	2	8	7	14	15	20	1	5	1	4	9	0
Porcupine Cr.	32	1	9					4	6	1	2	0	0	0	4	4	0	0	5	10	14	8	8	8	15	11	13	2
Wellington Cr.	15	7	2					9	4	9	1	5	2	1	22	8	7	7	8	7	6	29	9	10	4	7	6	5
Rattle Cr.	21	10	35					10	8	0	1	10	2	15	13	12	67	33	37	34	34	21	2	24	62	43	65	59
Morris Cr.	--	--	--												1	1	0	7	1	1	3	16	0	6	6	9	0	0
Lightning Drainage Total	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	78
Johnson Cr.*	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	54
Twin Cr.	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	3
Trestle Cr.*	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	187
Granite Cr.	37	37	30					0	7	11	9	47	90	49	41	25	7	57	101	149	132	166	104	52	106	75	129	68
Sullivan Springs	14		6					0	24	31	9	15	42	10	22	19	8	15	12	14	15	28	17	7	2	9	11	4
Granite Drainage Total	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	72
North Gold Cr.*	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	3
Gold Cr.*	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	110
W. Gold																					4	0	7	5	4	0	8	
Gold Drainage Total	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	118
M.F. East River																	4	8	21	20	48	71	34	36	25	22	28	28
Uleda Creek																	3	4	3	7	4	7	2	7	16	6	9	24
MFER Total																	7	12	24	27	52	78	36	43	41	28	37	52
N.F. East River																				1	0	0			0		0	
Pack River	49	25	14					65	21	22	0	6	4	17	0	8	28	22	24	31	53	44	16	11	4	0	1	7
Grouse Cr.*	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	69
Caribou																											37	6
Hellroaring																												3
Pack Drainage Total	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	85
Total 6 index streams *	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	434
Total of all streams	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	652

APPENDIX B

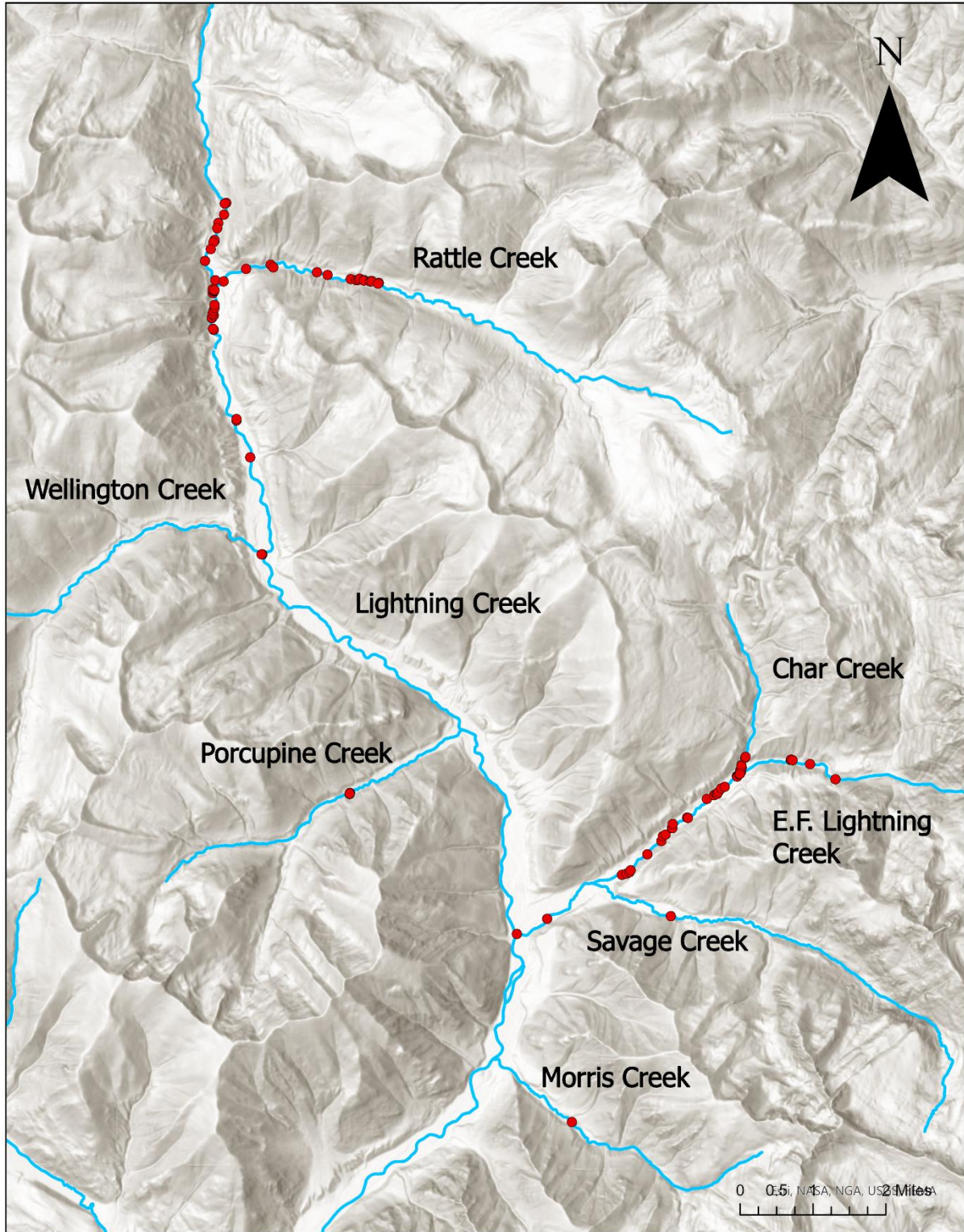


Figure B-1. Distribution map of Bull Trout redds observed in the Lightning Creek drainage in 2023.

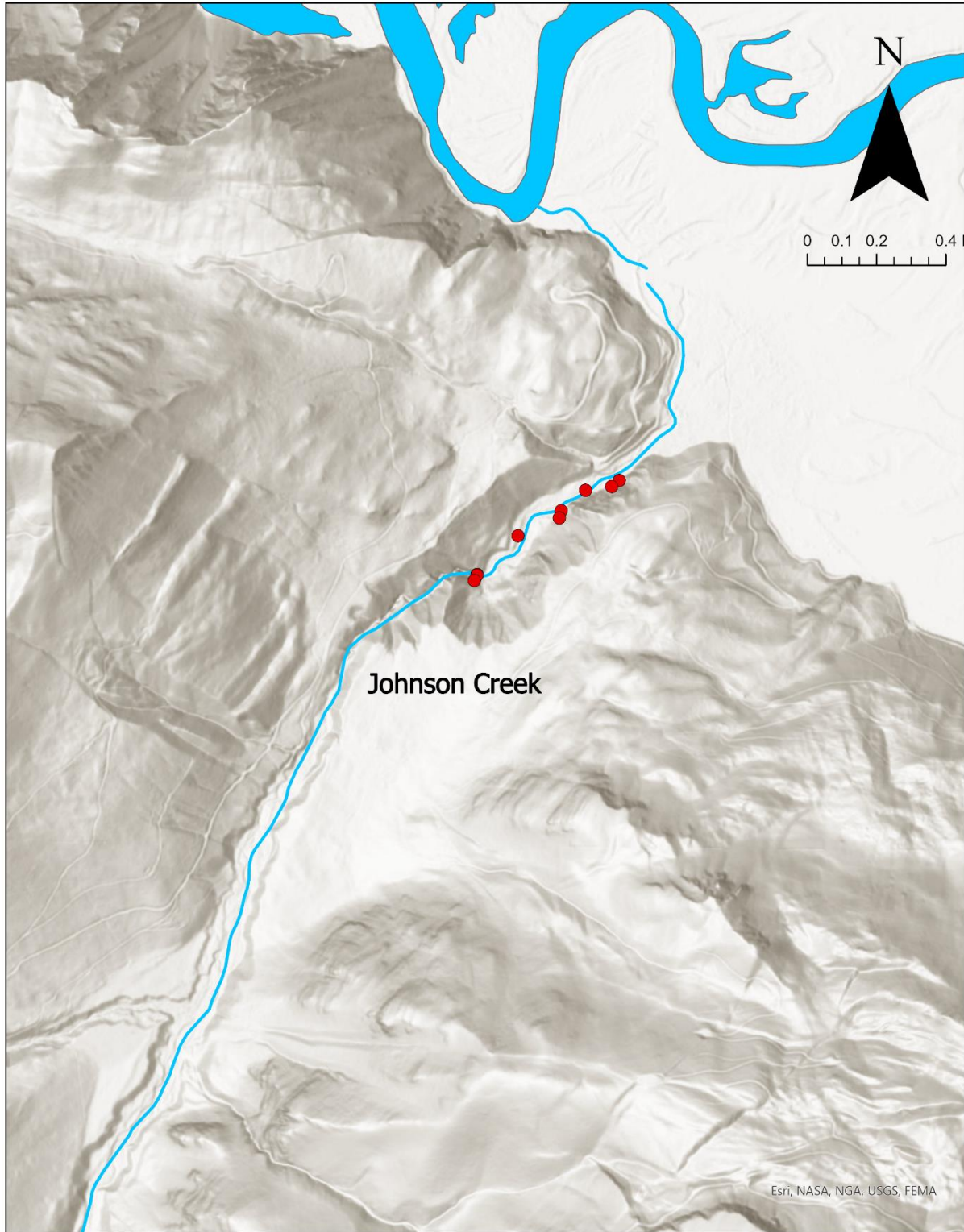


Figure B-2. Distribution map of Bull Trout redds observed in Johnson Creek in 2023.

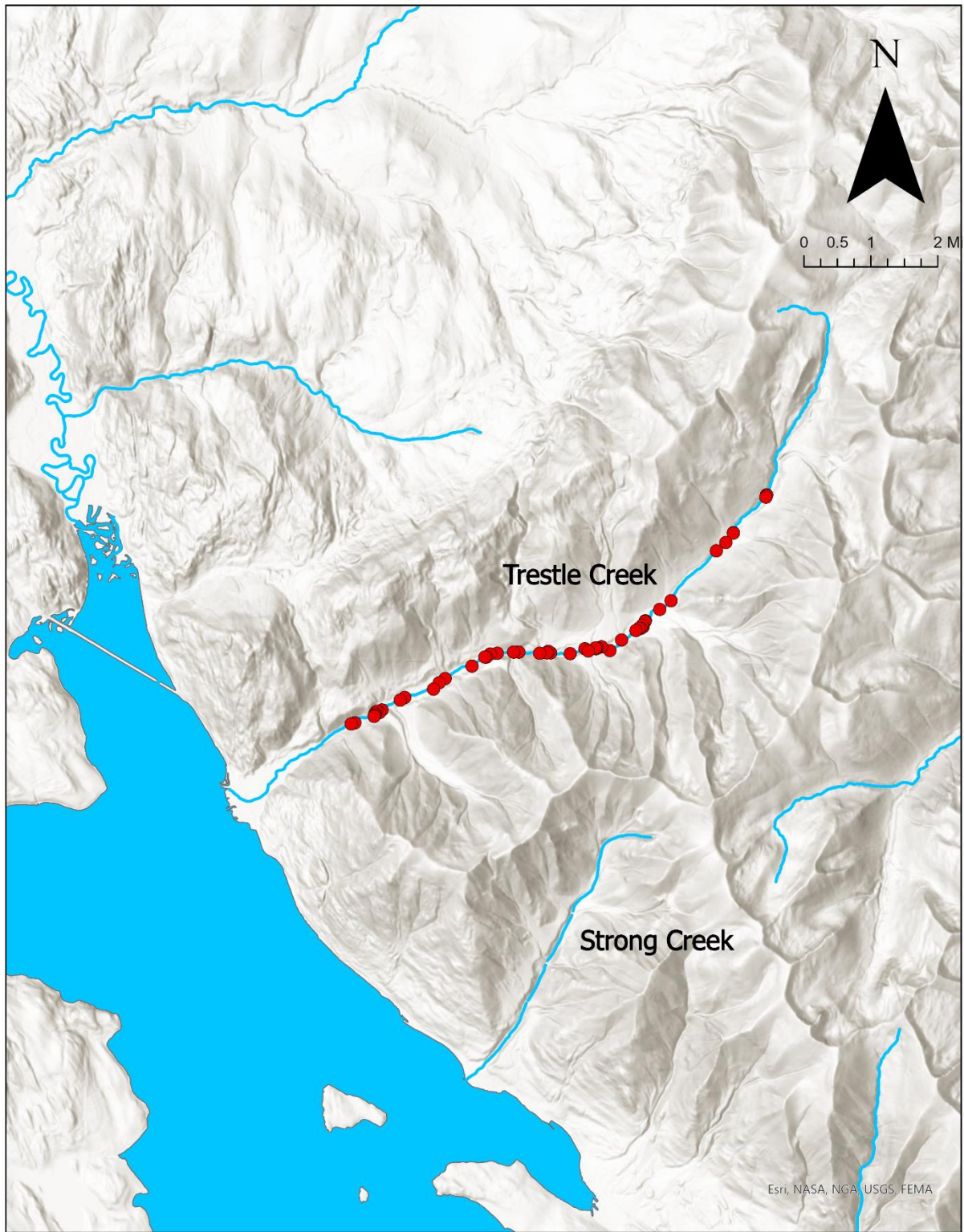


Figure B-3. Distribution map of Bull Trout redds observed in Trestle and Strong creeks in 2023.

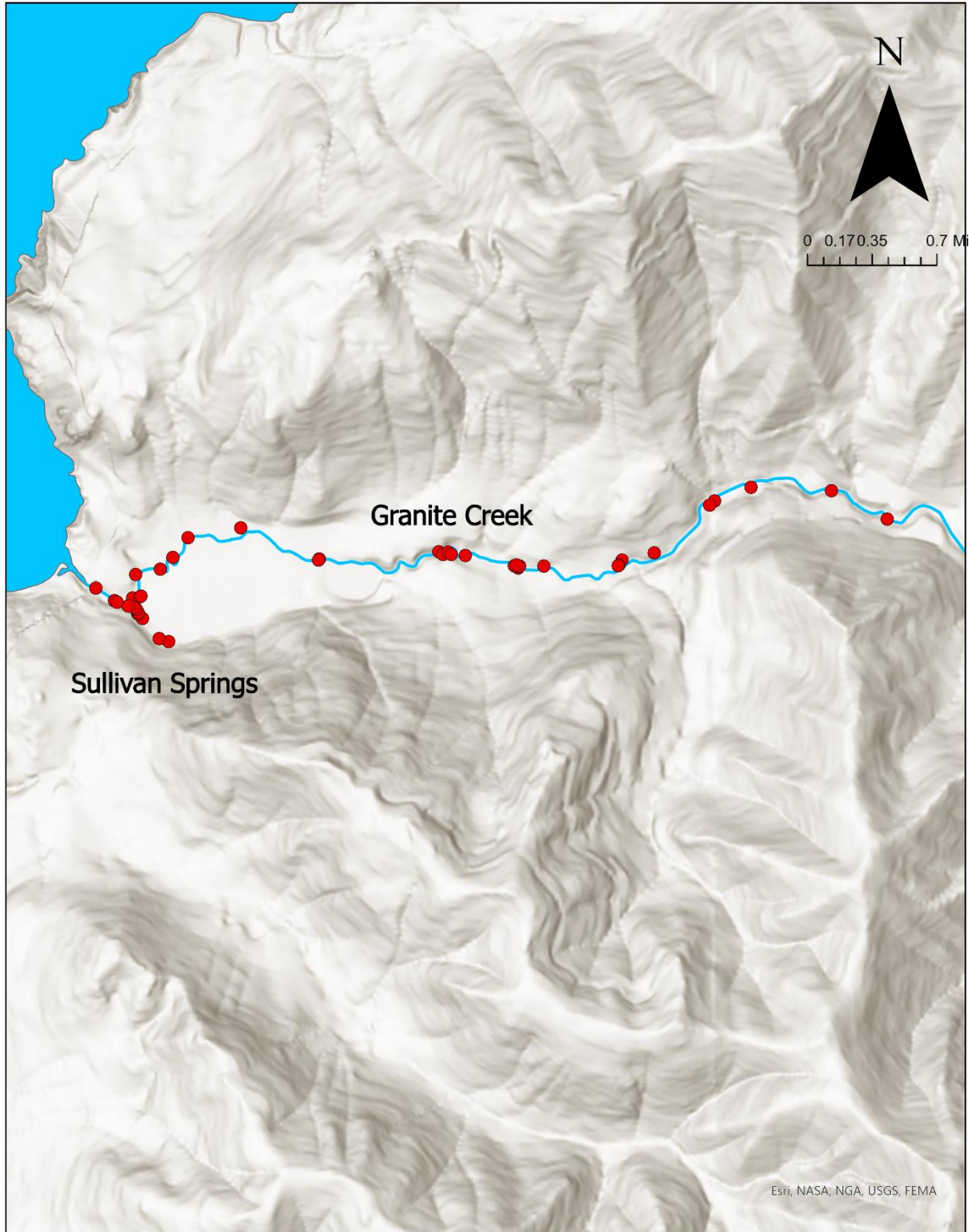


Figure B-4. Distribution map of Bull Trout redds observed in the Granite Creek drainage in 2023.

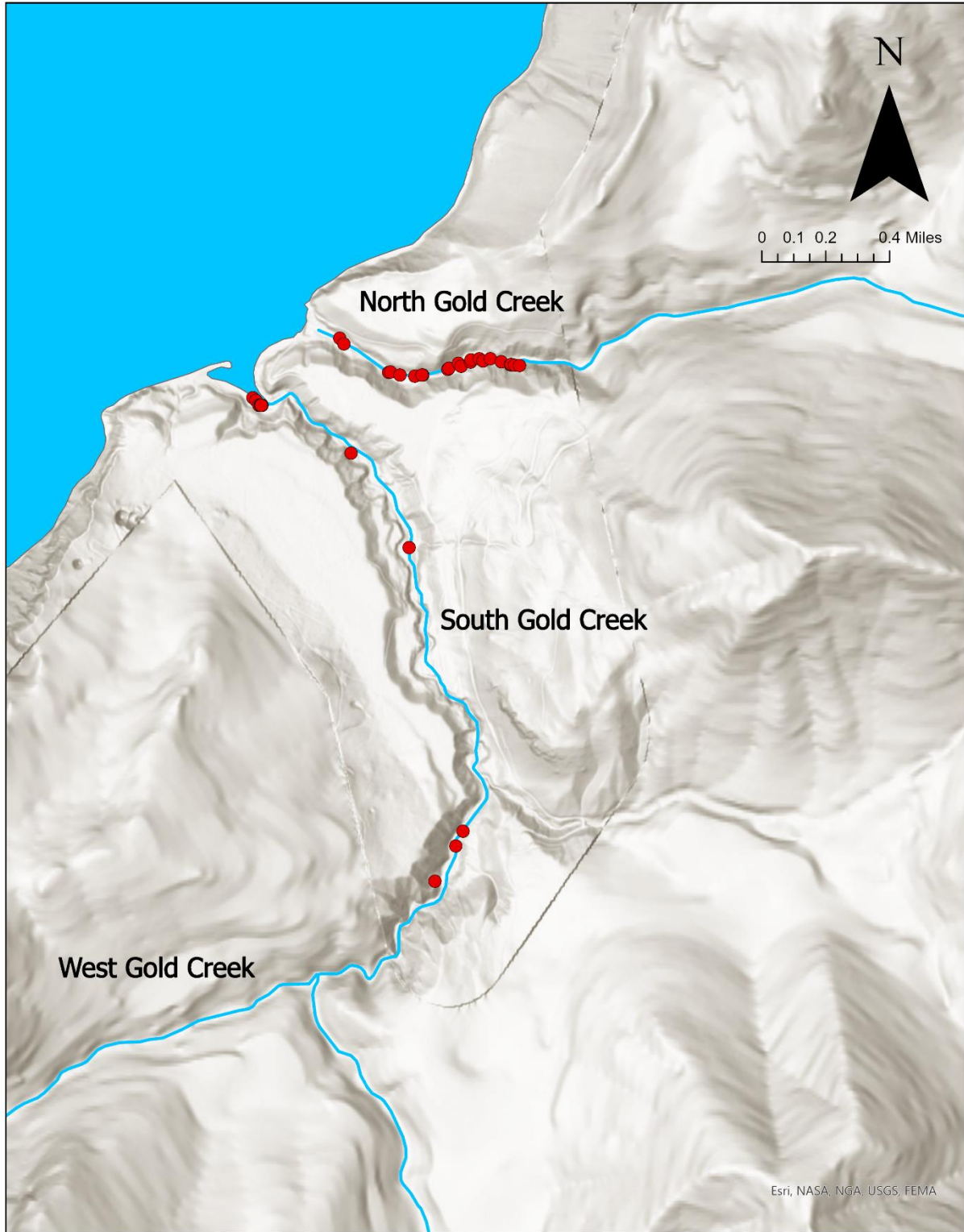


Figure B-5. Distribution map of Bull Trout redds observed in the Gold Creek drainage in 2023.



Figure B-6. Distribution map of Bull Trout redds observed in the Middle Fork East River drainage in 2023.

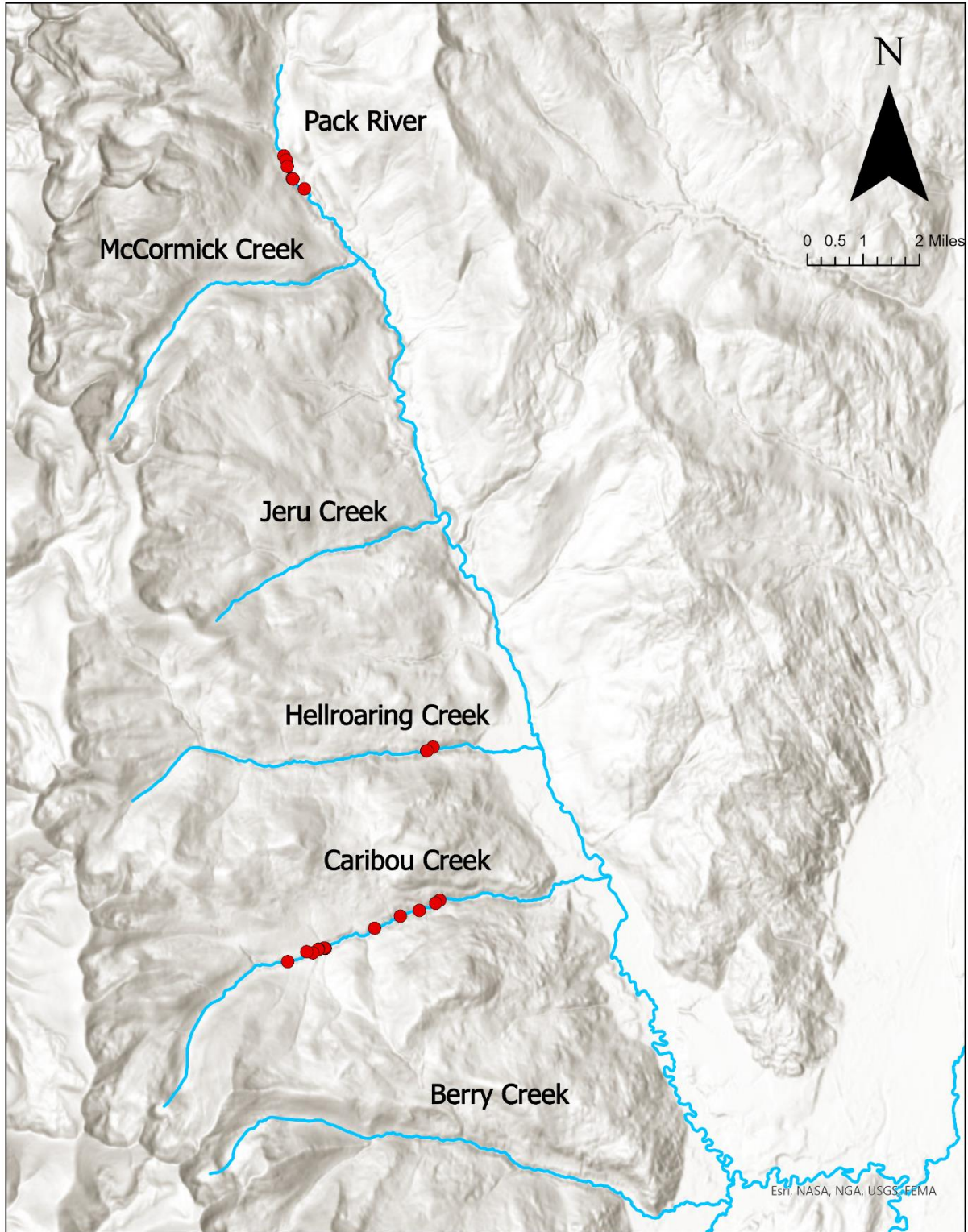


Figure B-8. Distribution map of Bull Trout redds observed in the Pack River drainage in 2023.

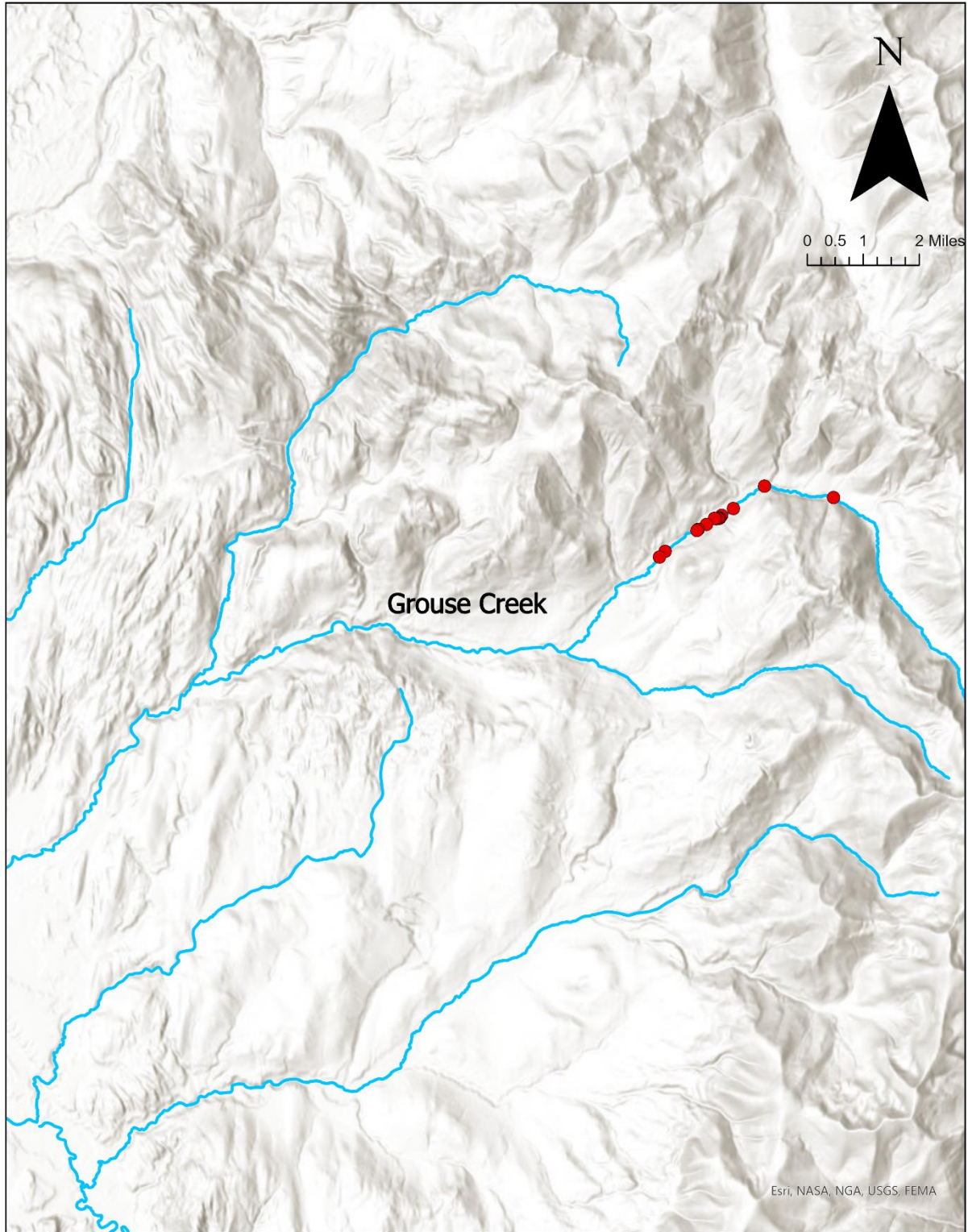


Figure B-8. Distribution map of Bull Trout redds observed in Grouse Creek, a tributary in the Pack River drainage in 2023.

APPENDIX C

Table C-1. Survey stream, Latitude and Longitude (WGS 84) of Bull Trout redd locations recorded using handheld GPS devices during the 2023 annual Bull Trout redd counts on 22 tributaries to Lake Pend Oreille, lower Priest River and the lower Clark Fork River, Idaho.

Stream	Latitude	Longitude
Gold Creek	47.973	-116.45106
Gold Creek	47.9719	-116.4473
Gold Creek	47.972	-116.44616
Gold Creek	47.9721	-116.44611
Gold Creek	47.9722	-116.44568
Gold Creek	47.9721	-116.44556
Gold Creek	47.9722	-116.44513
Gold Creek	47.9723	-116.44511
Gold Creek	47.9723	-116.44474
Gold Creek	47.9723	-116.44456
Gold Creek	47.9723	-116.44425
Gold Creek	47.9728	-116.45086
Gold Creek	47.9723	-116.44374
Gold Creek	47.9722	-116.44333
Gold Creek	47.9722	-116.4433
Gold Creek	47.9722	-116.4433
Gold Creek	47.9722	-116.44314
Gold Creek	47.9721	-116.44292
Gold Creek	47.9719	-116.44885
Gold Creek	47.9719	-116.44875
Gold Creek	47.9719	-116.44833
Gold Creek	47.9718	-116.44766
Gold Creek	47.9718	-116.44766
Gold Creek	47.9718	-116.44766
Gold Creek	47.9719	-116.44734
Gold Creek	47.9712	-116.4549884
Gold Creek	47.9709	-116.4545825
Gold Creek	47.9695	-116.4505485
Gold Creek	47.9666	-116.4479203
Gold Creek	47.958	-116.44548
Gold Creek	47.9576	-116.4458
Gold Creek	47.9565	-116.44674
Gold Creek	47.9712	-116.4549922
Gold Creek	47.9711	-116.4548573
Gold Creek	47.9709	-116.4547084
Gold Creek	47.9709	-116.4546446

Table C-1 continued

Stream	Latitude	Longitude
Gold Creek	47.9709	-116.4546192
Gold Creek	47.9709	-116.454605
Gold Creek	47.9709	-116.454604
Gold Creek	47.9709	-116.4546081
Granite Creek	48.0849	-116.42431
Granite Creek	48.0843	-116.42284
Granite Creek	48.0844	-116.42142
Granite Creek	48.0845	-116.42087
Granite Creek	48.0856	-116.4212
Granite Creek	48.0845	-116.42078
Granite Creek	48.0859	-116.41926
Granite Creek	48.0865	-116.41828
Granite Creek	48.0876	-116.41708
Granite Creek	48.0864	-116.40684
Granite Creek	48.0881	-116.41296
Granite Creek	48.0864	-116.4069
Granite Creek	48.0868	-116.3975
Granite Creek	48.0867	-116.39716
Granite Creek	48.0868	-116.39674
Granite Creek	48.0867	-116.39652
Granite Creek	48.0866	-116.39542
Granite Creek	48.0861	-116.39159
Granite Creek	48.086	-116.3913
Granite Creek	48.086	-116.39122
Granite Creek	48.0861	-116.39116
Granite Creek	48.0861	-116.39142
Granite Creek	48.0864	-116.38315
Granite Creek	48.0861	-116.38339
Granite Creek	48.0861	-116.38345
Granite Creek	48.0861	-116.38927
Granite Creek	48.0885	-116.36241
Granite Creek	48.09	-116.36678
Granite Creek	48.0902	-116.37308
Granite Creek	48.0895	-116.37592
Granite Creek	48.0895	-116.37592
Granite Creek	48.0893	-116.37632
Granite Creek	48.0868	-116.38065
Sullivan Springs	48.0821	-116.41861
Sullivan Springs	48.0823	-116.41935

Table C-1 continued

Stream	Latitude	Longitude
Sullivan Springs	48.0833	-116.42066
Sullivan Springs	48.0836	-116.421
Sullivan Springs	48.0837	-116.42105
Sullivan Springs	48.0836	-116.42099
Sullivan Springs	48.0838	-116.42112
Sullivan Springs	48.0839	-116.42132
Sullivan Springs	48.084	-116.42178
Sullivan Springs	48.0842	-116.42263
Johnson Creek	48.1309	-116.22603
Johnson Creek	48.1308	-116.22634
Johnson Creek	48.1307	-116.22743
Johnson Creek	48.1301	-116.22844
Johnson Creek	48.1299	-116.22852
Johnson Creek	48.1294	-116.23025
Johnson Creek	48.1283	-116.23195
Johnson Creek	48.1283	-116.23196
Johnson Creek	48.1281	-116.23206
Char Creek	48.2622	-116.06833
Char Creek	48.2624	-116.06855
Char Creek	48.2628	-116.06819
Char Creek	48.2631	-116.06829
Char Creek	48.2631	-116.06826
Char Creek	48.2642	-116.06753
Char Creek	48.2643	-116.06744
EF Lightning	48.2409	-116.11283
EF Lightning	48.2429	-116.10681
EF Lightning	48.2487	-116.09198
EF Lightning	48.2488	-116.09106
EF Lightning	48.249	-116.0905
EF Lightning	48.2493	-116.09026
EF Lightning	48.2514	-116.08694
EF Lightning	48.2531	-116.08413
EF Lightning	48.2538	-116.08386
EF Lightning	48.254	-116.08337
EF Lightning	48.2548	-116.08208
EF Lightning	48.2548	-116.08197
EF Lightning	48.2554	-116.08188
EF Lightning	48.2562	-116.07902
EF Lightning	48.2562	-116.0789

Table C-1 continued

Stream	Latitude	Longitude
EF Lightning	48.2587	-116.07513
EF Lightning	48.2592	-116.07371
EF Lightning	48.2594	-116.07322
EF Lightning	48.2593	-116.07311
EF Lightning	48.2596	-116.07285
EF Lightning	48.2601	-116.07229
EF Lightning	48.2603	-116.07157
EF Lightning	48.2617	-116.06918
EF Lightning	48.2616	-116.06913
EF Lightning	48.2619	-116.06872
EF Lightning	48.262	-116.06856
EF Lightning	48.2639	-116.05852
EF Lightning	48.2638	-116.05849
EF Lightning	48.2639	-116.05847
EF Lightning	48.2638	-116.0581
EF Lightning	48.2633	-116.05469
EF Lightning	48.2613	-116.04966
Lightning Creek	48.3373	-116.17044
Lightning Creek	48.3372	-116.17073
Lightning Creek	48.3358	-116.17091
Lightning Creek	48.3347	-116.17203
Lightning Creek	48.334	-116.17222
Lightning Creek	48.3323	-116.17279
Lightning Creek	48.3324	-116.1728
Lightning Creek	48.3322	-116.17303
Lightning Creek	48.3313	-116.17357
Lightning Creek	48.3297	-116.17466
Lightning Creek	48.3297	-116.17466
Lightning Creek	48.3272	-116.17262
Lightning Creek	48.3038	-116.16569
Lightning Creek	48.3086	-116.16843
Lightning Creek	48.3088	-116.16845
Lightning Creek	48.3206	-116.17296
Lightning Creek	48.3208	-116.17305
Lightning Creek	48.3222	-116.17334
Lightning Creek	48.3222	-116.17328
Lightning Creek	48.3225	-116.17295
Lightning Creek	48.3227	-116.17318
Lightning Creek	48.3231	-116.173

Table C-1 continued

Stream	Latitude	Longitude
Lightning Creek	48.3235	-116.17275
Lightning Creek	48.3235	-116.17275
Lightning Creek	48.3239	-116.1728
Lightning Creek	48.3239	-116.17281
Lightning Creek	48.3255	-116.1731
Lightning Creek	48.3257	-116.17291
Lightning Creek	48.3257	-116.17284
Lightning Creek	48.3258	-116.173
Lightning Creek	48.3258	-116.17299
Lightning Creek	48.3259	-116.17313
Lightning Creek	48.3258	-116.1728
Morris Creek	48.216	-116.10194
Porcupine Creek	48.2595	-116.14594
Porcupine Creek	48.2594	-116.14598
Porcupine Creek	48.2594	-116.146
Porcupine Creek	48.2594	-116.14602
Porcupine Creek	48.2594	-116.14601
Rattle Creek	48.327	-116.17099
Rattle Creek	48.3287	-116.16652
Rattle Creek	48.3292	-116.16168
Rattle Creek	48.3289	-116.16111
Rattle Creek	48.3282	-116.15245
Rattle Creek	48.3278	-116.15036
Rattle Creek	48.3273	-116.14581
Rattle Creek	48.3272	-116.14467
Rattle Creek	48.3272	-116.14417
Rattle Creek	48.3274	-116.14395
Rattle Creek	48.3272	-116.14315
Rattle Creek	48.3271	-116.14312
Rattle Creek	48.327	-116.14196
Rattle Creek	48.327	-116.14161
Rattle Creek	48.327	-116.14162
Rattle Creek	48.3268	-116.14024
Rattle Creek	48.3267	-116.14035
Savage Creek	48.2432	-116.08228
Wellington Creek	48.291	-116.16328
Wellington Creek	48.291	-116.16333
Wellington Creek	48.291	-116.16344
Wellington Creek	48.291	-116.16344

Table C-1 continued

Stream	Latitude	Longitude
Caribou Creek	48.4686	-116.5949
Caribou Creek	48.4681	-116.596
Caribou Creek	48.4668	-116.60024
Caribou Creek	48.4659	-116.60513
Caribou Creek	48.4638	-116.61173
Caribou Creek	48.4604	-116.62447
Caribou Creek	48.4605	-116.6248
Caribou Creek	48.4602	-116.62628
Caribou Creek	48.4602	-116.62633
Caribou Creek	48.4596	-116.62771
Caribou Creek	48.4598	-116.62924
Caribou Creek	48.4581	-116.63417
Grouse Creek	48.4811	-116.21339
Grouse Creek	48.483	-116.23125
Grouse Creek	48.4792	-116.23929
Grouse Creek	48.478	-116.24227
Grouse Creek	48.4775	-116.24274
Grouse Creek	48.4775	-116.24297
Grouse Creek	48.4775	-116.24331
Grouse Creek	48.4774	-116.24376
Grouse Creek	48.4775	-116.24411
Grouse Creek	48.4765	-116.24624
Grouse Creek	48.4756	-116.24841
Grouse Creek	48.4754	-116.24869
Grouse Creek	48.4719	-116.25686
Grouse Creek	48.4709	-116.25833
Hellroaring Creek	48.4948	-116.59671
Hellroaring Creek	48.4942	-116.59829
Hellroaring Creek	48.4942	-116.5983
Hellroaring Creek	48.4942	-116.59829
Hellroaring Creek	48.4942	-116.59822
Pack River	48.5959	-116.63519
Pack River	48.5952	-116.63456
Pack River	48.5942	-116.63426
Pack River	48.5921	-116.63301
Pack River	48.592	-116.63285
Pack River	48.5903	-116.6299
MF East River	48.39	-116.77655
MF East River	48.3908	-116.77384

Table C-1 continued

Stream	Latitude	Longitude
MF East River	48.3915	-116.77281
MF East River	48.3916	-116.77277
MF East River	48.3934	-116.74588
MF East River	48.3932	-116.76422
MF East River	48.3933	-116.76288
MF East River	48.3933	-116.76227
MF East River	48.393	-116.76051
MF East River	48.3929	-116.75853
MF East River	48.3927	-116.75664
MF East River	48.3926	-116.75338
MF East River	48.3926	-116.75335
MF East River	48.3926	-116.75319
MF East River	48.3882	-116.70523
MF East River	48.3896	-116.69853
MF East River	48.3929	-116.74391
MF East River	48.3929	-116.74391
MF East River	48.3918	-116.72676
MF East River	48.3917	-116.72443
Uleda Creek	48.3873	-116.70753
Trestle Creek	48.3248	-116.23617
Trestle Creek	48.3248	-116.23618
Trestle Creek	48.3245	-116.23635
Trestle Creek	48.3194	-116.24335
Trestle Creek	48.3194	-116.24339
Trestle Creek	48.318	-116.24499
Trestle Creek	48.3168	-116.24707
Trestle Creek	48.3096	-116.2568
Trestle Creek	116.257	-116.25687
Trestle Creek	48.3084	-116.25924
Trestle Creek	48.3068	-116.26241
Trestle Creek	48.3067	-116.26245
Trestle Creek	48.3059	-116.26286
Trestle Creek	48.3062	-116.263
Trestle Creek	48.3057	-116.26335
Trestle Creek	48.3057	-116.26377
Trestle Creek	48.3054	-116.2644
Trestle Creek	48.304	-116.26751
Trestle Creek	48.3025	-116.27004
Trestle Creek	48.303	-116.27183

Table C-1 continued

Stream	Latitude	Longitude
Trestle Creek	48.3029	-116.27272
Trestle Creek	48.3028	-116.27303
Trestle Creek	48.3029	-116.27317
Trestle Creek	48.3027	-116.2754
Trestle Creek	48.3021	-116.27861
Trestle Creek	48.3022	-116.28283
Trestle Creek	48.3024	-116.28338
Trestle Creek	48.3022	-116.2837
Trestle Creek	48.3022	-116.28366
Trestle Creek	48.3021	-116.28525
Trestle Creek	48.3023	-116.28971
Trestle Creek	48.3023	-116.29086
Trestle Creek	48.3021	-116.29437
Trestle Creek	48.302	-116.29596
Trestle Creek	48.3016	-116.29675
Trestle Creek	48.3016	-116.29706
Trestle Creek	48.3003	-116.29986
Trestle Creek	48.3024	-116.27468
Trestle Creek	48.2985	-116.30566
Trestle Creek	48.2979	-116.30691
Trestle Creek	48.297	-116.3082
Trestle Creek	48.2958	-116.31434
Trestle Creek	48.2954	-116.31532
Trestle Creek	48.294	-116.31929
Trestle Creek	48.2936	-116.31988
Trestle Creek	48.2936	-116.31986
Trestle Creek	48.2937	-116.32048
Trestle Creek	48.2934	-116.32085
Trestle Creek	48.2932	-116.32079
Trestle Creek	48.2931	-116.32097
Trestle Creek	48.2921	-116.32513
Trestle Creek	48.2919	-116.32595