Pend Oreille Basin Bull Trout Redd Monitoring
2021 Annual Project Update

Idaho Tributary Habitat Acquisition and Enhancement Program

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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. A total of 440 Bull Trout redds (all considered migratory) were counted among all surveyed streams in 2021. For all streams combined, counts were 31% below the previous 10-year average. Another year of mild fall weather in 2021 was conducive to counting redds, but a rain event occurred during the Granite Creek redd count and may have influenced visibility.

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. However, redd counts are a reliable technique for monitoring long-term trends in adult Bull Trout abundance.

METHODS

With assistance from Avista and other agencies, 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 2021. In addition, Idaho Department of Lands and 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 coordinates were collected at each redd and adult Bull Trout (alive or dead) were recorded if present. 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. Beginning in 2012, redd surveys were discontinued on the Clark Fork River and Twin Creek because counts at both locations were believed to be heavily influenced by Avista's ongoing upstream Bull Trout transport program and provided little meaningful long-term index information.

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.

	Downstream		Upstream	
Stream	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, 2021. A total of 440 Bull Trout redds (all considered migratory) were counted among all surveyed streams in 2021 (Table 3; Appendix A). This was 56 less (9%) than the total counted during 2020. Many stream counts were below past averages; however, several exhibited an increase for the first time in several years (Table 4, Figures 1–10; Appendix A). Favorable weather and stream flows made for ideal surveying conditions in all locations but Granite Creek (Table 5). Specific coordinates of redds are displayed in Appendix B.

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 and 2021 no redds were observed. 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 1984–2021.

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	2001–2020 Avg	726
2003	836	2011–2020 Avg	636

TABLE 4. Bull Trout redd counts by year from all surveyed tributaries in the Lake Pend Oreille basin, Idaho 2011–2021. Blank cells indicate that no redd count occurred. Data prior to 2011 is listed in Appendix A.

Stream	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2011-2020 Avg
Clark Fork R.	0											0
Lightning Cr.	20	1	1	4	11	-	3	8	13	3	8	7
East Fork Lightning Cr.	64	11	26	22	17	19	80	87	35	10	34	37
Savage Cr.	1		5	6	5	1	19	15	3	6	3	7
Char Cr.	9	0	4	2	0	0	0	4	2	2	1	2
Porcupine Cr.	13	2	4	15	0	14	10	29	13	14	11	11
Wellington Cr.	6	5	5	11	8	3	5	15	7	6	2	7
Rattle Cr.	65	59	8	63	5	5	20	32	47	12	12	32
Morris Cr.	0	0	3	14	0	3	32	18	0	0	4	7
Johnson Cr.	54	54	50	21	5	5	10	14	5	7	27	23
Twin Cr.	1											1
Strong Cr.	11	3	47	17	0	10	4	8	0	18	1	12
Trestle Cr.	178	187	133	159	117	91	75	73	90	97	171	120
Granite Cr.	129	68	217	115	68	48	96	150	86	116	19	109
Sullivan Springs	11	4	11	4	0	4	14	18	11	12	8	9
North Gold Cr.	6	3	28	25	41	22	54	0	15	19	25	21
Gold Cr.	56	110	106	88	69	71	169	70	96	111	48	95
W. Gold Cr.	0	8	29	10	3	0	3	0	0	1	0	5
M.F. East R.	28	28	25	51	51	50	23	27	9	25	8	32
Uleda Cr.	9	24	14	26	11	2	1	0	1	3	1	9
Pack R.	1	7	6	1	35	5	57	30	8	2	9	15
Grouse Cr.	116	69	12	54	48	-	32	23	25	26	29	45
Caribou Cr.	37	6	47	9	57	4	51	70	11	6	8	30
Hellroaring Cr.		3			2	2	24	11	23	0	11	9
McCormick Cr.										0	0	0
Total of all streams	815	652	781	717	553	359	782	702	500	496	440	636

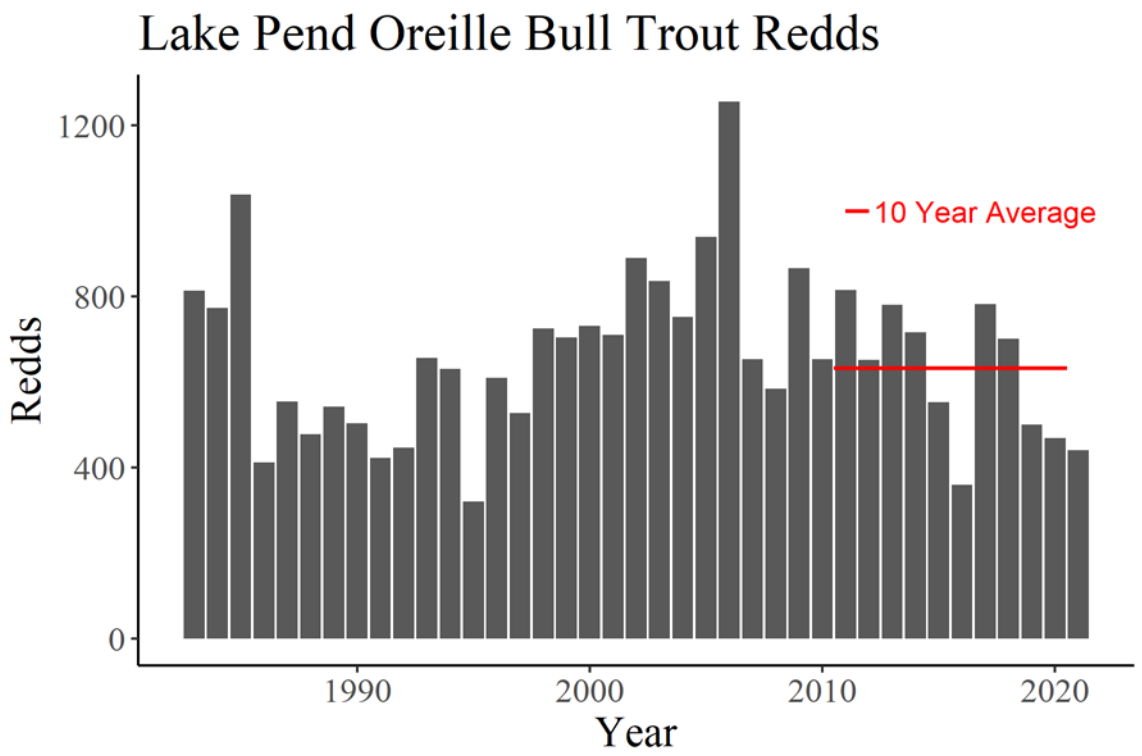

FIGURE 1. Total number of Bull Trout redds counted in all surveyed streams in the Pend Oreille drainage 1983–2021. The horizontal red line represents the 10-year average 2011–2020.

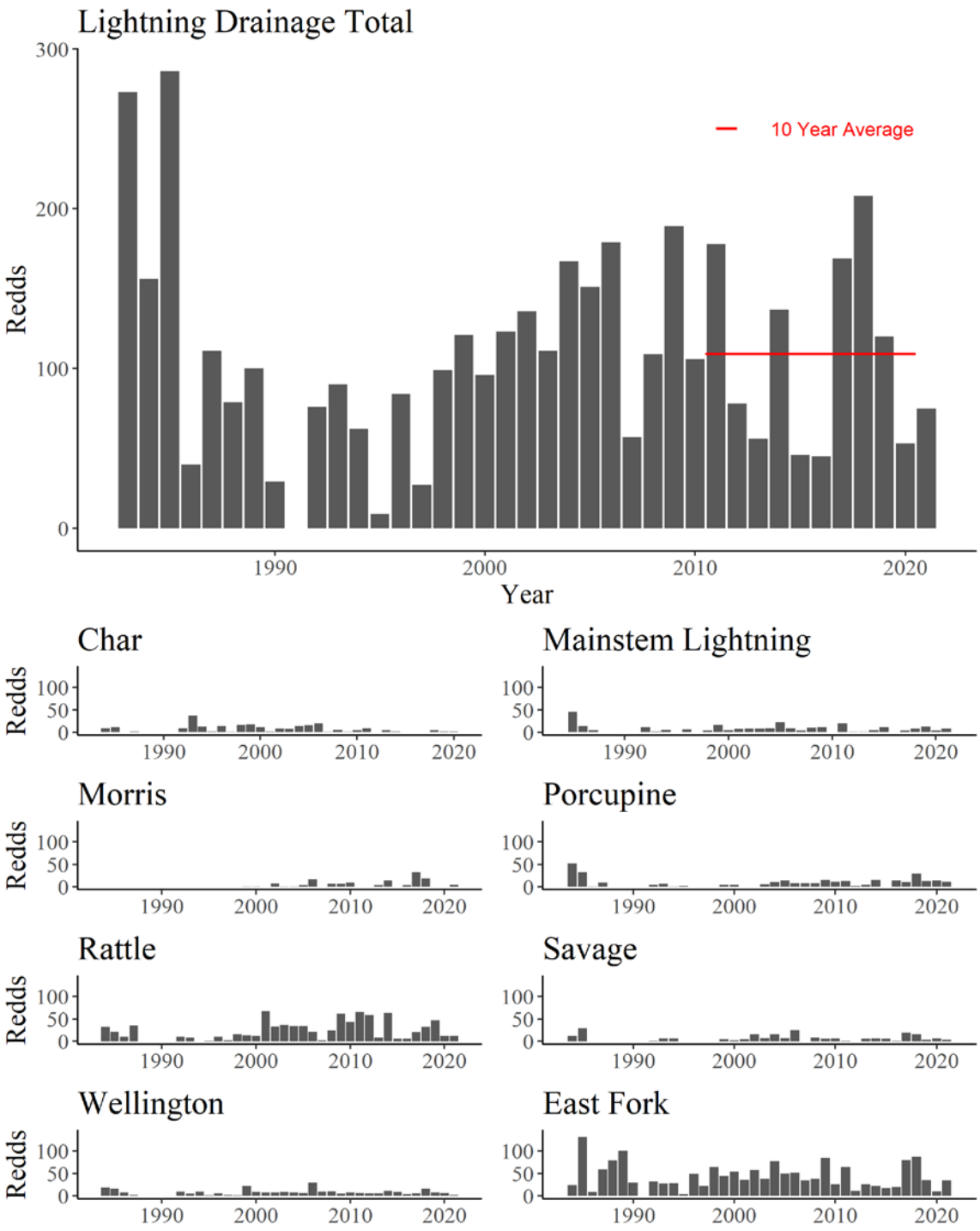

FIGURE 2. Number of Bull Trout redds counted in the Lightning Creek drainage 1983–2021. The horizontal red line represents the 10-year average 2011–2020.

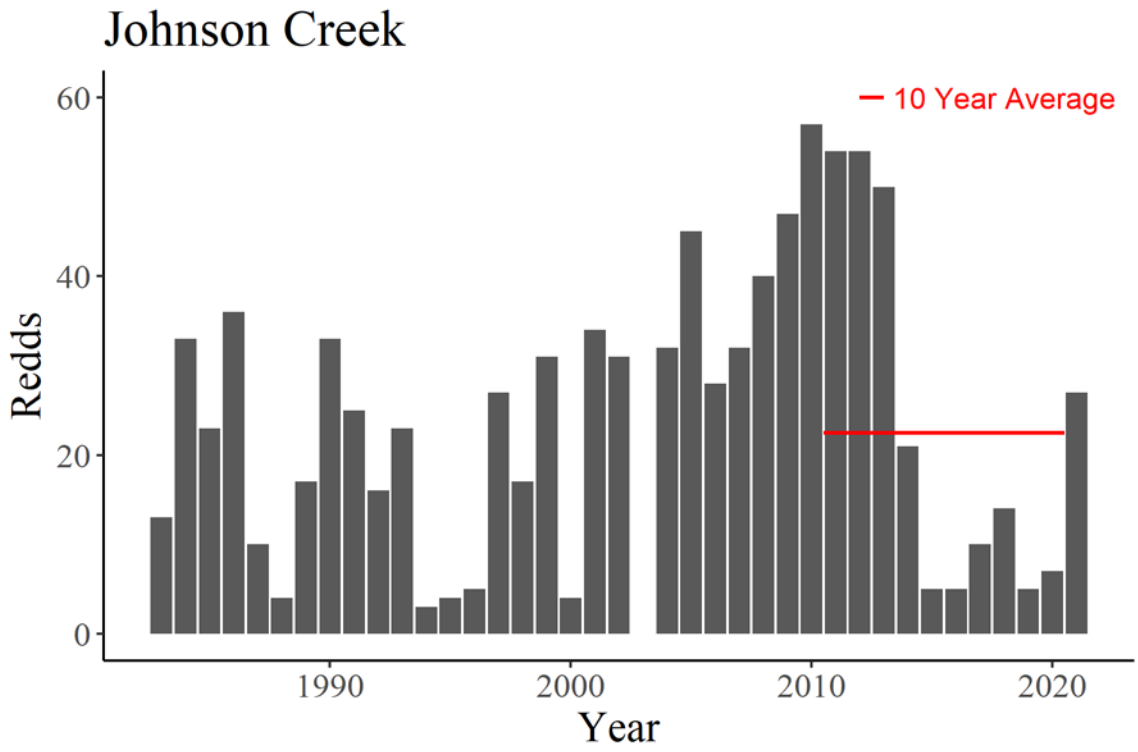

FIGURE 3. Number of Bull Trout redds counted in Johnson Creek 1983–2021. The horizontal red line represents the 10-year average 2011–2020.

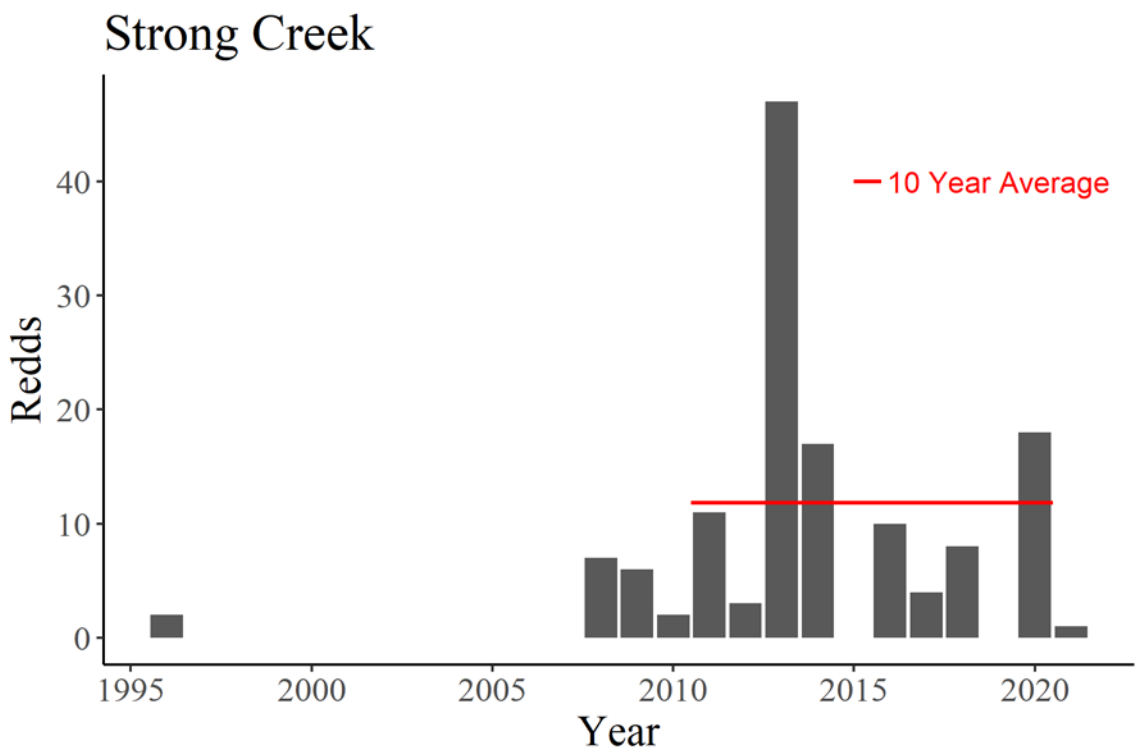

FIGURE 4. Number of Bull Trout redds counted in Strong Creek 1996–2021. The horizontal red line represents the 10-year average 2011–2020.

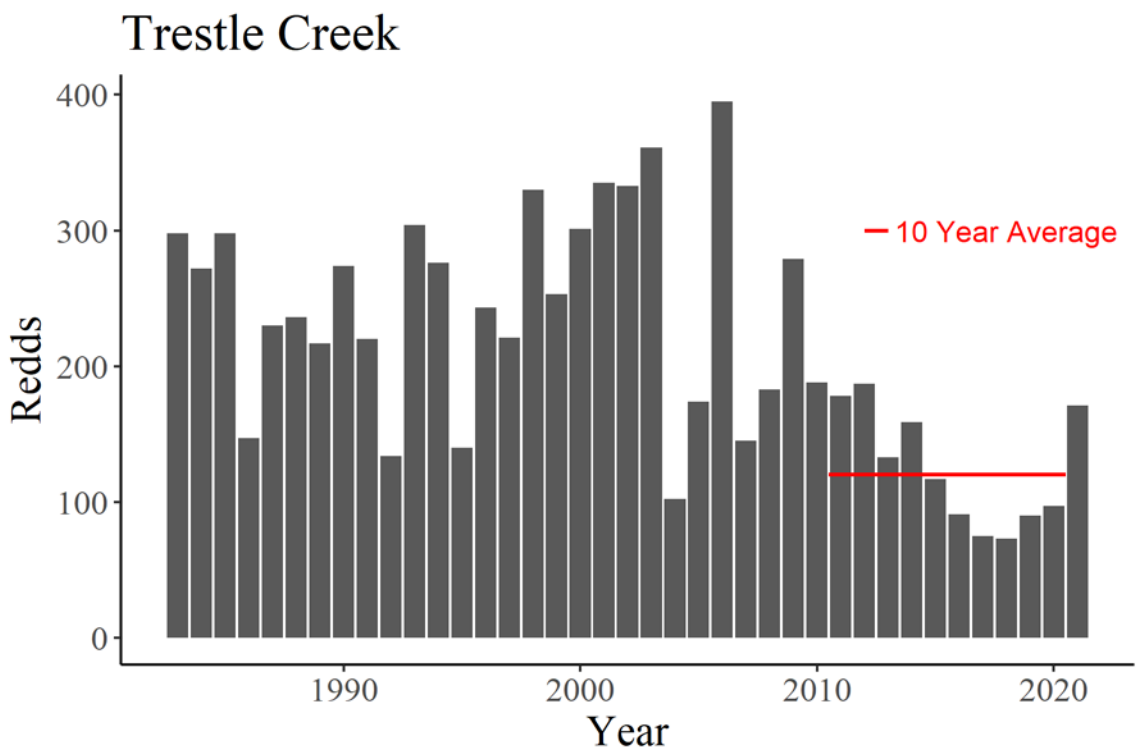

FIGURE 5. Number of Bull Trout redds counted in Trestle Creek from 1983–2021. The horizontal red line represents the 10-year average 2011–2020.

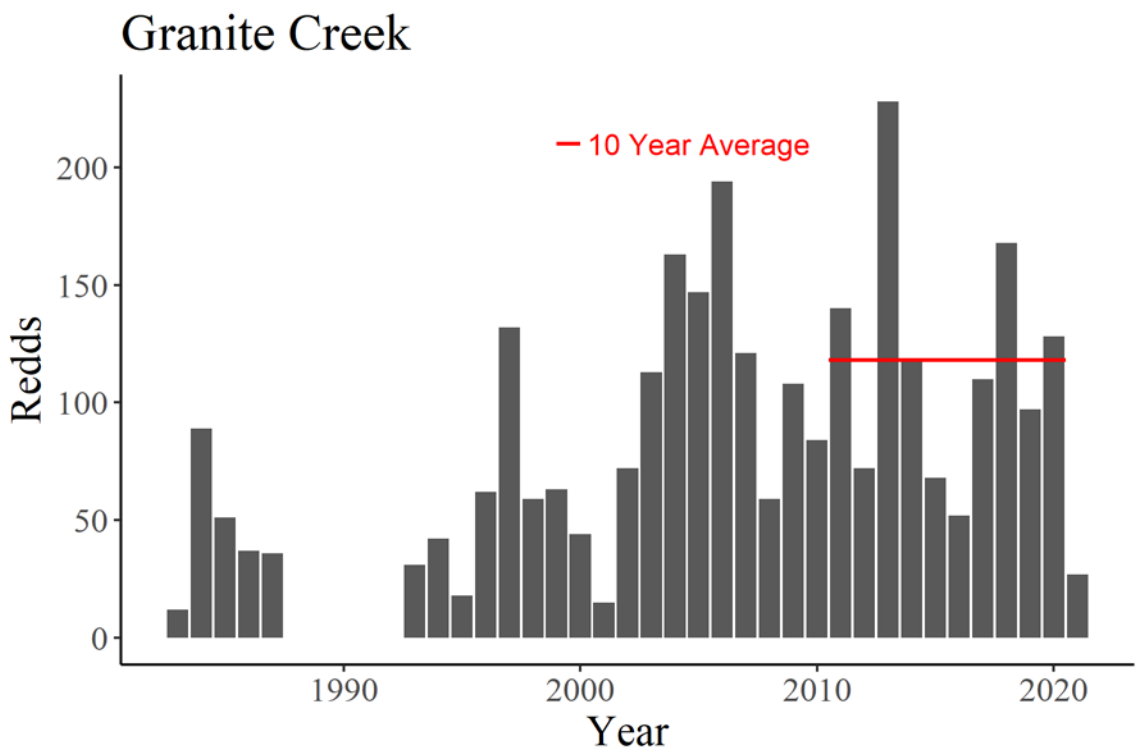

FIGURE 6. Number of Bull Trout redds counted in the Granite Creek drainage 1983–2021. The horizontal red line represents the 10-year average 2011–2020.

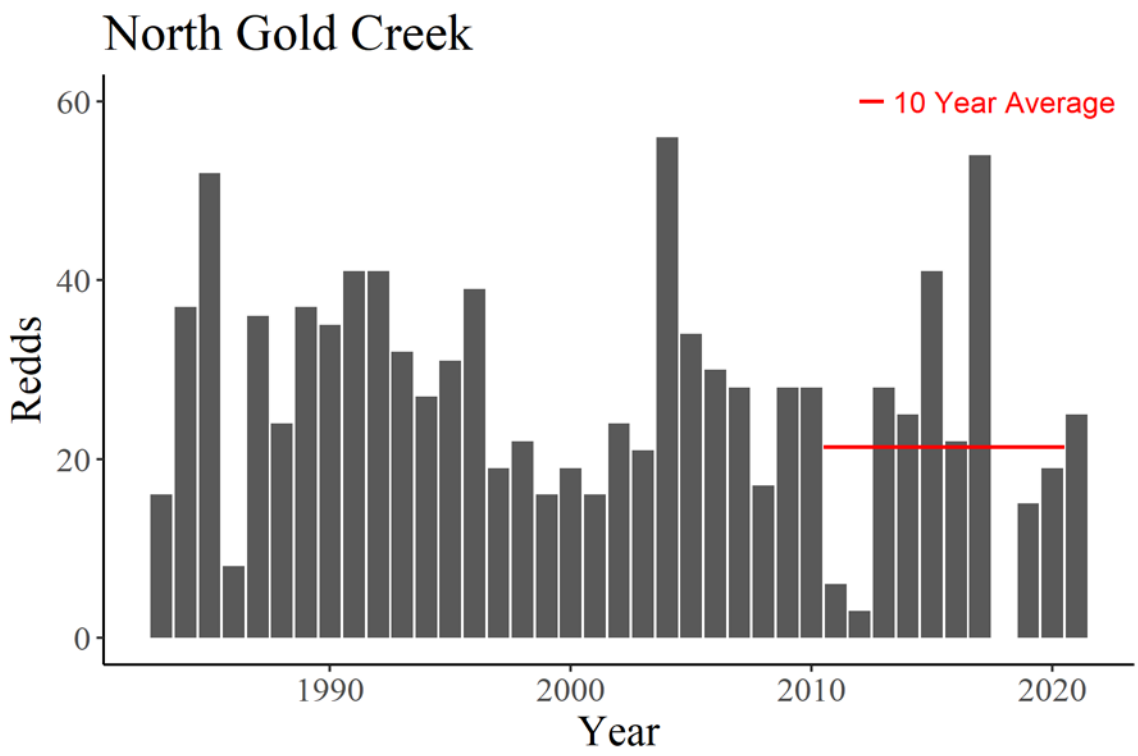

FIGURE 7. Number of Bull Trout redds counted in North Gold Creek 1983–2021. The horizontal red line represents the 10-year average 2011–2020.

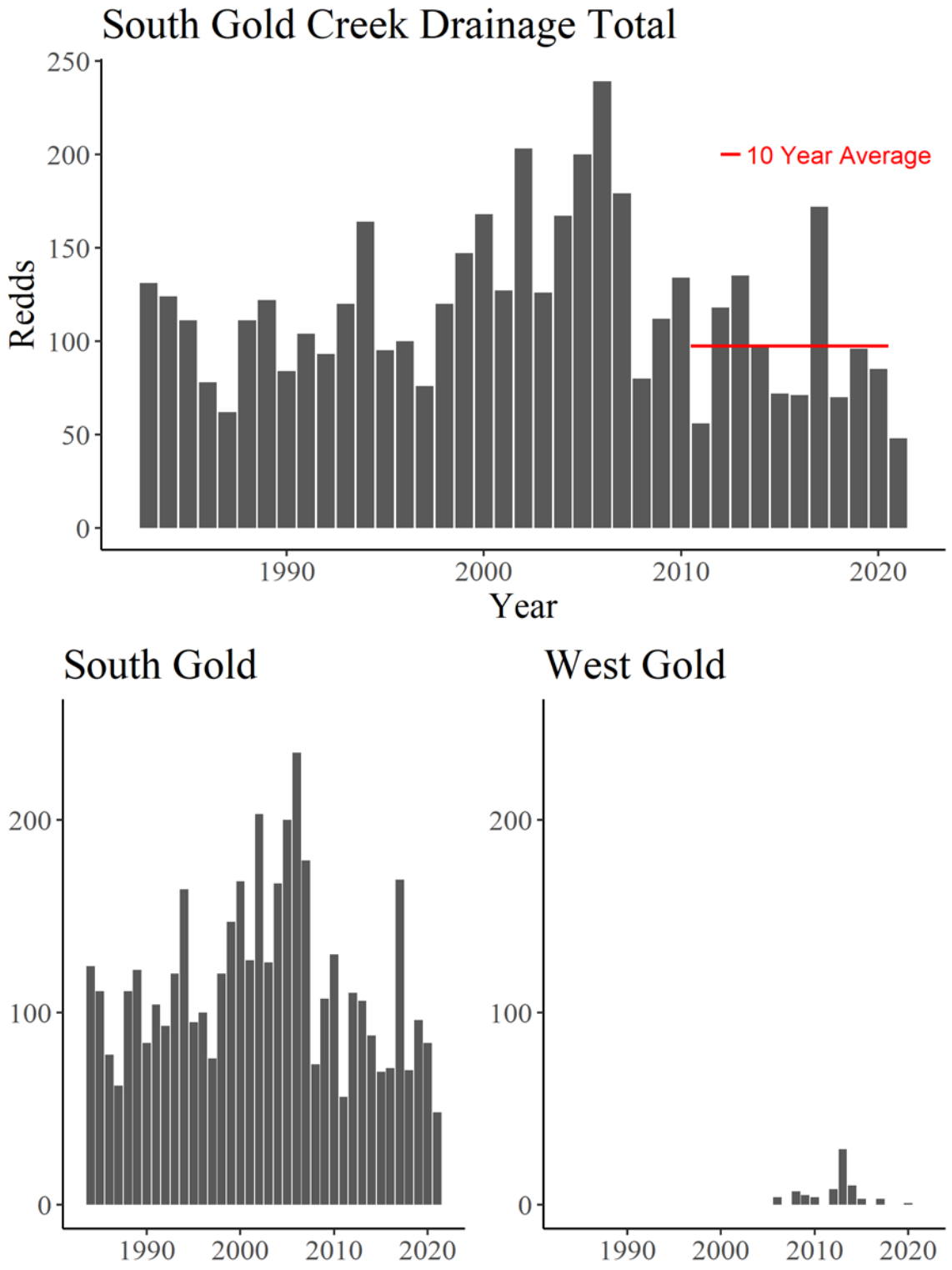

FIGURE 8. Number of Bull Trout redds counted in the South Gold Creek drainage 1983–2021. The horizontal red line represents the 10-year average from 2011–2020.

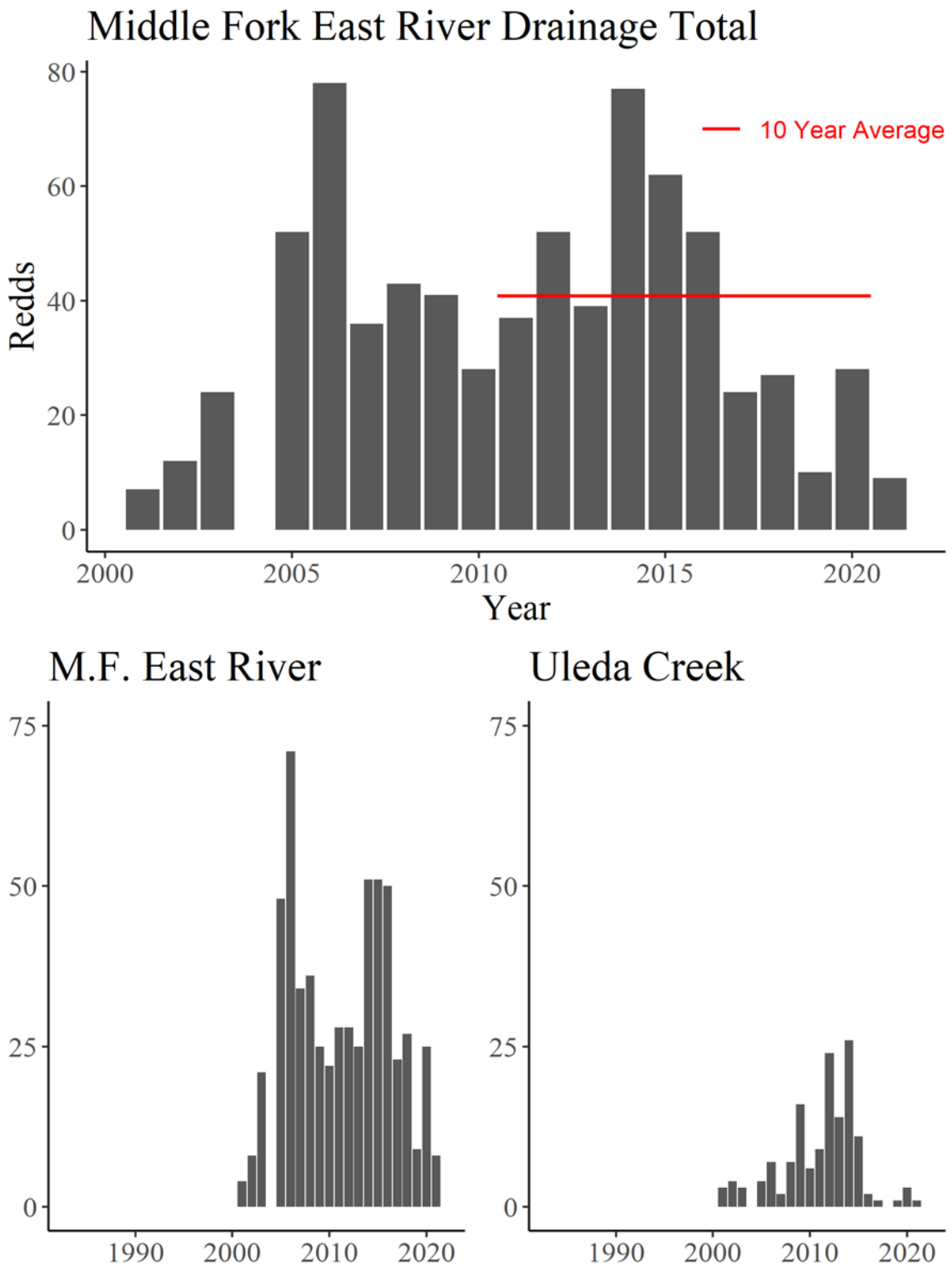

FIGURE 9. Number of Bull Trout redds counted in the Middle Fork East River drainage 2000–2021. The horizontal red line represents the 10-year average 2011–2020.

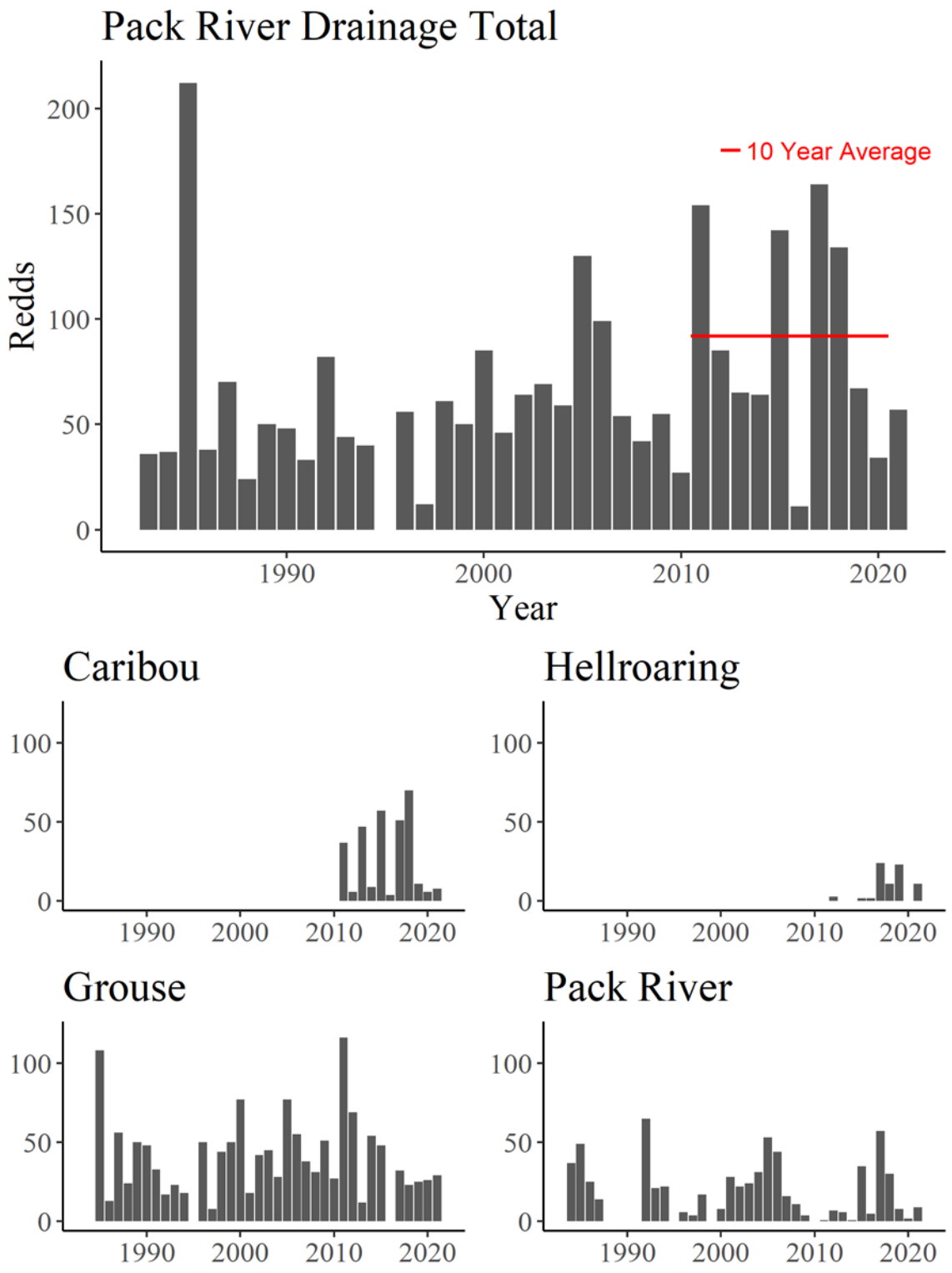

FIGURE 10. Number of Bull Trout redds counted in the Pack River drainage 1983–2021. The horizontal red line represents the 10-year average 2011–2020.

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. However, this year (2021), is six years after the event and represents the first year when a subset of individuals from the 2016 year-class would have matured and begun to return to spawn. As a result, the slight increase in 2021 may be driven by the return of additional fish surviving from 2015 or fish beginning to mature from subsequent year-classes.

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 2021, a rain event during the Granite Creek survey caused increasingly turbid water and low visibility, which may have had an effect on the number of redds observed. It is unlikely that a large number were missed; however, it is possible that redds smaller in size or covered in periphyton were not discovered. The rest of the creeks all exhibited optimal survey conditions (Table 5).

TABLE 5. Environmental conditions and water clarity rating (Poor, Moderate, Good) during the 2021 redd count on each creek.

Stream	Counting Conditions
Caribou Cr.	Good
Char Cr.	Good
East Fork Lightning Cr.	Good
Granite Cr.	Poor
Grouse Cr.	Good
Hellroaring Cr.	Good
Johnson Cr.	Good
Lightning Cr.	Good
Middle Fork East R.	Good
Morris Cr.	Good
North Gold Cr.	Good
Pack River	Good
Porcupine Cr.	Good
Rattle Cr.	Good
Savage Cr.	Good
South Gold Cr.	Good
Strong Cr.	Good
Sullivan Springs	Good
Trestle Cr.	Good
Uleda Cr.	Good
Wellington Cr.	Good
West Gold Cr.	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 2021. Similar conditions exist in Rattle Creek, where dry reaches have been observed for several years. The spring and summer leading up to redd counts in 2021 exhibited extremely low precipitation, and may have led to more sections of dry stream than normal. This potential for reduced access to spawning habitats may have influenced redd count numbers for 2021, especially in the Lightning Creek drainage. Landowner access for a portion of Strong Creek has also been restricted, and the middle third of the redd count section has not been counted

since 2016. The reach of Char Creek above a fish passage barrier first noted in 2008 (Jakubowski and Ryan 2009) was surveyed for the first time since 2009. The observed barrier is located approximately 150 m upstream from the confluence with East Fork Lightning Creek, and to date no redds have been observed above the 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 continued in 2020 and 2021, 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 barrier to Bull Trout in severe drought years like observed in 2021. Low numbers of redds were observed this year, and a majority of those occurred 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 fall redd surveys in 2020 and 2021, all redds that were observed were located above the previous barrier, suggesting the project was a success.

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, 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) Document the prevalence of stream intermittency to investigate the likelihood of fish being precluded from entering natal tributaries.
3) Investigate the potential for variability in redd counts depending on environmental conditions.
4) Further investigate the potential migration barrier in lower South Gold Creek.

5) Further investigate the developing blockage near the mouth of Wellington Creek.
6) 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 1984–2021. (Table located on subsequent page).

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	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2001-2020 Avg	2011-2020 Avg
Clark Fork R.									**2**	**8**	**17**	**18**	**3**	**7**	**8**	**5**	**5**	**6**	**7**	**8**	**1**	**0**	**3**	**2**	**0**	**1**	**0**	**0**											**3**	**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	1	1	4	11	-	3	8	13	3	8	**8**	**7**
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	11	26	22	17	19	80	87	35	10	34	**43**	**37**
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		5	6	5	1	19	15	3	6	3	**8**	**7**
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	0	4	2	0	0	0	4	2	2	1	**5**	**2**
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	2	4	15	0	14	10	29	13	14	11	**10**	**11**
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	5	5	11	8	3	5	15	7	6	2	**8**	**7**
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	59	8	63	5	5	20	32	47	12	12	**34**	**32**
Morris Cr.		--	--	--												1	1	0	7	1	1	3	16	0	6	6	9	0	0	3	14	0	3	32	18	0	0	4	**6**	**7**
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**	**78**	**56**	**137**	**46**	**45**	**169**	**208**	**120**	**53**	**75**	**121**	**109**
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**	**54**	**50**	**21**	**5**	**5**	**10**	**14**	**5**	**7**	**27**	**29**	**23**
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**											**4**	**1**
Strong Creek													**2**						**0**		**0**				**7**	**6**	**2**	**11**	**3**	**47**	**17**	**0**	**10**	**4**	**8**	**0**	**18**	**1**	**9**	**12**
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**	**187**	**133**	**159**	**117**	**91**	**75**	**73**	**90**	**97**	**171**	**185**	**120**
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	68	217	115	68	48	96	150	86	116	19	**102**	**109**
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	4	11	4	0	4	14	18	11	12	8	**11**	**9**
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**	**72**	**228**	**119**	**68**	**52**	**110**	**168**	**97**	**128**	**27**	**113**	**118**
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**	**3**	**28**	**25**	**41**	**22**	**54**	**0**	**15**	**19**	**25**	**25**	**21**
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	110	106	88	69	71	169	70	96	84	48	**123**	**92**
W. Gold																							4	0	7	5	4	0	8	29	10	3	0	3	0	0	1	0	**5**	**5**
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**	**118**	**135**	**98**	**72**	**71**	**172**	**70**	**96**	**85**	**48**	**127**	**97**
M.F. East River																		4	8	21	20	48	71	34	36	25	22	28	28	25	51	51	50	23	27	9	25	8	**30**	**32**
Uleda Creek																		3	4	3	7	4	7	2	7	16	6	9	24	14	26	11	2	1	0	1	3	1	**8**	**9**
MFER Total																		**7**	**12**	**24**	**27**	**52**	**78**	**36**	**43**	**41**	**28**	**37**	**52**	**39**	**77**	**62**	**52**	**24**	**27**	**10**	**28**	**9**	**38**	**41**
N.F. East River																					**1**	**0**	**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	7	6	1	35	5	57	30	8	2	9	**19**	**15**
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	69	12	54	48	-	32	23	25	26	29	**43**	**45**
Caribou																												37	6	47	9	57	4	51	70	11	6	8	**30**	**30**
Hellroaring																													3			2	2	24	11	23	0	11	**9**	**9**
McCormick																																						0		
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**	**85**	**65**	**64**	**142**	**11**	**164**	**134**	**67**	**34**	**57**	**78**	**92**
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	434	355	369	297	208	420	267	266	243	334	**445**	**333**
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	652	781	717	553	359	782	702	500	469	440	**725**	**633**

APPENDIX B

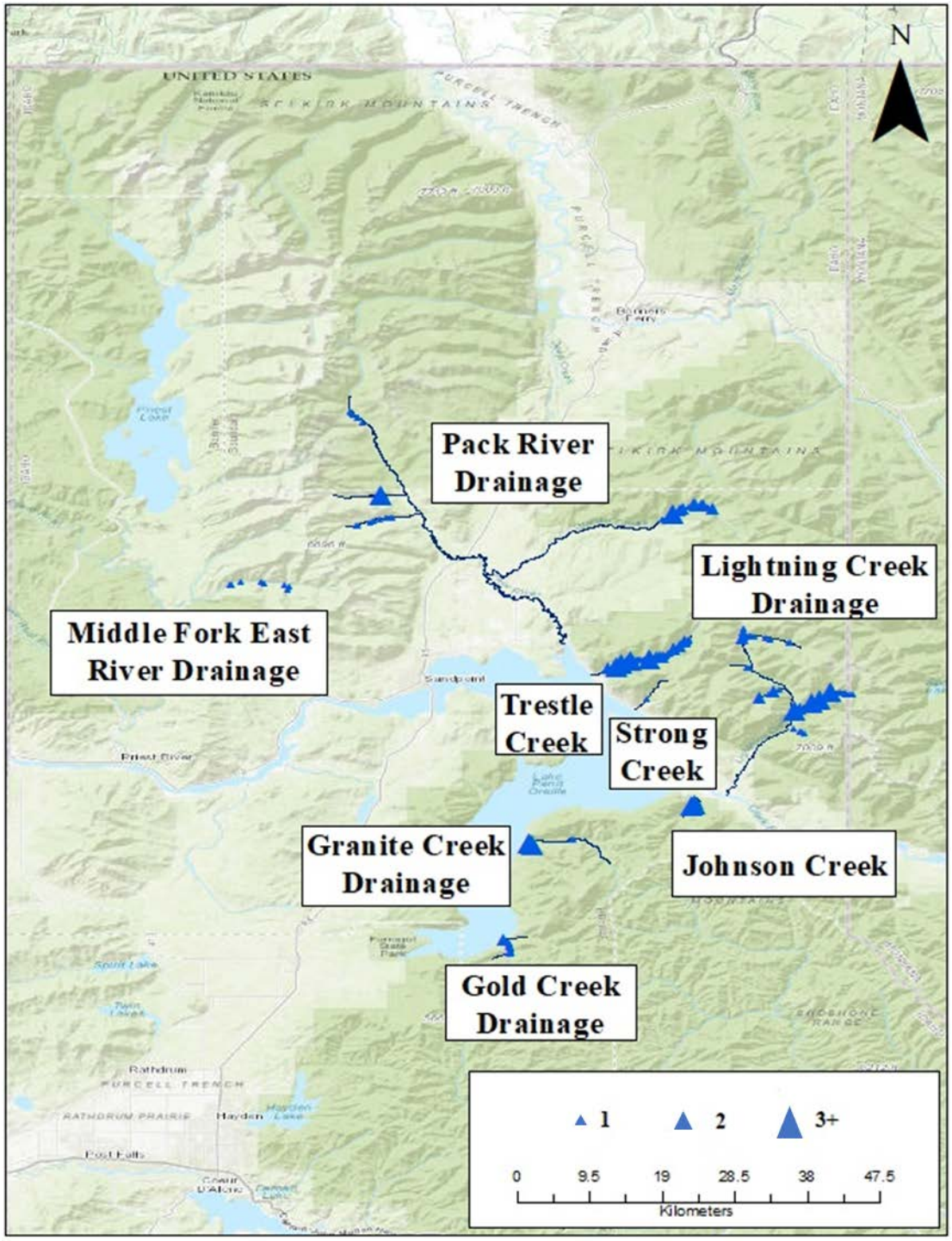

Figure B-1. Map of the Lake Pend Oreille basin outlining all drainages and sub-drainages surveyed for Bull Trout redds in 2021. Number of redds at each location is described by incrementally larger shapes (legend).

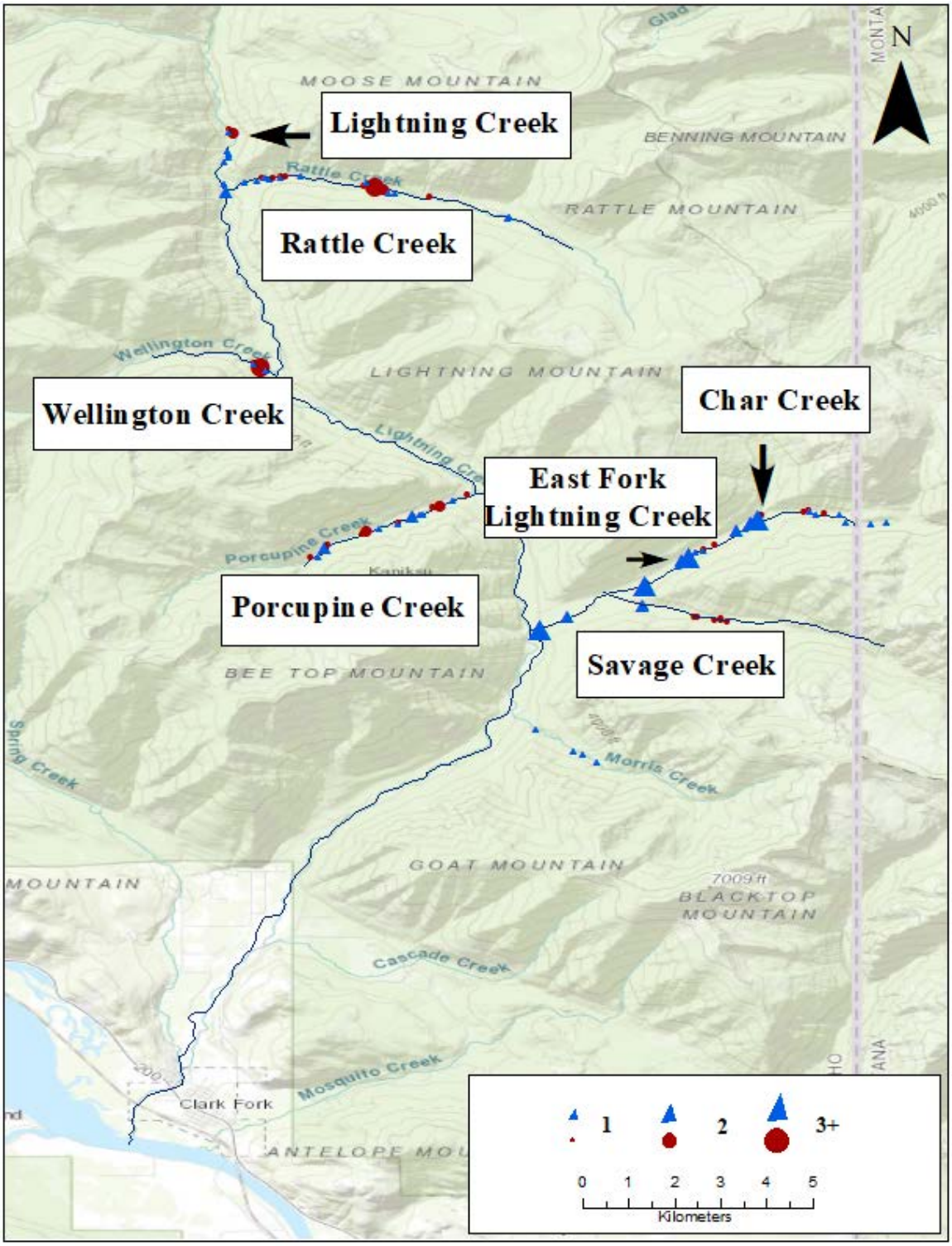

Figure B-2**.** Distribution map of Bull Trout redds observed in the Lightning Creek drainage in 2020 (red circle) and 2021 (blue triangle). Number of redds at each location is described by incrementally larger shapes (legend).

Figure B-3**.** Distribution map of Bull Trout redds observed in Johnson Creek in 2020 (red circle) and 2021 (blue triangle). Number of redds at each location is described by incrementally larger shapes (legend).

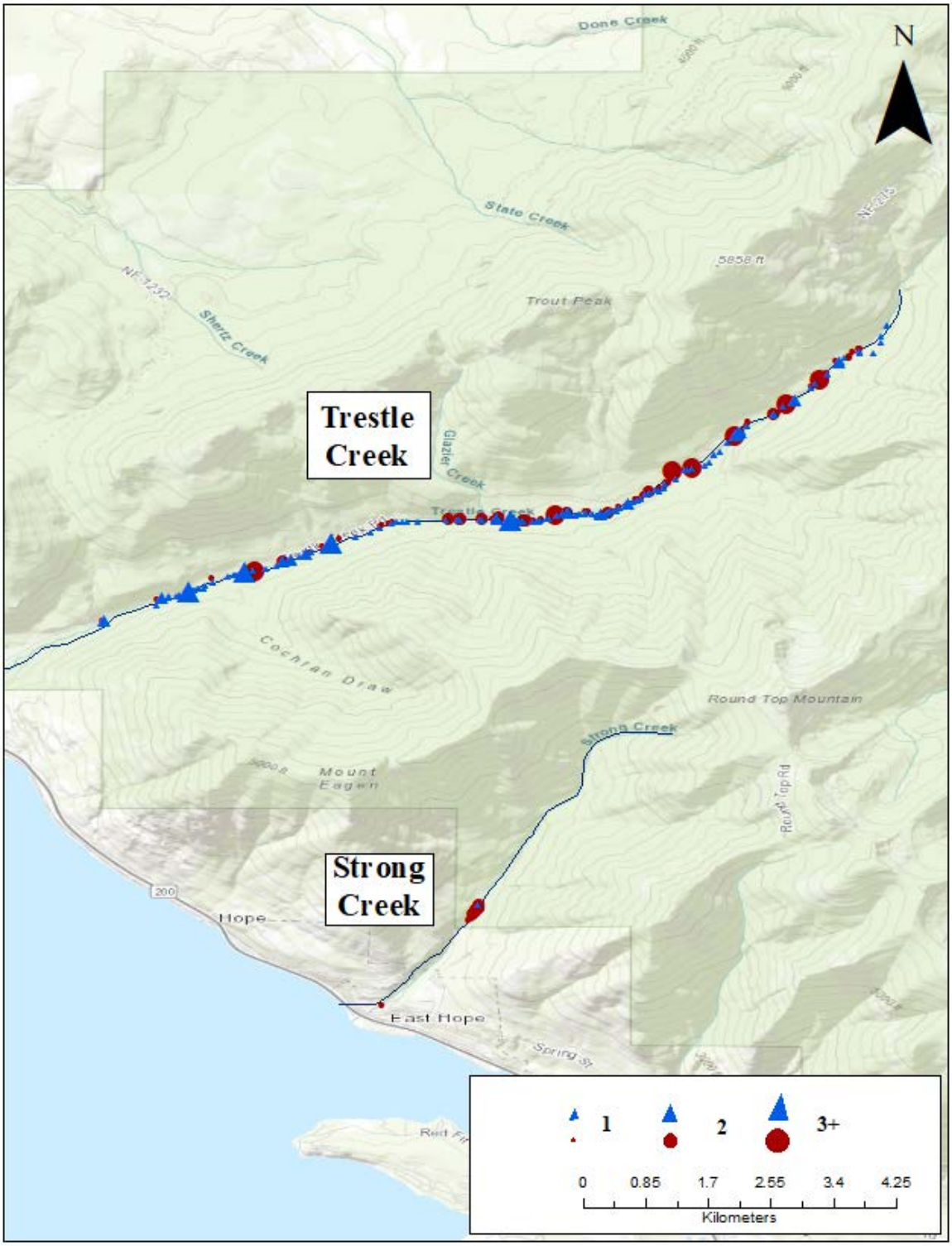

Figure B-4. Distribution map of Bull Trout redds observed in Trestle and Strong creeks in 2020 (red circle) and 2021 (blue triangle). Number of redds at each location is described by incrementally larger shapes (legend).

Figure B-5. Distribution map of Bull Trout redds observed in the Granite Creek drainage in 2020 (red circle) and 2021 (blue triangle). Number of redds at each location is described by incrementally larger shapes (legend).

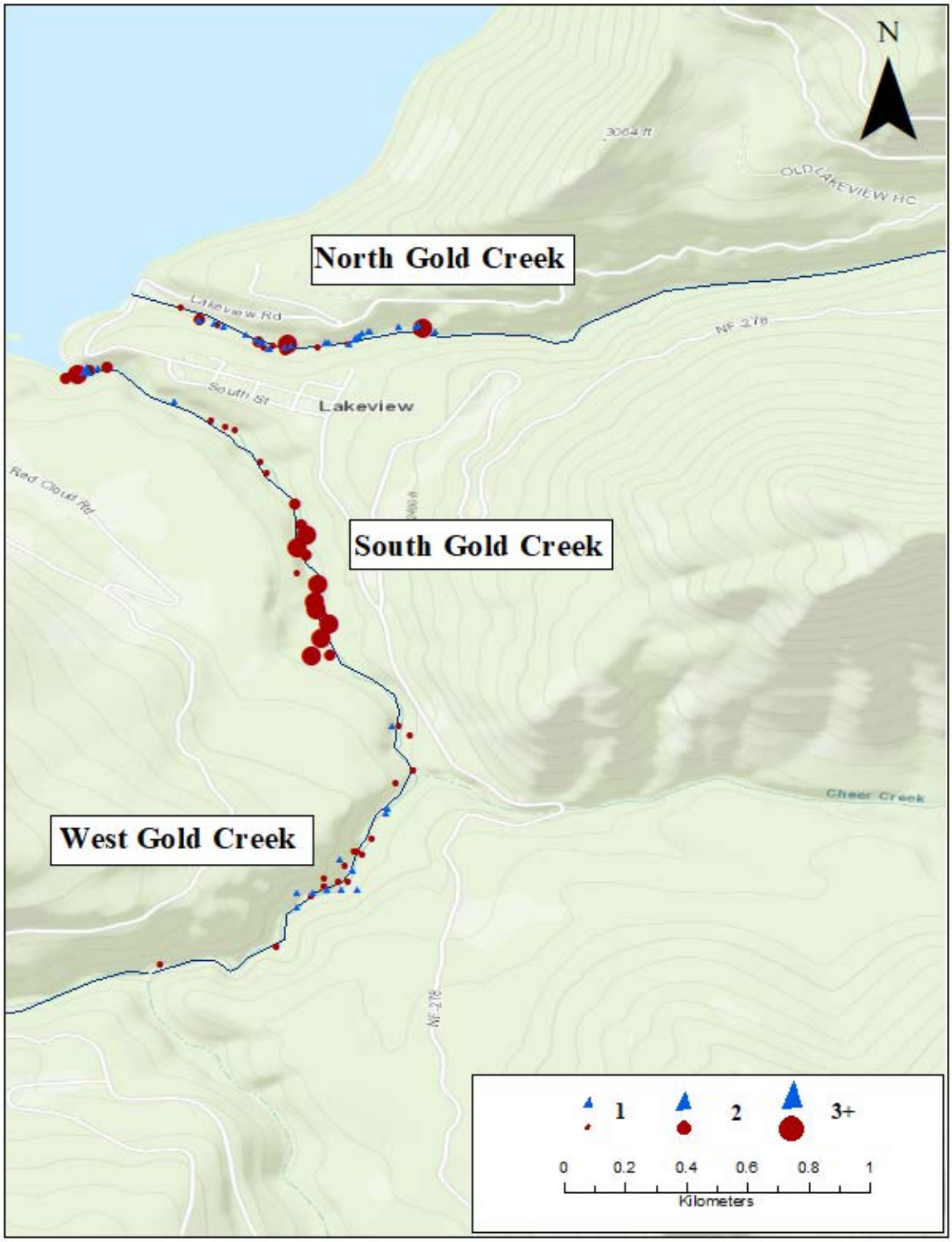

Figure B-6. Distribution map of Bull Trout redds observed in the Gold Creek drainage in 2020 (red circle) and 2021 (blue triangle). Number of redds at each location is described by incrementally larger shapes (legend).

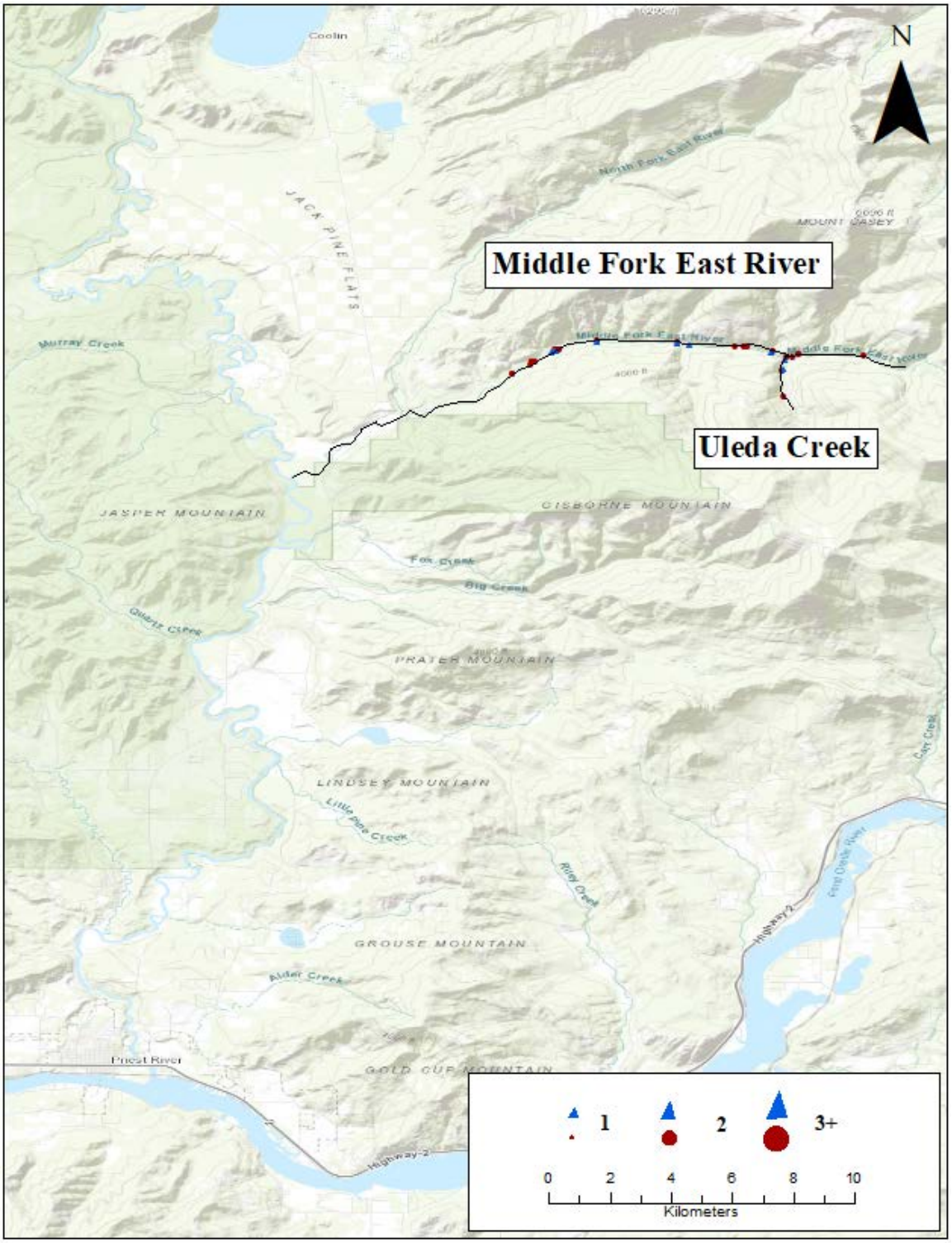

Figure B-7. Distribution map of Bull Trout redds observed in the Middle Fork East River drainage in 2020 (red circle) and 2021 (blue triangle). Number of redds at each location is described by incrementally larger shapes (legend).

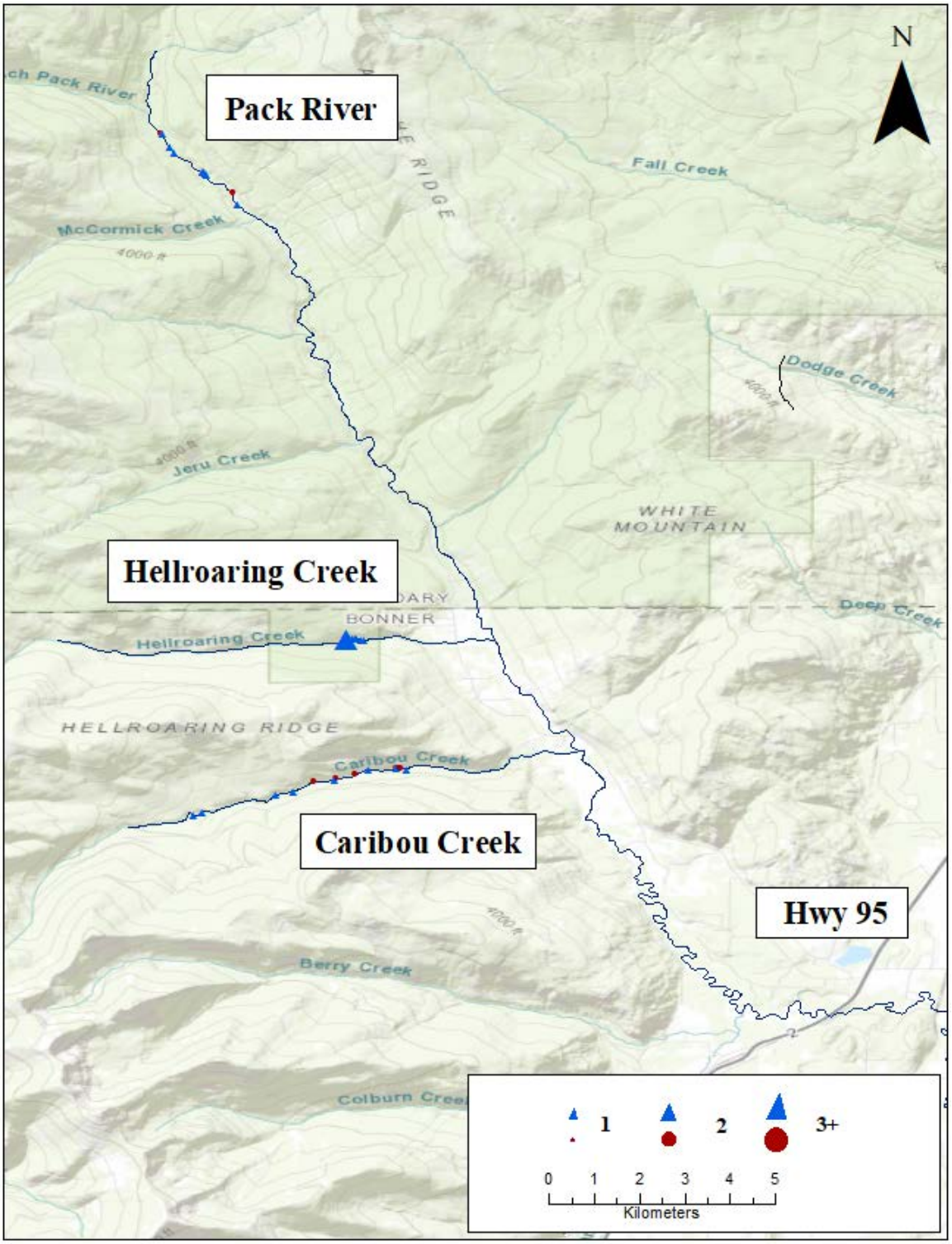

Figure B-8. Distribution map of Bull Trout redds observed in the Pack River drainage in 2020 (red circle) and 2021 (blue triangle). Number of redds at each location is described by incrementally larger shapes (legend).

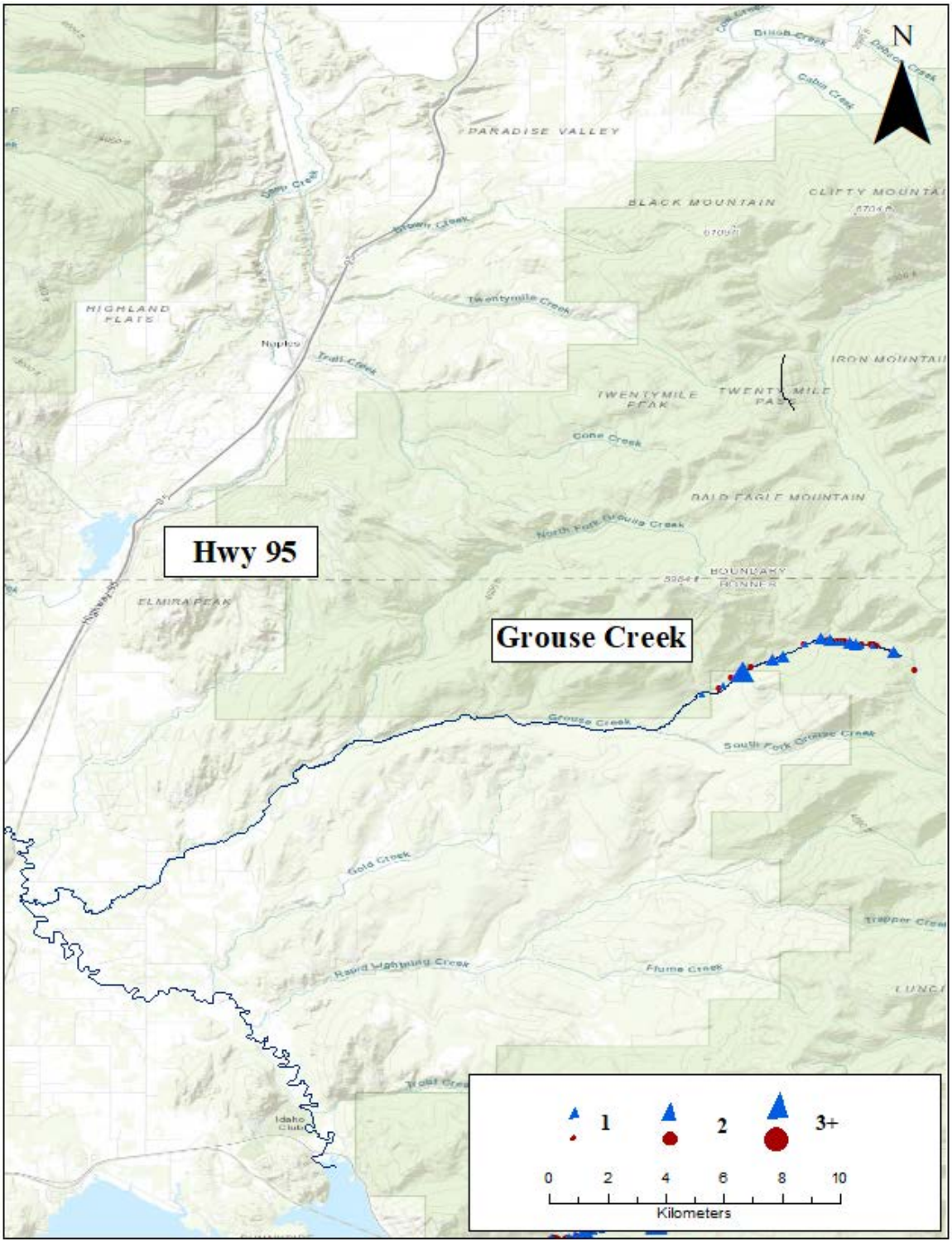

Figure B-9. Distribution map of Bull Trout redds observed in Grouse Creek, a tributary in the Pack River drainage in 2020 (red circle) and 2021 (blue triangle). Number of redds at each location is described by incrementally larger shapes (legend).