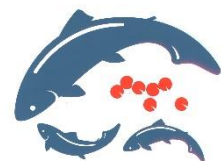


LOWER SNAKE RIVER COMPENSATION PLAN:
Summer Steelhead Creel Surveys on the
Grande Ronde, Wallowa, and Imnaha
Rivers for the 2018-19 Run Year

Oregon Department of Fish and Wildlife
Fish Research and Development, NE Region



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LOWER SNAKE RIVER
COMPENSATION PLAN

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Front cover photo: Fish on! Kyle Bratcher (District Fish Biologist) and Emily Branigan about to land a summer steelhead (his very first steelhead on a spey rod) while Keta patiently watches from the bank on the lower Grande Ronde River in October 2017. Photo by Celeste Cole.

ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Summer Steelhead Creel Surveys on the
Grande Ronde, Wallowa, and Imnaha
Rivers for the 2018-19 Run Year

CONTRACT NUMBER: F16AC00030

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This project was financed by the U.S. Fish and Wildlife Service under
the Lower Snake River Compensation Plan.

PREFACE

This report is for the funding period 1 October 2018 to 30 September 2019. The sampling period was from 1 September 2018 to 30 April 2019. The report summarizes statistical, angler surveys conducted during the summer steelhead angling season in major fishing areas on the Grande Ronde, Wallowa, and Imnaha rivers. Hatchery adult steelhead harvested during the 2018-2019 run year were primarily from the 2015 and 2016 brood years. Results of creel surveys conducted prior to fall 2018 are reported in previous Lower Snake River Compensation Plan evaluation annual reports (Carmichael et al. 1986, 1987, 1988, 1989, 1990; Flesher et al. 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1999, 2000, 2001, 2004a, 2004b, 2005, 2007, 2008a, 2008b, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, and 2020), many of which are available at: <https://www.fws.gov/office/lower-snake-river-compensation-plan/library>. The steelhead angling season surveyed in this report, during which only adipose fin-clipped fish could be harvested, was open from 1 September 2018 to 30 April 2019 in the Grande Ronde and Imnaha river basins.

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We would like to thank Mary Buckman (retired) for the statistical design of the surveys and Josh McCormick for the current methodology used for estimating angler effort, Celeste Cole and Gina Claeys their dedication in conducting the surveys, and Rod Engle for reviewing the document. We would also like to thank Michael Gembala and Jeremy Trump (Washington Department of Fish and Wildlife) for both conducting and coordinating and Braden Erickson for conducting the lower Grande Ronde survey during spring 2019. This project was financed as a cooperative agreement between the Oregon Department of Fish and Wildlife and the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan.

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SUMMARY

Analysis of creel survey data for the 2018-19 run year showed below average angler participation and success for summer steelhead fisheries in both the Grande Ronde and the Imnaha River basins for the third year in a row. Angler effort on the lower Grande Ronde River (9,291 hrs) was slightly higher than the previous season but the second lowest observed since the mid-1990's and about 64% of average (14,449 hrs) since we began surveys during the 1985-86 run year. Harvest on the Grande Ronde in 2018-19 (80 fish) was the lowest observed since the early 1990's and about 9% of the previous ten-year average (862 fish). On the Imnaha River, angler effort (1,375 hrs) was lower than last year but higher than two years ago and only 35% of average (3,936 hrs). Harvest on the Imnaha (45 fish) was slightly higher than the last two years and about 20% of the ten-year average (225 fish). Catch rates however, were better in all NE Oregon fisheries, except for the lower Grande Ronde, which was similar when compared to the previous season. All fisheries were similar to the overall average of 10 hours per fish except on the Wallowa and at Rondowa which were better.

The total catch of wild steelhead in the lower Grande Ronde River for the 2018-19 run year was 245 fish, below the 1985-86 to 2017-18 run year average of 876 fish. Wild fish comprised 48% of total catch, slightly higher than the previous two years. On the Imnaha, wild fish were 40% of the total catch, the lowest proportion observed since the 2011-2012 run year when unmarked hatchery fish were a component of the returns.

This report includes angler harvest card data (total catch, effort, and harvest) for the middle Grande Ronde River, the Wallowa River and Rondowa survey areas for the 2017-18 run year, summarized in the appendices. Based on creel and harvest card data, combined total catch in those areas was 1,806 fish, total harvest was 744 fish, and total effort was 23,615 hours. Angler effort, catch and harvest were higher than the previous year but these metrics were the second lowest observed since the late 90's. Low adult returns coupled with high and muddy flows in the spring of 2019 may explain the poor fishing success in these fisheries in the 2017-2018 run year.

Seventy-six percent of anglers that participated in Imnaha basin fisheries were local residents and 7% were out-of-state anglers. In Grande Ronde basin fisheries, local and out-of-state angler proportions were highly variable and dependent on location.

The 2018-19 fishing season was the fourth year in which regulation changes allowed anglers to target steelhead through the end of April. The end dates of our 2018-19 creel survey remained unchanged from prior seasons on the lower Grande Ronde (31 March) and Wallowa (15 April) rivers. The regulation change is not likely to affect total catch and harvest on the lower Grande Ronde River, since fishing effort there is typically low in April. This is the second year we surveyed through 30 April on the Imnaha River. We did not encounter any anglers during the eight sample days in this period. Lower than average adult steelhead returns coupled with higher than average flows (> 1,000 cfs) probably contributed to the lack of effort observed. Average run timing of hatchery returns to the Little Sheep Creek of 50% by 15 April suggests that hatchery fish are still

available in the river in good numbers during average return years. Creel surveys in the Imnaha and Wallowa rivers in late April are advised especially during average or above average return years.

INTRODUCTION

A closure of the summer steelhead (*Oncorhynchus mykiss*) fisheries in the Grande Ronde and Imnaha river basins began in 1974. This closure was prompted by declining adult returns, as indicated by adult counts at Ice Harbor Dam on the Snake River (USACOE 1996), and low steelhead redd counts on index streams in the Grande Ronde and Imnaha river basins (Oregon Department of Fish and Wildlife District Annual Reports 1949-1974). The Lower Snake River Compensation Plan (LSRCP), initiated by Congress in 1976, was developed to compensate for losses of anadromous salmonids in the Snake River basin due to construction and operation of the four lower Snake River dams built between 1962 and 1976. The focus of the LSRCP in-place, in-kind goals for Oregon is above Lower Granite Dam (Rkm 173), the uppermost of these four dams. One of the primary objectives of the LSRCP in Oregon is to restore historic recreational and tribal fisheries for summer steelhead in the Grande Ronde and Imnaha river basins (Carmichael 1989). Approximately 1.68 million steelhead smolts were targeted for release in Oregon each year during April and May in the Grande Ronde and Imnaha river basins between 1984 and 1999. In 2000, we reduced releases to approximately 1.2 million smolts in response to the National Marine Fisheries Service's recommendation to help reduce straying of Wallowa Hatchery stock steelhead, primarily into the Deschutes River (mid-Columbia tributary). In 2007, we further reduced smolt releases to approximately 1.065 million, partly due to an increased release size from five to four fish per pound (fpp) for Wallowa stock, which increased smolt-to-adult survival (Clarke et al. 2014), and due to a reduction of direct stream releases of Imnaha stock steelhead into Big Sheep Creek. In 2009, smolt releases were reduced again to approximately 1.015 million, due to reductions in releases of Imnaha stock into Big Sheep Creek. Released smolts provide hatchery adult returns that contribute to recreational fisheries and may supplement natural spawning populations in northeast Oregon. Consumptive recreational fisheries for summer steelhead re-opened in 1986, in part as a result of increases in hatchery adult returns. Prior to 1986, a limited catch and release fishery for summer steelhead occurred on the Grande Ronde River during fall 1984 and 1985.

We began creel surveys for summer steelhead during the fall of 1985 in both the Grande Ronde and Imnaha river basins, the goal being to provide annual harvest information needed to assess LSRCP goals (Carmichael and Wagner 1983). In general, the number of summer steelhead encountered in the recreational fishery has been restored to historic values, but the fishery is concentrated at different times and places (Fletcher et al. 1994). This report summarizes results of creel surveys conducted during the fall of 2018 and the spring of 2019 in the Grande Ronde and Imnaha river basins. In addition, this report contains estimates of total effort, catch, and harvest for all the 2018 spring fisheries in the Grande Ronde river basin, information that was not available for inclusion in the 2017-18 annual report. The Grande Ronde and Imnaha river basins

encompass the major steelhead fisheries that occur in Oregon tributaries to the Snake River upstream of Lower Granite Dam. The 2018-19 steelhead angling season in the Grande Ronde and Imnaha river basins was open from 1 September 2018 to 30 April 2019.

STUDY AREA

Creel surveys on the Grande Ronde River were conducted on a lower 24 km section from the Oregon-Washington state line (Rkm 62) upstream to Wildcat Creek (Rkm 86, Figure 1). Surveys on the Wallowa River were conducted on a 6 km section from its confluence with the Grande Ronde River at Rondowa (mouth of the Wallowa River) upstream to Howard Creek (Rkm 6) and a 50 km section from Minam State Park (Rkm 13) upstream to the mouth of Trout Creek (Rkm 63) near Enterprise. Anglers who

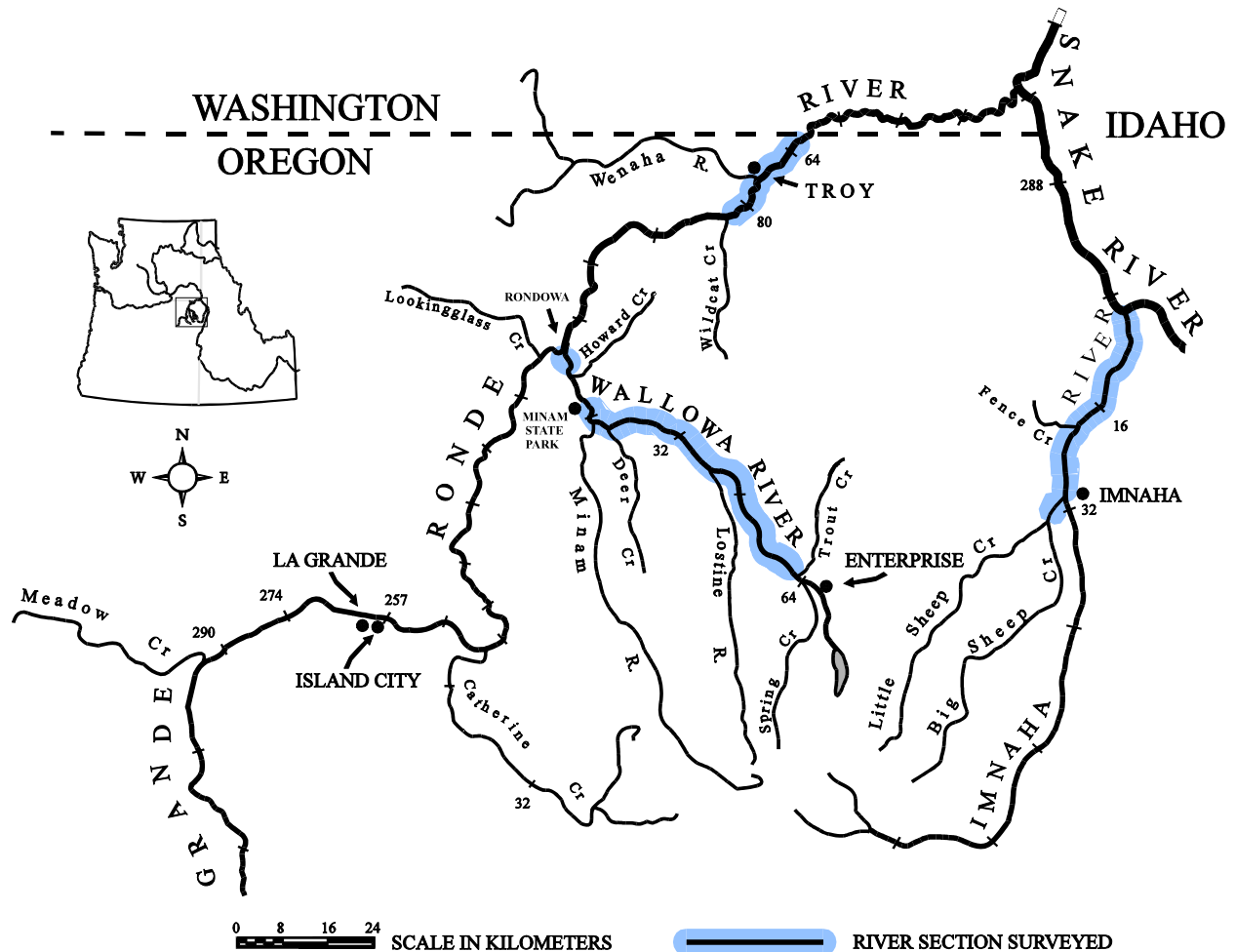


Figure 1. Map of northeastern Oregon showing where summer steelhead creel surveys were conducted in the Grande Ronde and Imnaha river basins during the 2018-19 run year.

parked their vehicles at Minam State Park to fish just below the park were included in the Wallowa survey. Because vehicle access into Rondowa was limited, anglers parked their vehicles in the Palmer Junction area, located 5.6 km upstream of Rondowa on the Grande Ronde River, and on Smith Mountain Road at the Hancock Forest Management gate, approximately 16 km by road to Rondowa. Thus, for the Rondowa survey, we interviewed anglers leaving the parking areas near Palmer Junction and at the gate on Smith Mountain Road when they were encountered. The survey on the Imnaha River was conducted on the lower 32 km from its confluence with the Snake River (Rkm 0) upstream to the mouth of Big Sheep Creek (Rkm 32) near the town of Imnaha, and beginning in 2010, on the lower 5 km section of Big Sheep Creek from the mouth upstream to Little Sheep Creek (Rkm 5, Figure 1).

METHODS

Beginning with this survey year, we updated our methodology for estimating total angler effort for the Lower Grande Ronde and Imnaha surveys using the mean number of anglers observed each day across all pressure counts rather than our previous area-under-the-curve estimate, which should provide a less biased estimate of angler effort for these surveys. Our new pressure estimate was coupled with catch rates estimated from interview data using the ratio of means to provide a final daily harvest estimate that was expanded to provide seasonal totals (Pollock et.al.1994). The formulas for calculating estimates of angler effort, catch rate, and catch for each fishery are described in Appendix D. Historical methods are described in Flesher et al. 2020, and in Carmichael et al. 1988. In addition to revising the angler effort estimation method, we modified what data was to be included or excluded for the final expansions. Missing pressure counts were not estimated. When interviewing anglers, all types (fly or other) and intentions were included (targeting steelhead, trout, or bass). For angler effort counts, no attempt was made to estimate angler hours fished or catch information for anglers associated with unattended vehicles or active but unattended camps on the river. For fish caught, origin (hatchery or wild) is reported as recorded and unknown clipped fish are estimated separately and not apportioned into hatchery or wild.

For the survey on the lower Grande Ronde River, we used a roving creel design that was conducted from 1 September 2018 to 31 March 2019. Although the fishing season extends to 30 April (extended from April 15 to April 30 beginning in 2016), we have not surveyed in April because past data show consistently low angler effort. During the creel season, our goal was to sample 50% of the weekends and holidays and 30% of the weekdays during each month. Sample days were chosen randomly in two-day blocks, representing two strata (weekend days and holidays, and weekdays). On each sample day, beginning at a randomly selected start time, the creel surveyor conducted a pressure count by tallying all anglers and vehicles every three hours while driving a vehicle along the entire survey route. Between pressure counts, the surveyor interviewed anglers by recording what species of fish they were angling for, what type of angling gear they were using, their residence, the number of hours they had fished, and the number and species of fish caught. The surveyor also sampled all harvested fish by

recording fork length (mm), sex, fin clips, presence of external tags, and scanned for a PIT (passive integrated transponder) tag using a portable tag detector (Allflex or Biomark, handheld PIT tag readers). In addition, if a hatchery fish was coded-wire-tagged (CWT), the surveyor asked permission from the angler to collect the snout, then excised the snout behind the eye and placed it with an identification number in a plastic bag for later processing.

Surveys in the Imnaha basin followed both access-based and roving creel designs that were conducted from 1 February through 30 April 2019. We extended the survey through April 30 rather than the usual end date of April 15 to estimate angler effort and catch for the last two weeks of the season. For these surveys, we used a check station for the Imnaha River area below Fence Creek (Rkm 23) and a roving survey in the area above Fence Creek and at Big Sheep Creek. We selected sample days using the same methodology described for the lower Grande Ronde River survey. Our goal was to survey 50% of the weekends and 30% of the weekdays during each month of each survey. For the check station, we used the methodology described by Carmichael et al. (1988). The check station was designed so that anglers leaving the lower river area during a sample day would stop voluntarily and the surveyor would interview each angler and sample all harvested fish. At the end of the second sample day, the surveyor would drive to Cow Creek (Rkm 7) and interview all anglers encountered that fished during the two-day period and did not exit through the check station. For the roving survey, we followed the same procedures as on the lower Grande Ronde River survey except that anglers were interviewed during pressure counts. For each pressure count, the surveyor closed the check station, interviewed and enumerated all anglers from Fence Creek to the town of Imnaha, then up Big Sheep Creek to the mouth of Little Sheep Creek and then returned. Time spent away from the check station was recorded, and catch and harvest data was expanded to account for the unsampled time.

For the Wallowa River and Rondowa survey areas, one surveyor conducted angler interviews from 1 February to 15 April 2019. We surveyed the Wallowa River area each sample day and surveyed the Rondowa area every other sample day. Beginning in 2012, we also surveyed the Rondowa area every weekend sample day to increase the number of interviews. At the Wallowa River, the surveyor drove a route from Trout Creek downstream to Minam State Park, stopping to interview anglers along the way, then waited at the park for approximately one hour and interviewed returning anglers that had hiked below the park to fish, and then repeated this sequence. On alternate sample days, the surveyor drove the survey route from Minam State Park upstream to Trout Creek, stopping to interview anglers along the way, then drove to the Smith Mountain parking area used by anglers to access Rondowa and spent an hour interviewing anglers returning from Rondowa, and then repeated the sequence. During February, 2019 the Smith Mountain road was closed to reduce vehicle disturbance of wildlife. Anglers also access Rondowa from the community of Palmer Junction on the Grande Ronde River, so our surveyor interviewed anglers there. During the rest of the season, the surveyor would occasionally drive to the Palmer Junction area to check for anglers accessing Rondowa. All harvested fish observed were sampled. From 1 February to 23 February, we surveyed five days each week (Sunday – Saturday) from

0900-1800 hours. From 24 February to 15 April, we surveyed four days each week from 0800-1900 hours.

For the lower Grande Ronde River and Imnaha River creel surveys, we estimated angler effort in hours and days, total catch, harvest, catch rate, percent hatchery fish in the catch, and the number of CWT marked fish harvested (see Carmichael et al. 1988). For the Wallowa and Rondowa survey areas, we estimated catch rate, percent hatchery fish in the catch, and the number of AdRV-only and CWT marked fish harvested. In addition, we determined age, sex ratio, and mean fork length of harvested fish in all survey areas. Catch rate was expressed as an index, hours per fish, in which lower values indicate better angling success and higher values indicate poorer angling success.

We do not creel certain springtime fishery locations in the Grande Ronde Basin (e.g., Catherine Creek and the upper Grande Ronde River) because these un-surveyed areas no longer receive hatchery supplementation so any harvest would be due to straying of hatchery fish from areas with active hatchery supplementation programs. Due to this, we believe that angler effort is low. On the Wallowa River and at Rondowa, our creel surveys are limited to angler interviews and sampling their catch. In un-surveyed areas, and areas where pressure counts are not conducted (e.g., Wallowa River and Rondowa), we rely on angler harvest card data for information on angler effort and success. For example, we estimate total monthly harvest by regressing angler harvest card estimates against creel survey harvest estimates for specific reaches in the Grande Ronde and Imnaha basins. The regression is updated annually as harvest data become available. However, there is usually a one or two-year delay in obtaining final angler harvest card estimates. For this reason, the current annual report has harvest estimates for run year 2017-2018. Total catch for these areas is estimated by multiplying total harvest estimates by the ratio of sampled catch to sampled harvest as determined by creel surveys. Total angler effort (hours) is total catch divided by the sample catch rate (fish/hour).

ACCOMPLISHMENTS AND FINDINGS

On the lower Grande Ronde River from 1 September 2018 to 31 March 2019, we sampled 50.0% of the weekends and holidays (35 days) and 28.9% of the weekdays (41 days) for a total of 76 sample days. On the Wallowa River from 1 February to 15 April 2019, we sampled 69.6% of the weekends and holidays (16 days) and 33.3% of the weekdays (17 days) for a total of 33 sample days. During the same time period at Rondowa, we sampled 34.8% of the weekends and holidays (8 days) and 11.8% of the weekdays (6 days) for a total of 14 sample days. On the Imnaha River and Big Sheep Creek from 1 February to 30 April 2019, we sampled 51.9% of the weekends and holidays (14 days) and 33.9% of the weekdays (21 days) for a total of 35 sample days. Tables in Appendix A provide more details on sampling effort by fishing location.

We estimated a total of 1,808 angler days or 9,291 hours were spent on the lower Grande Ronde River during the 2018-19 season. Anglers caught and released 245 wild and 190 hatchery steelhead, and harvested 80 hatchery steelhead for an average catch rate index of 11 hours per fish (Figures 2-6, Appendix Table A-1). The percent of steelhead caught that were hatchery origin ranged from 0% (February 2019) to 82% (January 2019, Figure 7, Appendix Table B). Thirty-six percent of harvested hatchery steelhead spent one year in freshwater and one year in saltwater (hereafter designated 1:1), and 64% spent one year in freshwater and two years in saltwater (designated 1:2), based on age-length keys developed using known aged fish (Table 1). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 601 (± 12) mm for age 1:1, and 673 (± 21) mm for age 1:2. Sex ratio was 38% male, 60% female, and 2% unknown. Forty-two percent of the anglers on the lower Grande Ronde River were local Oregon residents, 24% were non-local Oregon residents, 11% were Washington State residents and 23% resided outside the states of Oregon and Washington (Table 2). On the lower Grande Ronde River, anglers harvested an estimated 11 CWT marked steelhead from our hatchery releases (Table 3).

At Rondowa, the catch rate index averaged 1 hour per fish, however sample size was low for the season with only four total anglers interviewed (Figure 4, Appendix Table A-2). The percent of steelhead caught that were hatchery origin was 100% in March (Figure 7, Appendix Table B). Only three fish were sampled from the Rondowa reach and all three were hatchery fish and were sampled in March. Age composition of harvested hatchery steelhead was 100% 1:2 (Table 1). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 717 (± 63) mm for age 1:2. Sex ratio was 33% male and 67% female. Only four anglers were interviewed from the Rondowa reach and all were non-local Oregon resident anglers (Table 2). At Rondowa, we sampled one CWT marked steelhead from our hatchery releases; however, expanded estimates for the entire fishery, as reported on in Table 3, will not be determined until state angler harvest card data become available.

On the Wallowa River, the catch rate index averaged 7 hours per fish (Figure 4, Appendix Table A-3). The percent of steelhead caught that were hatchery origin ranged from 82% in February to 94% in April (Figure 7, Appendix Table B). Age composition of harvested hatchery steelhead was 41% 1:1 and 59% 1:2 (Table 1). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 597 (± 14) mm for age 1:1 and 715 (± 22) mm for age 1:2. Sex ratio was 50% male, 48% female, and 2% unknown. Fifty-five percent of the anglers on the Wallowa River were local Oregon residents, 40% were non-local Oregon residents, 0% were Washington State residents and 5% resided outside the states of Oregon and Washington (Table 2). On the Wallowa River, we sampled 7 CWT marked steelhead from our hatchery releases; however, expanded estimates for the entire fishery will not be determined until state angler harvest card data become available (Table 3).

On the Imnaha River and Big Sheep Creek, we estimated a total of 562 angler days or 1,436 hours were spent during the 2018-19 season. Anglers caught and released 38 wild and 11 hatchery steelhead, and harvested 28 hatchery and 17 unknown steelhead

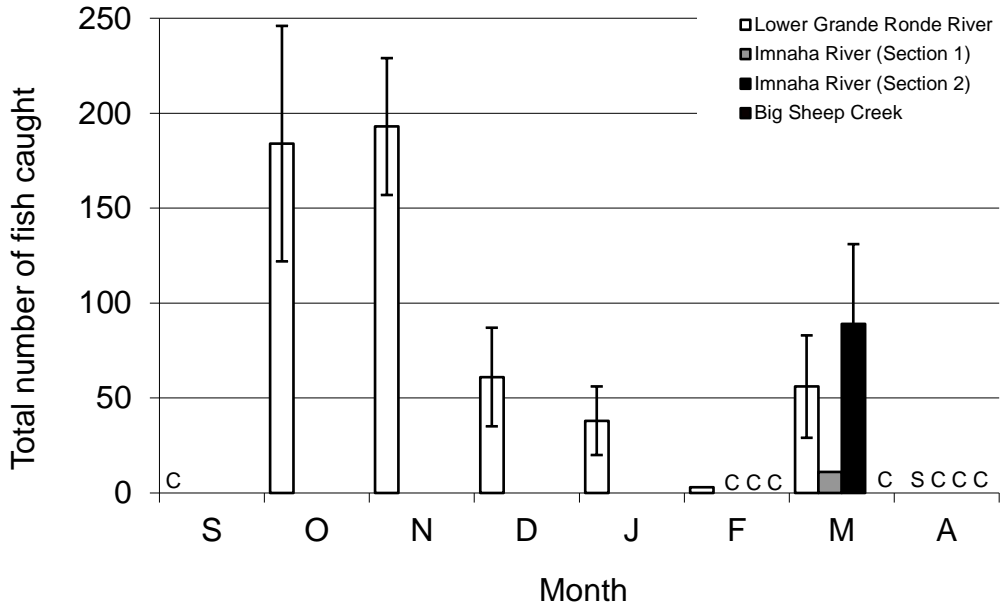


Figure 2. Estimated total catch of summer steelhead (vertical bars show 95% confidence intervals) on the lower Grande Ronde River, two sections of the Imnaha River, and Big Sheep Creek during the 2018-19 run year. "C" indicates no catch and "S" indicates no survey. Surveys were conducted from 1 September 2017 to 31 March 2019 on the lower Grande Ronde River, and from 1 February to 30 April 2018 on the Imnaha River and Big Sheep Creek.

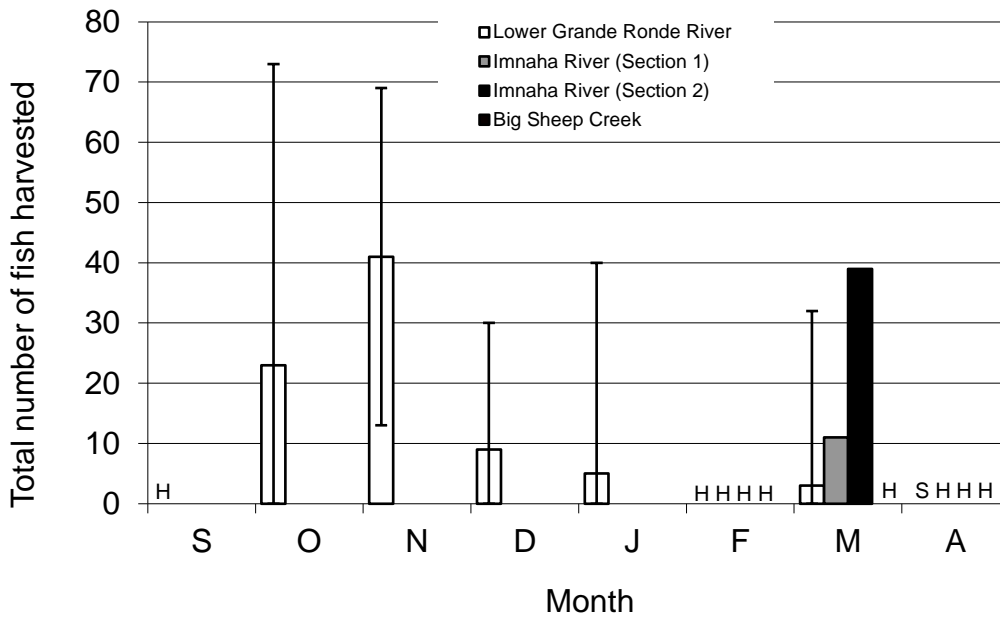


Figure 3. Estimated total harvest of summer steelhead (vertical bars show 95% confidence intervals) on the lower Grande Ronde River, two sections of the Imnaha River, and Big Sheep Creek during the 2018-19 run year. For the Imnaha during March in Section 1 and 2, the totals include both hatchery and unknown fish harvested. "H" indicates no harvest and "S" indicates no survey. Surveys were conducted from 1 September 2018 to 31 March 2019 on the lower Grande Ronde River, and from 1 February to 30 April 2019 on the Imnaha River and Big Sheep Creek.

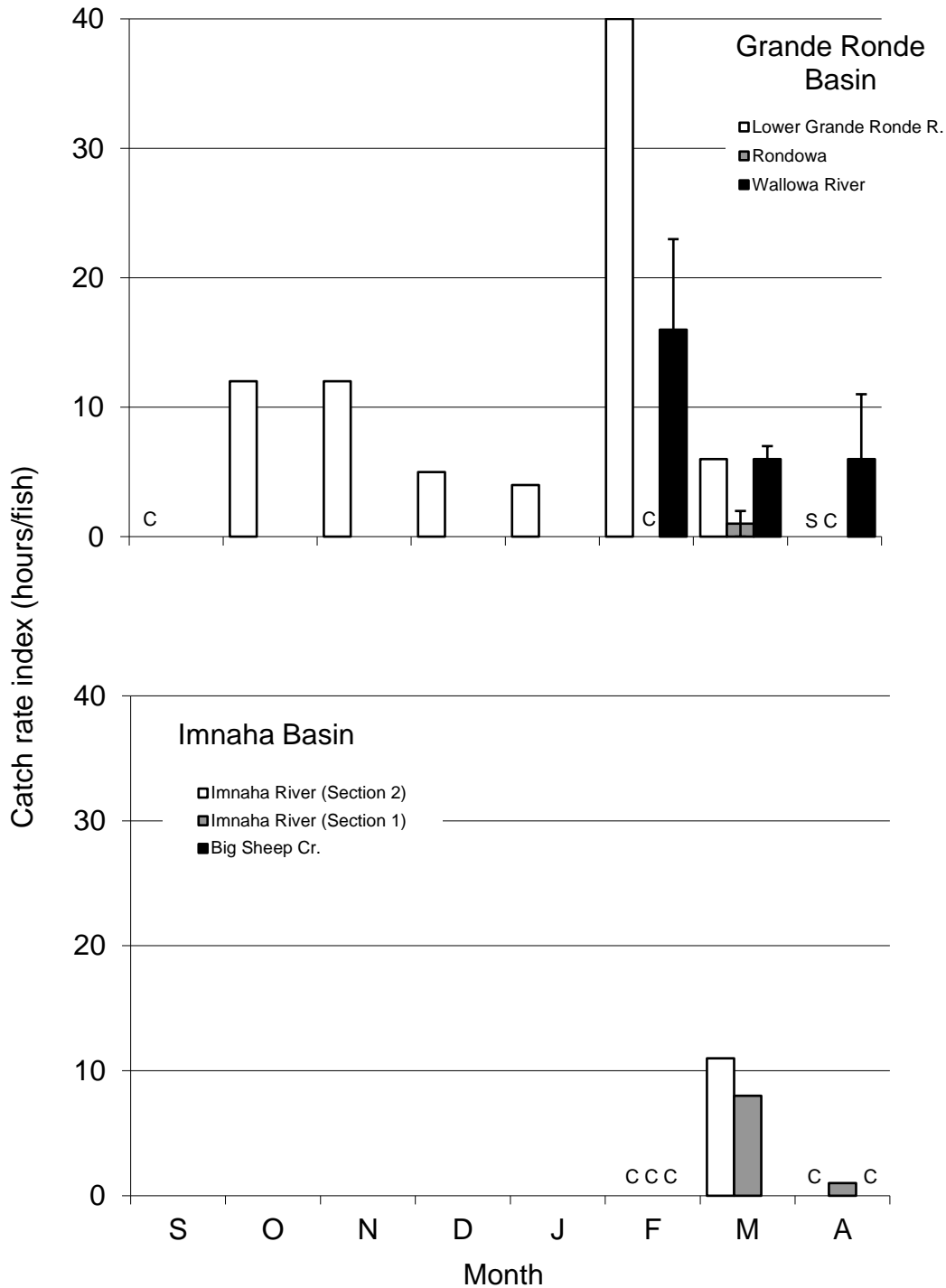


Figure 4. Estimated catch rate index (hours/fish) for summer steelhead (vertical bars show 95% confidence intervals) in the Grande Ronde and Imnaha river basins during the 2018-19 run year. “S” indicates no survey and “C” indicates no catch. Survey areas and times include the lower Grande Ronde River (1 September 2018 - 31 March 2019), and Rondowa, and Wallowa River (1 February - 15 April 2019), and two sections of the Imnaha River, and Big Sheep Creek (1 February - 30 April 2019). Note: A lower catch rate index implies better angling success.

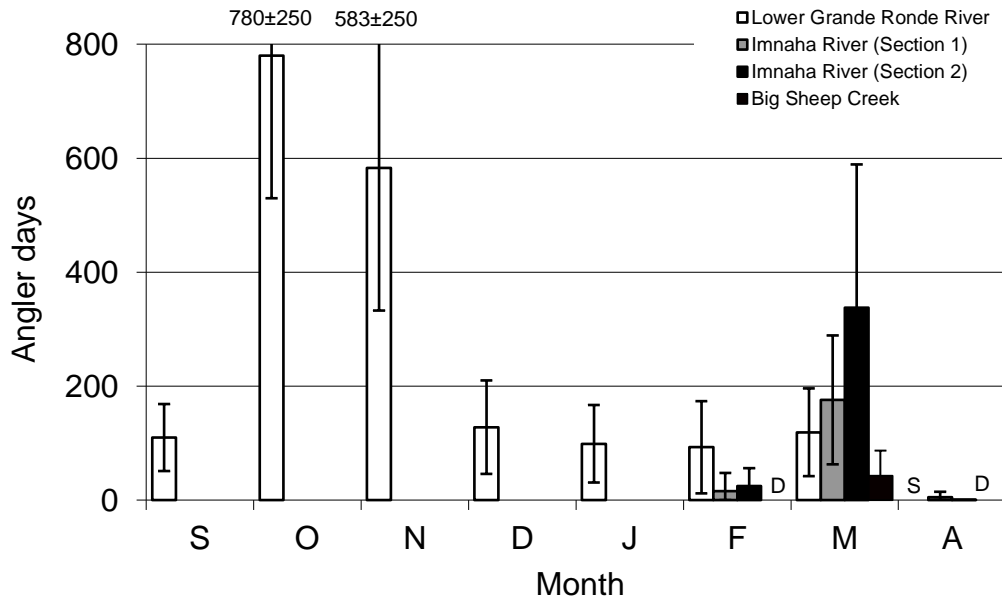


Figure 5. Estimated number of angler days for summer steelhead (vertical bars show 95% confidence intervals) on the lower Grande Ronde River, two sections of the Imnaha River, and Big Sheep Creek during the 2018-19 run year. “S” indicates no survey and “D” indicates no angler days. Surveys were conducted from 1 September 2018 to 31 March 2019 on the lower Grande Ronde River, and from 1 February to 30 April 2019 on the Imnaha River and Big Sheep Creek.

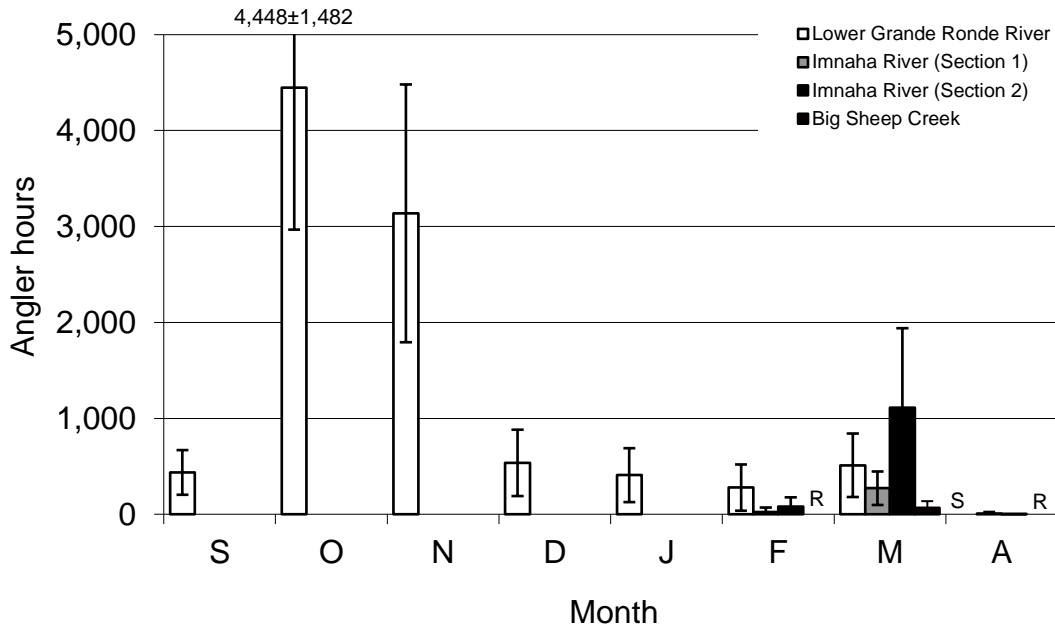


Figure 6. Estimated number of angler hours for summer steelhead (vertical bars show 95% confidence intervals) on the lower Grande Ronde River, two sections of the Imnaha River, and Big Sheep Creek during the 2018-19 run year. “S” indicates no survey and “R” indicates no angler hours. Surveys were conducted from 1 September 2018 to 31 March 2019 on the lower Grande Ronde River, and from 1 February to 30 April 2019 on the Imnaha River and Big Sheep Creek.

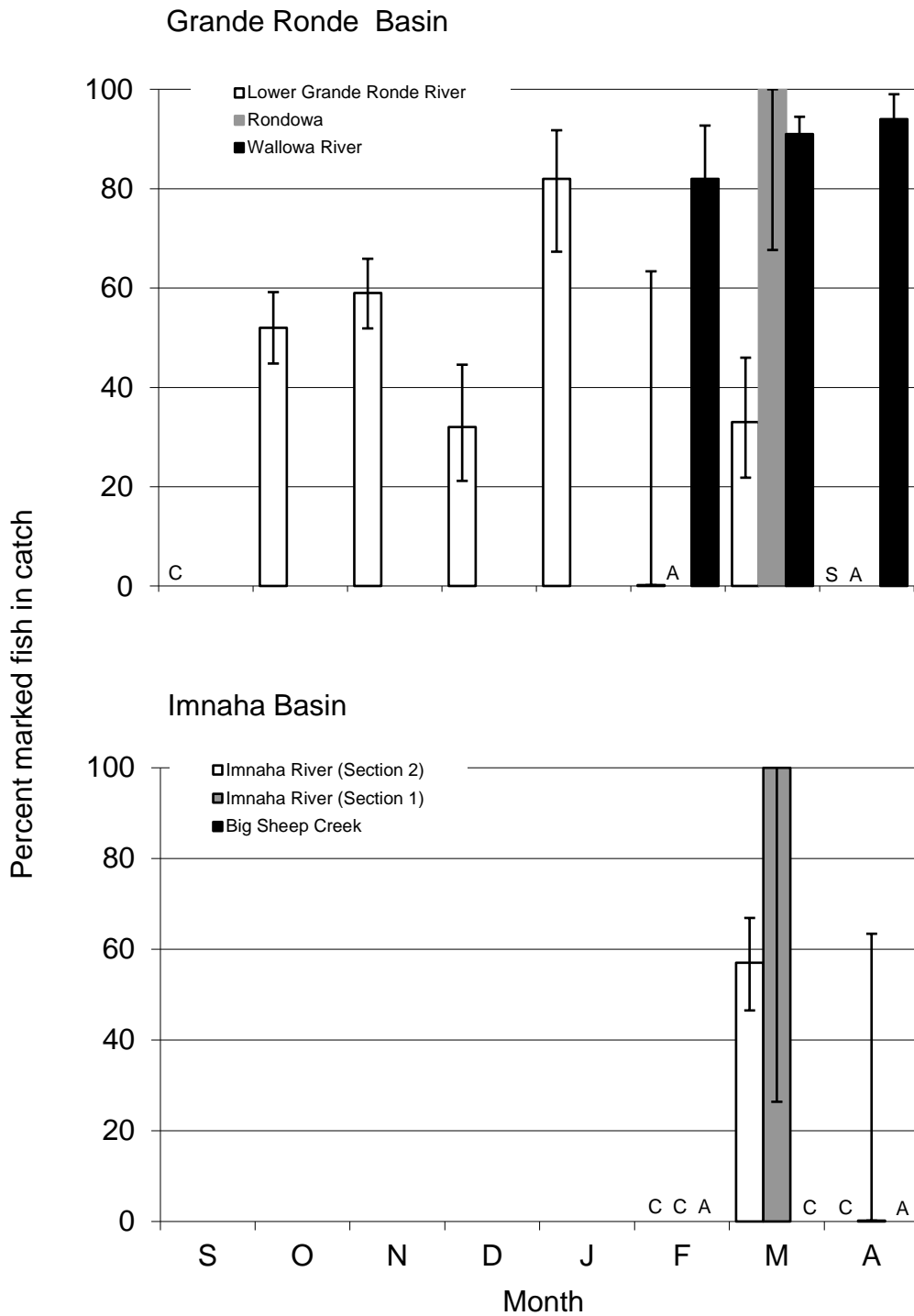


Figure 7. Estimated percent of summer steelhead caught (vertical bars show 95% confidence intervals; using a binomial distribution) in the Grande Ronde and Imnaha river basins during the 2018-19 run year that were marked. "S" indicates no survey, "C" indicates no catch, and "A" indicates no anglers. All unmarked fish were considered to be wild. Survey areas and times include the lower Grande Ronde River (1 September 2018 - 31 March 2019), and Rondowa, and Wallowa River (1 February - 15 April 2019), and two sections of the Imnaha River, and Big Sheep Creek (1 February - 30 April 2019).

Table 1. Percent age composition and mean fork length (\pm 95% confidence intervals) of hatchery summer steelhead sampled in creel surveys in the Grande Ronde and Imnaha river basins during the 2018-19 run year. Age composition and mean fork length by age are estimated from fork lengths of harvested fish and age-length keys developed from previous and current year known aged (from scales, coded-wire tags, and genetic samples taken during spawning) hatchery returns to Wallowa Hatchery and Little Sheep Creek Facility (for the Imnaha River basin including the Imnaha River and Big Sheep Creek). Age is expressed as years spent in freshwater prior to ocean migration:years spent in the ocean prior to spawning migration. A hyphen (-) indicates not sampled or undefined.

Creel survey area, sex	Age composition (%)			Mean fork length (mm)			
	N	1:1	1:2	N	1:1	N	1:2
Lower GR R.							
Males	17	41	59	7	614 \pm 15	10	706 \pm 44
Females	27	30	70	8	590 \pm 18	18	655 \pm 20
Unknown	1	100	0	0	-	0	-
Total	45	36	64	15	601 \pm 12	28	673 \pm 21
Rondowa.							
Males	1	0	100	0	-	1	740
Females	2	0	100	0	-	2	705 \pm 191
Total	3	0	100	0	-	3	717 \pm 63
Wallowa R.							
Males	23	57	43	13	602 \pm 15	10	764 \pm 37
Females	22	27	73	6	587 \pm 41	16	684 \pm 15
Unknown	1	0	100	0	-	0	-
Total	46	41	59	19	597 \pm 14	26	715 \pm 22
Imnaha R. basin							
Males	2	100	0	2	558 \pm 254	0	-
Females	4	50	50	2	607 \pm 438	2	627 \pm 184
Unknown	5	80	20	2	555 \pm 318	0	-
Total	11	73	27	6	573 \pm 41	2	627 \pm 184

Table 2. Residence and type of anglers interviewed during creel surveys in the Grande Ronde and Imnaha river basins during the 2018-19 run year. Local Oregon resident anglers were from Union and Wallowa counties.

Creel survey area	Number of anglers			Percent			
	StS	Trout	Total	Local Oregon resident anglers	Non-local Oregon resident anglers	Washington resident anglers	Other out-of-state anglers
Lower GR	429	7	436	42	24	11	23
Rondowa	4	0	4	0	100	0	0
Wallowa	362	2	364	55	40	0	5
Imnaha	126	0	126	76	17	1	6
Big Sheep Cr	4	0	4	0	75	0	25

Table 3. Number of Ad+CWT, AdLV+CWT or AdRV+CWT marked summer steelhead recovered during creel surveys in the Grande Ronde and Imnaha river basins during the 2018-19 run year. Recoveries were expanded for the entire fishery. No CWT recoveries in the Imnaha basin for the 2018-19 run year.

Creel survey area	Tag code	Release site	Experimental group ^a	Brood Year	Number recovered	
					Observed	Expanded ^b
Lower GR River	09 09 73	Deer Cr.	Fall Brood/late	2015	2	7
	09 10 74	Spring Cr.	Production/early	2016	1	4
Wallowa River	09 09 66	Spring Cr.	Production/early	2015	1	ND
	09 09 68	Spring Cr.	Prod/Vol/late	2015	1	ND
	09 09 71	Deer Cr.	Production/early	2015	1	ND
	09 09 72	Deer Cr.	Fall Brood/early	2015	1	ND
	09 10 73	Spring Cr.	Fall B/Vol/late	2016	1	ND
	09 10 76	Spring Cr.	Production/early	2016	1	ND
	09 10 81	Deer Cr.	Fall Brood/early	2016	1	ND
Rondowa	09 09 64	Spring Cr.	Fall B/Vol/late	2015	1	ND

^a Production (Prod) and Fall Brood (Fall B) releases are forced-released over a 24-hour period. The volitional (Vol) releases are a current management strategy designed to help remove steelhead smolts that may residualize. Early groups are released in early April and late groups are released in late April or early May. The reciprocal study group was released at Washington Dept. of Fish and Wildlife's (WDFW) Cottonwood Cr. acclimation pond on the lower Grande Ronde River in Washington.

^b ND indicates expansions not determined until statewide annual harvest card data become available.

for an average catch rate index of 12 hours per fish on the lower section (mouth to Fence Creek) and 8 hours per fish on the upper section (Fence Creek to town of Imnaha), and no fish were caught on Big Sheep Creek (Figures 2-6, Appendix Tables A-4, A-5, and A-6). The percent of steelhead caught that were hatchery origin ranged from 0% (April 2019 in Section 1 - Fence Creek to town of Imnaha) to 100% (March 2019 in Section 1; Figure 7, Appendix Table B). Age composition of harvested hatchery steelhead was 73% 1:1 and 27% 1:2 (Table 1). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 573 (± 41) mm for age 1:1, and 627 (± 184) mm for age 1:2. Sex ratio was 18% male, 36% female, and 46% unknown. Seventy-six percent of the anglers on the Imnaha River were local Oregon residents, 17% were non-local Oregon residents, 1% were Washington State residents and 6% resided outside the states of Oregon and Washington (Table 2). On Big Sheep Creek, 75% of the anglers were non-local Oregon residents and 25% resided outside the states of Oregon and Washington (Table 2). On the Imnaha River, we estimated that anglers did not harvest any CWT marked steelhead from our hatchery releases (Table 3).

Angler effort on the lower Grande Ronde was the second lowest observed since the mid-1990's but slightly higher than the previous season and about 64% of average since we began surveys over 30 years ago, while the Imnaha was lower than last year but higher than two years ago and only 35% of average (Figure 8).

Harvest on the lower Grande Ronde was the lowest observed since the early 90's and only about 9% of the most recent ten-year average, whereas the Imnaha was slightly higher than the previous two years but still low at 20% of the ten-year average (Figure 9 and Table 4). Total catch (harvested and released) on the lower Grande Ronde and the Imnaha was lowest observed since the mid-90's and only 21% and 8%,

respectively, of the 10-year average. Catch and release of wild steelhead this year on the lower Grande Ronde was 48% of the total catch, which was higher than the last two years and about average over all years, whereas on the Imnaha wild fish was 40% of the total catch, and the lowest proportion observed since 2012 when unmarked hatchery fish were a component of the returns.

Total catch, harvest, and release of both hatchery and wild steelhead for the 2017-18 run year on the Wallowa and at Rondowa, as determined by angler harvest card data that is available after a one-year delay, were all higher than the previous year but these metrics were the second lowest observed since the late 90's (Table 5).

Catch rates in 2018-19 were better in all Grande Ronde and Imnaha basin steelhead fisheries except for the lower Grande Ronde which was similar when compared to the previous year. All fisheries were similar to the overall average of 10 hours per fish since surveys began in 1985 except for the Wallowa and Rondowa fisheries which were better (Table 6).

The percent of local resident anglers participating in summer steelhead fisheries was lowest on Big Sheep Creek and at Rondowa, followed by the lower Grande Ronde River and highest on the Imnaha River (Table 2). For the Grande Ronde and Imnaha basin fisheries as a whole, the percent of local resident angler days have decreased while the percent of non-local and out-of-state angler days have increased since we began surveys in the 1985-86 run year (Figure 10). This trend is primarily due to an increase in the number of non-local and out-of-state angler days.

We continue to see a statistically significant linear relationship ($P < 0.001$) between harvest estimates generated from angler harvest cards and those from our creel surveys for summer steelhead fisheries in the Grande Ronde and Imnaha river basins (Figure 11). Based on this relationship, total harvest estimates for spring steelhead fisheries in run year 2017-18 were 200 fish at Rondowa, 466 fish in the Wallowa River and 78 fish in the middle Grande Ronde River, for a total harvest estimate of 744 fish in the Grande Ronde basin, excluding the lower Grande Ronde River (Figure 9, Appendix Table C-1). We estimated that no coded-wire-tagged fish were harvested at Rondowa and 11 coded-wire tagged fish were harvested in the Wallowa River in run year 2017-18. Total catch estimates for spring steelhead fisheries in run year 2017-18 were 826 fish at Rondowa, 839 fish in the Wallowa River, and 141 fish in the middle Grande Ronde River, for a total catch estimate of 1,806 fish in the Grande Ronde basin, excluding the lower Grande Ronde River (Appendix Table C-2). Angler effort for run year 2017-18 was estimated to be 12,449 hours at Rondowa, 9,499 hours in the Wallowa River, and 1,667 hours in the middle Grande Ronde River, for a total effort estimate of 23,615 hours in the Grande Ronde basin, excluding the lower Grande Ronde River (Appendix Table C-3).

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

The 2019 adult Wallowa stock steelhead returns to Wallowa Hatchery and Big Canyon Facility (1,821 adults, to be reported in the 2019 Annual Progress Report) was well below the 10-year average (from 2009-2018) of 4,264 adults. Angler participation on the lower Grande Ronde River (9,291 hours) was the second lowest observed since the mid-1990s, slightly higher than the 2017-18 season and about 64% of average (14,449 hrs) since we began surveys during the 1985-86 run year. Harvest in 2018-19 (80 fish) was the lowest observed since the early 1990's and only about 9% of the recent ten-year average (862 fish). For the third consecutive year, low catch estimates were due partly to the lowest catch of wild steelhead since the late 1990's. Similarly, the Imnaha stock steelhead return to Little Sheep Creek Facility was 615 adults, below the 10-year average return of 1,335 adults, and angler effort was lower than last year but higher than two years ago and only 35% of average, while harvest was slightly higher than the previous two years and 20% of the ten-year average. Low adult returns coupled with high and muddy river conditions during the spring may best explain the poor angler participation on the lower Grande Ronde and Imnaha rivers.

Catch rates were better than the previous year in all fisheries surveyed, except for the lower Grande Ronde. Catch and release of wild steelhead are included in the total catch rate and for the last two years on the Imnaha and the last three years on the lower Grande Ronde, the percent of wild steelhead in the total catch decreased to below 50%; 40% on the Imnaha for this year and 42% for last year, and 48%, 33% and 34% on the lower Grande Ronde for this year and the last two years. These decreases in the percent of wild fish in the catch contributed to the lower than usual overall catch for these fisheries. This suggests that the wild fish portion of the total catch contributes heavily to the success of recreational steelhead fisheries in both the Grande Ronde and Imnaha basins, especially in low hatchery return years.

The 2018-19 fishing season was the fourth year in which regulation changes allowed anglers to target steelhead through the end of April, and the end dates of our 2018-19 creel survey remained unchanged from prior seasons for the lower Grande Ronde (31 March) and the Wallowa (15 April); however, this was the second year we surveyed through 30 April rather than 15 April on the Imnaha River. For the lower Grande Ronde, we do not believe the regulation change will meaningfully affect total catch and harvest since fishing effort there is typically low in April. For the Imnaha survey from 16-30 April, we did not interview any anglers during eight sample days in this period. Lower than average adult steelhead returns coupled with higher than average flows (> 1,000 cfs) probably contributed heavily to the lack of effort observed. Based on average run timing of hatchery returns to the Little Sheep Creek of 50% by 15 April suggests that hatchery fish are still available in the river in good numbers as long as returns are average or above and water conditions are conducive for angling. In future years creel surveys in the Imnaha and Wallowa rivers in late April are still advised especially during average or above average return years, if sufficient funding is available.

These fishery statistics continue to illustrate the importance of current hatchery programs to the success of recreational summer steelhead fisheries in both the Grande Ronde and Imnaha river basins. Statistics for the Wallowa and Rondwa fisheries for the 2018-19 run year will be reported in the 2019-20 annual creel report.

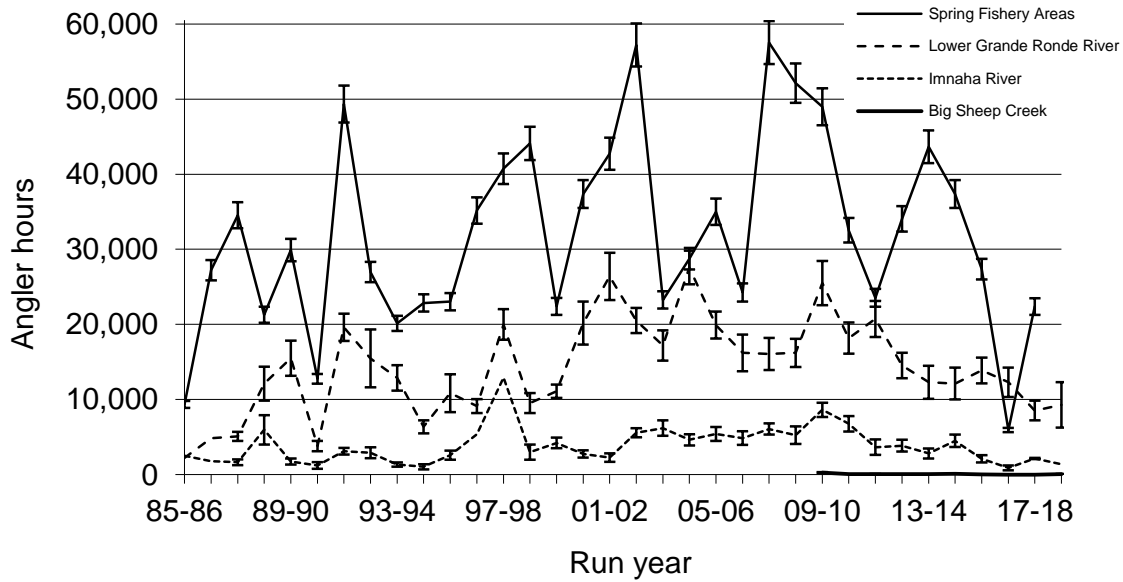


Figure 8. Angler effort (in hours) for summer steelhead in spring fishery areas (upper Grande Ronde and Willowa rivers, Catherine Creek, and Rondowa), lower Grande Ronde River, and Imnaha River for the 1985-86 to 2018-19 run years. Spring fishery areas for 2018-19 run year is a value to be estimated from angler harvest card data, which was not available when this report was submitted. Vertical bars are 95% confidence intervals, which are unavailable for the 85-86 and 86-87 run years, the Imnaha fishery for the 96-97 and 97-98 run years, and for spring fishery areas beginning with the 96-97 run year.

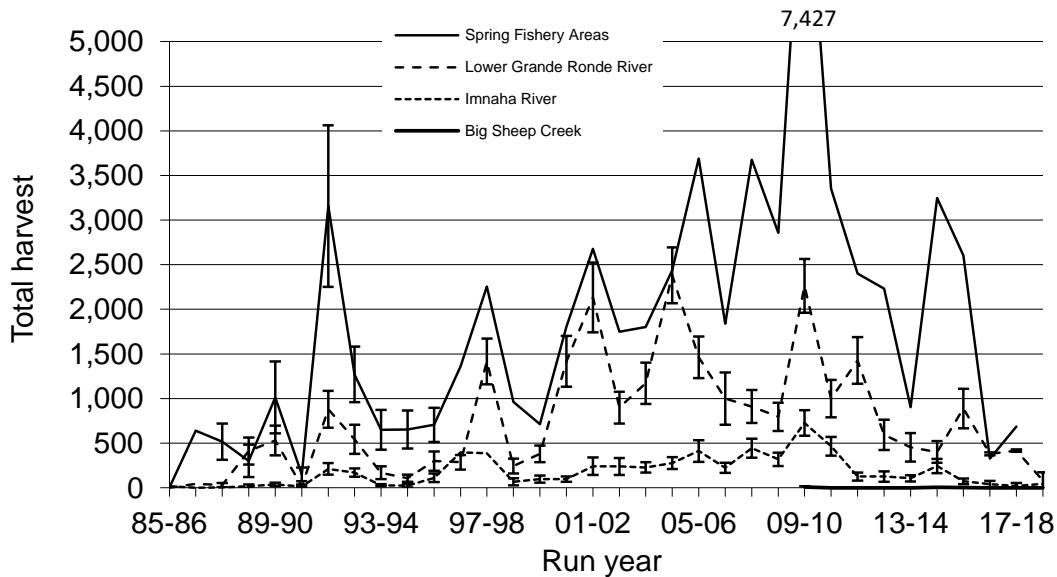


Figure 9. Number of hatchery summer steelhead harvested by recreational anglers in spring fishery areas (upper Grande Ronde and Willowa rivers, Catherine Creek, and Rondowa), lower Grande Ronde River, and Imnaha River for the 1985-86 to 2018-19 run years. Spring fishery areas for 2018-19 run year is a value to be estimated from angler harvest card data, which was not available when this report was submitted. Vertical bars are 95% confidence intervals, which are unavailable for the 85-86 and 86-87 run years, the Imnaha fishery for the 96-97 and 97-98 run years, and for spring fishery areas beginning with the 96-97 run year.

Table 4. Estimated total catch (harvested and released) of hatchery and wild summer steelhead from statistical angler surveys conducted on the lower Grande Ronde River from 1 September to 15 April, and in the Imnaha River basin (includes Big Sheep Creek beginning with the 2009-10 run year) from 1 February to 15 April for the 1985-86 to 2018-19 run years. Angling regulations were not consistent among years and river sections, which may have affected the number of harvested hatchery fish. A hyphen (-) indicates a statistical angler survey was not conducted.

Run year	Lower Grande Ronde River				Imnaha River Basin			
	Harvest	Released		Total catch	Harvest	Released		Total Catch
		Hatchery	Natural ^a			Hatchery	Natural ^a	
85-86 ^b	0	0	289	289	18	0	153	171
86-87 ^b	45	0	524	569	0	8	192	200
87-88 ^b	31	9	455	495	4	0	65	69
88-89 ^b	413	87	385	885	19	4	308	331
89-90 ^b	530	60	512	1,102	37	9	43	89
90-91 ^b	18	87	99	204	15	35	50	100
91-92 ^b	879	494	410	1,783	212	180	321	713
92-93 ^b	544	567	573	1,684	171	65	130	366
93-94 ^b	168	84	483	735	29	0	72	101
94-95 ^b	107	45	150	302	24	0	39	63
95-96 ^b	300	263	387	950	112	67	210	389
96-97	286	179	193	658	-	-	-	-
97-98	1,415	908	432	2,755	-	-	-	-
98-99	244	119	213	576	67	39	44	150
99-00	380	120	474	974	98	50	190	338
00-01	1,417	619	1,240	3,276	97	86	309	492
01-02	2,132	1,059	1,968	5,159	242	210	273	725
02-03	898	330	1,181	2,409	239	134	552	925
03-04	1,172	756	1,052	2,980	228	120	921	1,269
04-05	2,381	1,468	2,627	6,476	278	154	1,050	1,482
05-06	1,462	1,008	1,692	4,162	412	330	1,120	1,862
06-07	999	641	814	2,454	225	70	465	760
07-08	910	287	567	1,764	443	338	1,572	2,353
08-09	795	336	937	2,068	319	108	638	1,065
09-10	2,262	1,024	2,121	5,407	736	519	4,481	5,736
10-11	1,000	434	1,780	3,214	466	188	1,500	2,154
11-12	1,427	398	2,460	4,285	126	71	238	435
12-13 ^c	594	302	1,090	1,986	126	4	206	336
13-14 ^c	454	154	786	1,394	106	23	279	408
14-15 ^c	401	184	1,069	1,654	249	134	442	825
15-16 ^c	903	492	1,410	2,805	75	38	119	232
16-17 ^c	379	131	267	777	42	8	63	113
17-18 ^c	417	206	313	936	22	119	103	244
18-19 ^c	80	190	245	515	45	11	38	94
Average	768	389	876	2,033	169	100	521	790

^a Includes unmarked hatchery fish for run years 85-86 to 88-89 on the lower Grande Ronde River, and for run years 02-03 to 11-12 on the Imnaha River.

^b Angler surveys were conducted only during selected months (in parentheses) on the lower Grande Ronde River during run years 85-86 (Oct-Nov), 86-87 and 87-88 (Sept-Dec), 88-89 and 92-93 (Sept-Dec, 15Feb-15Apr), 89-90 and 93-94 (Sept-Dec, Feb-15Apr), 90-91 (Sept-Dec, Mar-15Apr), 95-96 (Sept-Jan, 16Feb-15Apr), and on the Imnaha River during run years 85-86 and 86-87 (Oct-Nov, Mar), 87-88 and 89-90 through 94-95 (Mar-15Apr), 88-89 (Mar-Apr), and 95-96 (Sept-15Nov, Mar-15Apr).

^c Angler surveys on the lower Grande Ronde River beginning with the 2012-13 run year were conducted from Sept-Mar.

Table 5. Estimated total catch (harvested and released) of hatchery and wild summer steelhead from angler surveys conducted on the Wallowa River and at Rondowa from 1 February to 15 April for the 1985-86 to 2017-18 run years. Estimates for run years 1985-86 to 1995-96 are based on a statistical angler survey and estimates for run years 1996-97 to present are based on a regression between angler harvest card data and creel survey harvest data. Angling regulations were not consistent among years and river sections, which may have affected the number of harvested hatchery fish. A hyphen (-) indicates that an angler survey was not conducted.

Run year	Wallowa River			Total catch	Rondowa			Total Catch
	Harvest	Released			Harvest	Released		
		Hatchery	Natural ^a			Hatchery	Natural ^a	
85-86	2	0	1,331	1,333	-	-	-	-
86-87	641	0	1,880	2,521	-	-	-	-
87-88 ^b	447	0	1,517	1,964	70	0	273	343
88-89 ^b	294	21	152	467	-	-	-	-
89-90 ^b	798	376	239	1,413	38	0	20	58
90-91 ^b	0	924	146	1,070	-	-	-	-
91-92	1,514	821	333	2,668	832	537	229	1,598
92-93 ^b	1,083	732	305	2,120	-	-	-	-
93-94 ^b	481	75	285	841	143	38	47	228
94-95 ^b	565	245	300	1,110	61	17	44	122
95-96	495	214	167	876	-	-	-	-
96-97	679	380	151	1,210	434	255	82	771
97-98	1,139	525	132	1,796	733	90	154	977
98-99	468	150	121	739	282	94	73	449
99-00	300	88	135	523	238	450	136	824
00-01	925	491	379	1,795	465	229	126	820
01-02	1,492	793	398	2,683	874	145	330	1,349
02-03	861	524	282	1,667	687	955	2,077	3,719
03-04	948	574	281	1,803	754	607	934	2,295
04-05	809	879	241	1,929	1,125	565	662	2,352
05-06	1,638	1,006	329	2,973	1,667	2,441	695	4,803
06-07	720	470	216	1,406	881	448	362	1,691
07-08	1,399	1,000	251	2,650	2,050	1,903	649	4,602
08-09	1,467	766	437	2,670	1,166	511	691	2,368
09-10	2,231	1,328	659	4,218	3,725	2,514	1,812	8,051
10-11	1,526	880	521	2,927	1,577	847	862	3,286
11-12	957	503	369	1,829	1,208	1,053	689	2,950
12-13	773	182	404	1,359	1,178	273	317	1,768
13-14	558	261	280	1,099	280	2	139	421
14-15	1,690	1,082	662	3,434	1,303	997	890	3,190
15-16	1,300	951	573	2,824	1,133	1,574	1,020	3,727
16-17	149	149	36	334	93	108	79	280
17-18	466	212	161	839	200	374	252	826
Average	873	503	414	1,791	859	631	505	1,995

^a Includes unmarked hatchery fish for run years 85-86 to 88-89.

^b Angler surveys were conducted only during selected dates (in parentheses) on the Wallowa River during run years 88-89 and 92-93 (Feb-Apr), and 90-91 (16Feb-15Apr), and at Rondowa during run years 87-88 and 94-95 (Mar-15Apr), 89-90 (17-31Mar), and 93-94 (16Mar-15Apr).

Table 6. Catch rate index (hours/fish \pm 95% confidence intervals) in summer steelhead creel survey areas in the Grande Ronde and Imnaha river basins for the 1985-86 to 2018-19 run years. Note that a lower catch rate index implies greater angling success. A hyphen (-) indicates not sampled or undefined.

Run year	Catch rate index (hours/fish)						
	Lower GR River	Upper GR River	Catherine Creek	Rondowa	Wallowa River	Imnaha River	Big Sheep Creek
85-86	8 \pm 7	-	-	-	7 \pm 7	15 \pm 7	-
86-87	9 \pm 3	-	-	-	11 \pm 3	9 \pm 8	-
87-88	10 \pm 4	-	-	11 \pm 9	16 \pm 3	24 \pm 9	-
88-89	14 \pm 4	40 \pm 55	-	-	43 \pm 21	18 \pm 11	-
89-90	14 \pm 4	14 \pm 8	-	34 \pm 27	17 \pm 5	20 \pm 8	-
90-91	19 \pm 8	24 \pm 11	-	-	6 \pm 2	13 \pm 6	-
91-92	11 \pm 3	10 \pm 3	3 \pm 3	6 \pm 1	10 \pm 2	4 \pm 1	-
92-93	9 \pm 2	14 \pm 4	49 \pm 49	-	11 \pm 2	8 \pm 1	-
93-94	18 \pm 5	31 \pm 17	-	12 \pm 4	17 \pm 3	13 \pm 3	-
94-95	21 \pm 6	25 \pm 13	-	15 \pm 5	17 \pm 3	17 \pm 8	-
95-96	11 \pm 2	15 \pm 4	-	-	21 \pm 4	7 \pm 2	-
96-97	14 \pm 4	18 \pm 9	33 \pm 69	-	13 \pm 3	6 \pm 2	-
97-98	7 \pm 1	13 \pm 9	7 \pm 10	11 \pm 6	10 \pm 1	18 \pm 9	-
98-99	17 \pm 4	19 \pm 9	14 \pm 20	-	18 \pm 4	20 \pm 7	-
99-00	11 \pm 2	25 \pm 19	-	8 \pm 7	17 \pm 4	12 \pm 3	-
00-01	6 \pm 1	18 \pm 17	-	6 \pm 4	11 \pm 2	6 \pm 1	-
01-02	5 \pm 1	11 \pm 17	-	7 \pm 4	7 \pm 1	3 \pm 1	-
02-03	8 \pm 1	-	-	8 \pm 6	12 \pm 2	6 \pm 2	-
03-04	6 \pm 1	-	-	3 \pm 2	7 \pm 1	5 \pm 1	-
04-05	4 \pm 0	-	-	5 \pm 1	5 \pm 1	4 \pm 1	-
05-06	5 \pm 1	-	-	2 \pm 1	7 \pm 1	3 \pm 1	-
06-07	8 \pm 1	-	-	6 \pm 2	7 \pm 1	6 \pm 1	-
07-08	9 \pm 1	-	-	7 \pm 2	7 \pm 1	3 \pm 0	-
08-09	8 \pm 1	-	-	12 \pm 4	8 \pm 1	5 \pm 1	-
09-10	5 \pm 0	-	-	3 \pm 1	4 \pm 0	2 \pm 0	0.8 \pm 0.3
10-11	6 \pm 1	-	-	4 \pm 2	4 \pm 0	3 \pm 0	6 \pm 1
11-12	5 \pm 1	-	-	3 \pm 1	6 \pm 1	8 \pm 2	-
12-13	7 \pm 1	-	-	9 \pm 2	10 \pm 1	11 \pm 3	24 \pm 25
13-14	9 \pm 2	-	-	65 \pm 93	10 \pm 2	7 \pm 2	-
14-15	7 \pm 3	-	-	5 \pm 1	5 \pm 1	6 \pm 1	4 \pm 1
15-16	5 \pm 1	-	-	3 \pm 1	5 \pm 1	9 \pm 3	7 \pm 3
16-17	14 \pm 10	-	-	4 \pm 3	9 \pm 3	8 \pm 4	-
17-18	11 \pm 5	-	-	12 \pm 16	11 \pm 2	14 \pm 8	-
18-19	11	-	-	1 \pm 1	7 \pm 1	12	-
Average	10 \pm 2	20 \pm 5	21 \pm 24	10 \pm 5	11 \pm 3	10 \pm 2	8 \pm 11
10 yr ave	8 \pm 2	-	-	11 \pm 14	7 \pm 2	8 \pm 3	8 \pm 11
5 yr ave	10 \pm 4	-	-	5 \pm 5	7 \pm 3	10 \pm 4	6 \pm 19

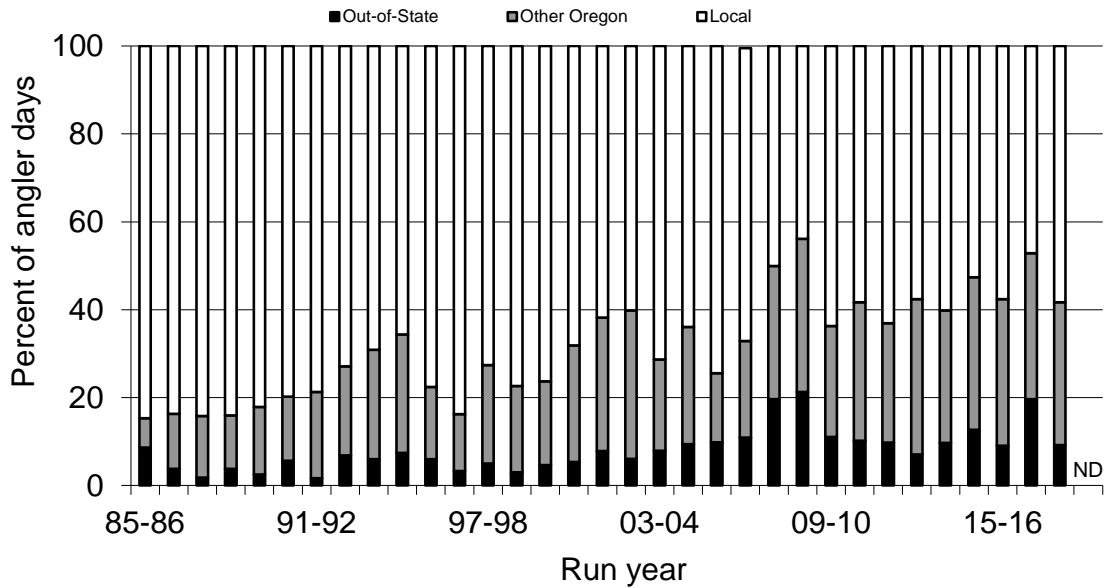


Figure 10. Percent of local resident angler days (Union or Wallowa county residents), non-local Oregon resident angler days, and out-of-state angler days for summer steelhead fisheries in the Grande Ronde and Imnaha river basins for the 1985-86 to 2018-19 run years. ND indicates not determined until statewide annual harvest card data become available.

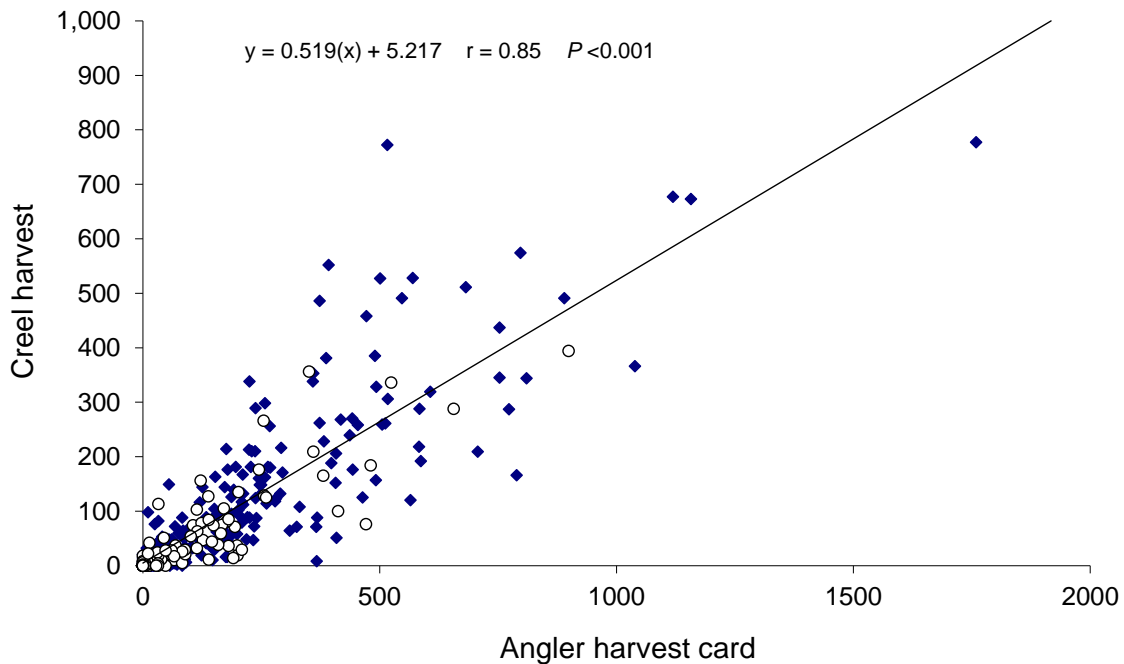


Figure 11. Relation between angler harvest card (punch card) and creel survey harvest for summer steelhead fisheries in the Grande Ronde (◆) and Imnaha (○) river basins for years when harvest estimates for specific reaches were available (1993-1996 for the upper Grande Ronde and Wallowa, 1994-1995 for Rondowa, 1992-1993 for Catherine Creek, 1993-spring 2018 for the lower Grande Ronde, and 1986-1996, 1999-2018 for the Imnaha fishery areas).

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APPENDIX A

Fishery Statistics for the 2018-19 run year

Appendix Table A-1. Fishery statistics for summer steelhead on the lower Grande Ronde River during the 2018-19 run year. Statistics include mean estimates $\pm 95\%$ confidence intervals. Only adipose fin-clipped fish were harvested. A hyphen (-) indicates not sampled or undefined. An "h" indicates hour.

Month, day type	Sample size		Total Hours ^a	Total Catch ^a	Total harvest ^a	Catch rate		Angler days ^a
	Days	Anglers				fish/h	h/fish	
September:								
Weekday	6	14	227 \pm 274	0	0	-	-	47 \pm 57
Weekend	6	10	189 \pm 76	0	0	-	-	65 \pm 26
Month	12	24	436 \pm 233	0	0	-	-	110 \pm 59
October:								
Weekday	5	66	2,701 \pm 951	159 \pm 114	30	0.141	7	562 \pm 198
Weekend	4	77	1,408 \pm 690	38 \pm 34	0	0.032	31	215 \pm 105
Month	9	143	4,448 \pm 1,428	184 \pm 62	23 \pm 50	0.080	12	780 \pm 250
November:								
Weekday	6	57	1,393 \pm 1,006	127 \pm 90	19 \pm 20	0.157	6	273 \pm 197
Weekend	6	97	1,495 \pm 739	68 \pm 46	20 \pm 18	0.047	21	271 \pm 134
Month	12	154	3,138 \pm 1,343	193 \pm 36	41 \pm 28	0.086	12	583 \pm 250
December:								
Weekday	6	14	182 \pm 190	9 \pm 26	0	0.156	6	63 \pm 66
Weekend	4	16	326 \pm 216	47 \pm 40	8 \pm 2	0.172	6	64 \pm 42
Month	10	30	537 \pm 346	61 \pm 26	9 \pm 21	0.185	5	128 \pm 82
January:								
Weekday	6	10	147 \pm 113	16 \pm 36	6	0.373	3	44 \pm 34
Weekend	5	20	207 \pm 176	18 \pm 26	0	0.142	7	46 \pm 39
Month	11	30	410 \pm 281	38 \pm 18	5 \pm 35	0.225	4	99 \pm 68
February:								
Weekday	6	5	61 \pm 86	0	0	-	-	16 \pm 23
Weekend	5	15	162 \pm 146	2 \pm 8	0	0.021	47	37 \pm 33
Month	11	20	279 \pm 242	3	0	0.025	40	93 \pm 81
March:								
Weekday	6	24	448 \pm 362	37 \pm 53	3	0.162	6	104 \pm 84
Weekend	5	11	107 \pm 109	18 \pm 26	0	0.221	5	25 \pm 25
Month	11	35	511 \pm 330	56 \pm 27	3 \pm 29	0.178	6	119 \pm 77
Season	76	436	9,291 \pm 3,032	515 \pm 105	80 \pm 93	0.091	11	1,808 \pm 590

^a Totals may not add up because of the way the expansions are calculated based on surveys days and the number of days in a strata (day type - weekday and weekend/holidays, month, and season).

Appendix Table A-2. Catch rate ($\pm 95\%$ confidence intervals) for summer steelhead at Rondowa during the 2018-19 run year. Only adipose fin-clipped fish were harvested. A hyphen (-) indicates not sampled or undefined. An "h" indicates hour.

Month, day type	Sample size		Catch rate	
	Days	Anglers	fish/h	(h/fish)
February:				
Weekday	2	0	-	-
Weekend	1	0	-	-
Month	3	0	-	-
March:				
Weekday	3	0	-	-
Weekend	6	4	0.692 \pm 0.616	1 \pm 1
Month	9	4	0.692 \pm 0.616	1 \pm 1
April:				
Weekday	1	0	-	-
Weekend	1	0	-	-
Month	2	0	-	-
Season	14	4	0.692 \pm 0.616	1 \pm 1

Appendix Table A-3. Catch rate ($\pm 95\%$ confidence intervals) for summer steelhead on the Wallowa River during the 2018-19 run year. Only adipose fin-clipped fish were harvested. An "h" indicates hour.

Month, day type	Sample size		Catch rate	
	Days	Anglers	fish/h	(h/fish)
February:				
Weekday	7	38	0.083 \pm 0.073	12 \pm 11
Weekend	6	80	0.053 \pm 0.026	19 \pm 9
Month	13	118	0.062 \pm 0.028	16 \pm 7
March:				
Weekday	6	101	0.184 \pm 0.060	5 \pm 2
Weekend	7	125	0.158 \pm 0.051	6 \pm 2
Month	13	226	0.170 \pm 0.039	6 \pm 1
April:				
Weekday	4	17	0.188 \pm 0.148	5 \pm 4
Weekend	3	3	-	-
Month	7	20	0.166 \pm 0.139	6 \pm 5
Season	33	364	0.138 \pm 0.028	7 \pm 1

Appendix Table A-4. Fishery statistics for summer steelhead in Section 1 (Fence Creek to town of Imnaha) of the Imnaha River during the 2018-19 run year. Statistics include mean estimates $\pm 95\%$ confidence intervals. Only adipose fin-clipped fish were harvested. A hyphen (-) indicates not sampled or undefined. An "h" indicates hour.

Month, day type	Sample size		Total Hours ^a	Total catch ^a	Unknown harvest ^a	Catch rate		Angler days ^a
	Days	Anglers				fish/h	h/fish	
February:								
Weekday	6	0	0	0	0	-	-	0
Weekend	6	4	16 \pm 31	0	0	-	-	12 \pm 23
Month	12	4	24 \pm 48	0	0	-	-	16 \pm 32
March:								
Weekday	7	14	163 \pm 168	12 \pm 31	12	0.226	4	130 \pm 134
Weekend	4	9	106 \pm 79	0	0	-	-	76 \pm 57
Month	11	23	273 \pm 175	11	11	0.119	8	176 \pm 113
April:								
Weekday	8	1	9 \pm 17	3 \pm 17	0	1.030	1	6 \pm 11
Weekend	4	0	0	0	0	-	-	0
Month	12	1	8 \pm 16	3	0	0.936	1	5 \pm 10
Season	35	28	281 \pm 198	13 \pm 60	10	0.122	8	186 \pm 131

^a Totals may not add up because of the way the expansions are calculated based on surveys days and the number of days in a strata (day type - weekday and weekend/holidays, month, and season).

Appendix Table A-5. Fishery statistics for summer steelhead in Section 2 (mouth to Fence Creek) of the Imnaha River and overall total for Section 1 and 2 combined during the 2018-19 run year. Statistics include mean estimates $\pm 95\%$ confidence intervals. Only adipose fin-clipped fish were harvested. A hyphen (-) indicates not sampled or undefined. An "h" indicates hour.

Month Day type	Sample size		Total hours	Total catch	Hatchery harvest	Unknown harvest	Catch rate		Angler days
	Days	Anglers					Fish/hr	h/fish	
February									
Weekday	6	4	25 \pm 56	0	0	0	-	-	17 \pm 38
Weekend	6	4	40 \pm 28	0	0	0	-	-	8 \pm 6
Month	12	8	80 \pm 99	0	0	0	-	-	25 \pm 31
March									
Weekday	7	29	318 \pm 111	0	0	0			120 \pm 42
Weekend	4	60	722 \pm 613	79 \pm 23	21 \pm 21	6	0.083	12	203 \pm 172
Month	11	89	1,113 \pm 826	89 \pm 42	31 \pm 40	8	0.094	11	338 \pm 251
April									
Weekday	8	0	0	0	0	0	-	-	0
Weekend	4	1	3	0	0	0	-	-	1
Month	12	1	3	0	0	0	-	-	1
Season	35	98	1,094 \pm 1,162	81 \pm 68	28 \pm 65	7	0.085	12	336 \pm 357
Sec 1 + 2	35	126	1,375	94	28	17	-	-	522

^a Totals may not add up because of the way the expansions are calculated based on surveys days and the number of days in a strata (day type - weekday and weekend/holidays, month, and season).

Appendix Table A-6. Fishery statistics for summer steelhead in Big Sheep Creek (mouth to Little Sheep Creek) in the Imnaha River basin during the 2018-19 run year. Statistics include mean estimates \pm 95% confidence intervals. Only adipose fin-clipped fish were harvested. A hyphen (-) indicates not sampled or undefined. An "h" indicates hour.

Month, day type	Sample size		Total Hours ^a	Total catch ^a	Total harvest ^a	Catch rate		Angler days ^a
	Days	Anglers				fish/h	h/fish	
February								
Weekday	6	0	0	0	0	-	-	0
Weekend	6	0	0	0	0	-	-	0
Month	12	0	0	0	0	-	-	0
March:								
Weekday	7	4	53 \pm 68	0	0	-	-	42 \pm 54
Weekend	4	0	15 \pm 29	0	0	-	-	11 \pm 21
Month	11	4	67 \pm 69	0	0	-	-	43 \pm 44
April:								
Weekday	8	0	0	0	0	-	-	0
Weekend	4	0	0	0	0	-	-	0
Month	12	0	0	0	0	-	-	0
Season	35	4	61 \pm 68	0	0	-	-	40 \pm 45

^a Totals may not add up because of the way the expansions are calculated based on surveys days and the number of days in a strata (day type - weekday and weekend/holidays, month, and season).

APPENDIX B

Percent of Summer Steelhead That Were Marked Hatchery Fish and Caught During the 2018-19 Run Year

Appendix Table B. Percent of marked hatchery summer steelhead caught during each survey month in the Grande Ronde and Imnaha River basins during the 2018-19 run year. In parentheses are total catch for the lower Grande Ronde and Imnaha rivers and Big Sheep Creek, and sampled catch for the Wallowa River and Rondowa. On the Imnaha River, Section 1 is from Fence Creek upstream to the town of Imnaha, and Section 2 is from the mouth upstream to Fence Creek. A hyphen (-) indicates not sampled or undefined.

Creel survey area	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Lower GR River	-(0)	52(185)	59(192)	32(60)	82(38)	0(3)	33(57)	-
Rondowa	-	-	-	-	-	-(0)	100(9)	-(0)
Wallowa River	-	-	-	-	-	82(28)	91(172)	94(17)
Imnaha River (Section 1)	-	-	-	-	-	-(0)	100(11)	0(3)
Imnaha River (Section 2)	-	-	-	-	-	-(0)	57(90)	-(0)
Big Sheep Cr.	-	-	-	-	-	-(0)	-(0)	-(0)

APPENDIX C

Fishery Statistics for Spring Fisheries for the 2017-18 Run Year

Appendix Table C-1. Estimated harvest of summer steelhead, and observed and expanded harvest of coded-wire tagged steelhead, in spring fisheries in the Grande Ronde basin for the 2017-18 run year. Total harvest = 0.519 (harvest card) + 5.217. Sample rate expansion = total harvest/sampled fish. A sample rate expansion of 25 or greater was considered unreliable; in such cases expanded = observed. Harvest estimates are only for months when steelhead angling season was open (Sept - April) and angler harvest card data was greater than zero. Does not include the lower Grande Ronde (location code 231) fishery. A hyphen (-) indicates not sampled or undefined.

Fishery, location code, statistics, tagcode	Fishery statistics and tags recovered by month									Expanded tags
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total	
Upper Grande Ronde (233)										
Angler harvest cards	0	0	0	0	0	0	0	0		
Total harvest	-	-	-	-	-	-	-	-	0	
Catherine Creek (120)										
Angler harvest cards	0	0	0	0	0	0	0	0		
Total harvest	-	-	-	-	-	-	-	-	0	
Rondowa (234)										
Angler harvest cards	0	7	27	27	89	89	89	0		
Sampled fish	0	0	0	0	0	2	0	0		
Total harvest	-	9	19	19	51	51	51	-	200	
Sample rate expansion	-	-	-	-		25.5	-	-		
Wallowa (235)										
Angler harvest cards	0	0	7	88	199	188	232	122		
Sampled fish	0	0	0	0	0	53	42	13		
Total harvest	-	0	9	51	108	103	126	69	466	
Sample rate expansion	-	-	-	-	-	1.9	3.0	5.3		
09 08 14						1	0	0	1	2
09 09 66						2	0	0	2	4
09 09 67						1	0	0	1	2
09 09 68						0	1	0	1	3
Wenaha (184)										
Angler harvest cards	0	0	0	0	0	0	0	0		
Total harvest	-	-	-	-	-	-	-	-	0	
Middle Grande Ronde (232)										
Angler harvest cards	0	41	41	7	0	0	22	0		
Total harvest	-	26	26	9	-	-	17	-	78	
Total Grande Ronde harvest (excluding lower Grande Ronde)									744	

Appendix Table C-2. Estimated catch of summer steelhead in spring fisheries in the Grande Ronde basin for the 2017-18 run year. Total catch = (sampled catch/sample harvest) x total harvest. For months with little or no sampling, the average proportion was used. For areas with little or no sampling, data from the survey in closest proximity was used. Does not include the lower Grande Ronde fishery. A hyphen (-) indicates not sampled or undefined.

Fishery ^a , statistics	Fishery statistics by month								Total	
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr		
Upper Grande Ronde										
Sampled harvest	-	-	-	-	-	-	-	-	-	-
Sampled catch	-	-	-	-	-	-	-	-	-	-
Total harvest	-	-	-	-	-	-	-	-	-	0
Total catch	-	-	-	-	-	-	-	-	-	0
Catherine Creek										
Sampled harvest	-	-	-	-	-	-	-	-	-	-
Sampled catch	-	-	-	-	-	-	-	-	-	-
Total harvest	-	-	-	-	-	-	-	-	-	0
Total catch	-	-	-	-	-	-	-	-	-	0
Rondowa										
Sampled harvest	-	-	-	-	-	2	0	-	-	2
Sampled catch	-	-	-	-	-	6	3	-	-	9
Total harvest	-	9	19	19	51	51	51	-	-	200
Total catch	-	41	86	86	230	153	230	-	-	826
Wallowa										
Sampled harvest	-	-	-	-	-	55	43	13	-	111
Sampled catch	-	-	-	-	-	96	79	24	-	199
Total harvest	-	-	9	51	108	103	126	69	-	466
Total catch	-	-	16	91	194	180	231	127	-	839
Wenaha										
Sampled harvest	-	-	-	-	-	-	-	-	-	-
Sampled catch	-	-	-	-	-	-	-	-	-	-
Total harvest	-	-	-	-	-	-	-	-	-	0
Total catch	-	-	-	-	-	-	-	-	-	0
Middle Grande Ronde										
Sampled harvest	-	-	-	-	-	-	-	-	-	-
Sampled catch	-	-	-	-	-	-	-	-	-	-
Total harvest	-	26	26	9	-	-	17	-	-	78
Total catch	-	47	47	16	-	-	31	-	-	141
Total Grande Ronde catch (excluding lower Grande Ronde)									1,806	

^a Wallowa data were used for the upper Grande Ronde, middle Grande Ronde, and Catherine Creek; lower Grande Ronde data, in Flesher et al. 2020, were used for the Wenaha.

Appendix Table C-3. Estimated angler effort (hours) for summer steelhead in spring fisheries in the Grande Ronde basin for the 2017-18 run year. Angler effort in hours = Total catch/sampled catch rate in fish per hour. For months with little or no sampling, the average proportion was used. For areas with little or no sampling, data from the survey in closest proximity was used. Does not include the lower Grande Ronde fishery. A hyphen (-) indicates not sampled or undefined.

Fishery ^a , statistics	Fishery statistics by month								Total	
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr		
Upper Grande Ronde										
Catch rate	-	-	-	-	-	-	-	-	-	-
Total catch	-	-	-	-	-	-	-	-	-	0
Angler effort	-	-	-	-	-	-	-	-	-	0
Catherine Creek										
Catch rate	-	-	-	-	-	-	-	-	-	-
Total catch	-	-	-	-	-	-	-	-	-	0
Angler effort	-	-	-	-	-	-	-	-	-	0
Rondowa										
Catch rate	-	-	-	-	-	0.324	0.034	-	-	0.085
Total catch	-	41	86	86	230	153	230	-	-	826
Angler effort	-	482	1,012	1,012	2,706	472	6,765	-	-	12,449
Wallowa										
Catch rate	-	-	-	-	-	0.102	0.072	0.111	-	0.089
Total catch	-	-	16	91	194	180	231	127	-	839
Angler effort	-	-	180	1,022	2,108	1,765	3,208	1,144	-	9,499
Wenaha										
Catch rate	-	-	-	-	-	-	-	-	-	-
Total catch	-	-	-	-	-	-	-	-	-	0
Angler effort	-	-	-	-	-	-	-	-	-	0
Middle Grande Ronde										
Catch rate	-	-	-	-	-	-	-	-	-	-
Total catch	-	47	47	16	-	-	31	-	-	141
Angler effort	-	528	528	180	-	-	431	-	-	1,667
Total Grande Ronde angler effort (excluding lower Grande Ronde)									23,615	

^a Wallowa data were used for the upper Grande Ronde, middle Grande Ronde, and Catherine Creek; lower Grande Ronde data, in Flesher et al. 2020, were used for the Wenaha.

APPENDIX D

A summary of the methodology and associated formulas used to estimate angler effort (new for 2018-19 run year), catch rate, and catch for the lower Grande Ronde summer steelhead fishery. These methods are essentially unchanged from those described in Carmichael et al. (1988), except for angler effort, but some calculations have been clarified or explicitly described that were unclear in the original document (written by Josh McCormick, former ODFW fisheries biometrician).

EQUATIONS USED TO ESTIMATE CREEL SURVEY METRICS (Josh McCormick)

Effort

Total angling effort in angler hours on day d in time stratum (\hat{E}_d) for each location strata and angler time is estimated as:

$$\hat{E}_d = T_d \bar{I}_d, \quad (1)$$

where T_d is the total number of hours in the fishing day and \bar{I}_d is the mean of the angler counts conducted on day d .

If only one instantaneous count is conducted, then variance of daily effort cannot be estimated (Rasmussen et al. 1998; Su and Clapp 2013). Additionally, if only a single shift is sampled within a day, as was assumed in this study, there is no exact daily variance estimator as among-shift variability cannot be accounted for. Daily variance of effort can be estimated if multiple counts within a day are conducted and if the sampling period is set to the entire day or if multiple shifts are surveyed. Variance estimators and sample size estimators for simple random designs or cluster designs are described relatively simply in Scheaffer et al. (2006).

Angling effort (\hat{E}_k) for the k th stratum is estimated as:

$$\hat{E}_k = N_k \frac{\sum_{d=1}^n \hat{E}_d}{n_k}, \quad (2)$$

where N_k is the number of days in the stratum and n_k is the number of days surveyed in the sampling period.

Estimates of effort among strata can be summed to estimate effort (\hat{E}) over the duration of the fishing season or time period of interest. The variance estimator for equation (2) depends on the estimate of within day variance, which cannot be calculated when only one count is made or one shift is sampled. However, the within stratum variance ($\hat{V}(\hat{E}_k)$) can be approximated as (Pollock et al. 1994; Scheaffer et al. 2006; Su and Clapp 2013):

$$\hat{V}(\hat{E}_k) = N_k^2 \left(\frac{s_{\hat{E}_k}^2}{n_k} \right), \quad (3)$$

where $s_{\hat{E}_k}^2$ is the sample variance which is calculated as:

$$s_{\hat{E}_k}^2 = \frac{\sum_{d=1}^n (\hat{E}_d - \bar{E}_k)^2}{n_k - 1}, \quad (4)$$

where \bar{E}_k the average daily effort estimate over the sampling period.

Similar to the point estimate, the overall season variance ($\hat{V}(\hat{E})$) is calculated as the sum of the estimated strata variances. A confidence interval for estimated angling effort over the sampling period ($CI_{\hat{E}}$) is estimated as:

$$CI_{\hat{E}} = \hat{E} \pm Z_{\alpha/2} \sqrt{\hat{V}(\hat{E})}, \quad (5)$$

where $Z_{\alpha/2}$ is the critical value for the confidence interval (e.g., 1.96 for a 95% confidence interval).

Catch Rate

Mean angler catch rate in fish per angler hours on day d (\hat{R}_d) for each location strata and angler type is estimated as:

$$\hat{R}_d = \frac{\sum_{i=1}^{j_d} c_{d,i}}{\sum_{i=1}^{j_d} h_{d,i}}, \quad (6)$$

where j_d is the total number of anglers interviewed on day d , $c_{d,i}$ is number of fish caught by the i th angler on day d , and $h_{d,i}$ is the total number of hours fished by the i th angler on day d .

Similar to daily effort estimates, variance cannot be estimated for catch rate when only one shift is sampled within a day. Su and Clapp (2013) recommended that catch rate for the stratum (\hat{R}_k) be estimated as:

$$\hat{R}_k = \sum_{d=1}^n \left(\hat{E}_d / \sum_{d=1}^n \hat{E}_d \right) \hat{R}_d. \quad (7)$$

Estimates of \hat{E}_k and \hat{R}_k can be substituted for \hat{E}_d and \hat{R}_d respectively to generate a season catch rate estimate. Because of the complexity of the approximate variance equation for the catch rate estimate for the stratum or season, I recommended the use of iterative methods to estimate variance and catch rate over the duration of the sampling period

Catch

Catch on day d (\hat{C}_d) for each location strata and angler type is estimated as:

$$\hat{C}_d = \hat{R}_d \hat{E}_d. \quad (8)$$

There is no exact variance estimator for daily catch under the sampling conditions assumed here, however, if multiple angler counts are conducted and the entire day is

sampled then daily catch variance can be estimated as the variance of the product of catch rate and effort (Goodman 1960).

Catch for the stratum (\hat{C}_k) is estimated as:

$$\hat{C}_k = N_k \frac{\sum_{d=1}^n \hat{C}_d}{n_k}. \quad (9)$$

Estimated catch among strata is then added to estimate season catch. Similar to effort, approximate stratum catch variance can be estimated using equation (3) with catch sample variance substituted for effort variance (estimated using equation 4). Stratum variance is then added to estimate season catch variance and confidence intervals and sample sizes can be estimated equation (5) respectively, with catch metrics substituted for effort metrics.

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