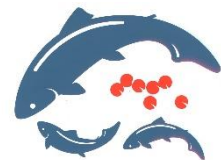


LOWER SNAKE RIVER COMPENSATION PLAN:
Summer Steelhead Creel Surveys on the
Grande Ronde, Wallowa, and Imnaha
Rivers for the 2017-18 Run Year

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



Michael W. Flesher
Lance R. Clarke
Michelle Jones



LOWER SNAKE RIVER
COMPENSATION PLAN

This program receives federal financial assistance from the U.S. Fish and Wildlife Service and prohibits discrimination on the basis of race, color, national origin, age, gender, or disability. If you believe that you have been discriminated against as described above in any program, activity, or facility, or if you desire further information, please contact ADA coordinator, Oregon Department of Fish and Wildlife, 4034 Fairview Industrial Dr. SE, Salem, OR 97302, 503-947-6000, or contact the Office of Diversity and Inclusive Workforce Management, U.S. Fish and Wildlife Service, 5275 Leesburg Pike, Mailstop: ODIWM Falls Church, Virginia 22041 - 3803 or call (703) 358-1724.

This report is available at: <http://www.fws.gov/snakecomplan/reports/ODFWreports.html>

Front cover photo: Two happy anglers fighting a steelhead 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 2017-18 Run Year

CONTRACT NUMBER: F16AC00030

PROJECT PERIOD: 1 October 2017 to 30 September 2018

Prepared by: Michael W. Flesher
Lance R. Clarke
Michelle Jones

December, 2020

Oregon Department of Fish and Wildlife
4034 Fairview Industrial Drive SE
Salem, OR 97302

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 2017 to 30 September 2018. The sampling period was from 1 September 2017 to 15 April 2018. 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 2017-2018 run year were primarily from the 2014 and 2015 brood years. Results of creel surveys conducted prior to fall 2017 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, and 2019), many of which are available at: <http://www.fws.gov/lsnakecomplan/reports/ODFWreports.html>. The steelhead angling season surveyed in this report, during which only adipose fin-clipped fish could be harvested, was open from 1 September 2017 to 30 April 2018 in the Grande Ronde and Imnaha river basins.

ACKNOWLEDGMENTS

We would like to thank Mary Buckman (retired) for the statistical design of the surveys, Celeste Cole and Christopher Morse for their dedication in conducting the surveys, and Rod Engle, Pat Keniry, and Joseph Feldhaus for reviewing the document. We would also like to thank Todd Miller and Jeremy Trump (Washington Department of Fish and Wildlife) for coordinating and Daniel Cunnane for conducting the lower Grande Ronde survey during spring 2018. 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.

CONTENTS

	Page
PREFACE	i
ACKNOWLEDGMENTS.....	ii
LIST OF FIGURES.....	iv
LIST OF TABLES.....	vi
LIST OF APPENDICES.....	vii
SUMMARY.....	1
INTRODUCTION.....	2
STUDY AREA	3
METHODS	4
ACCOMPLISHMENTS AND FINDINGS	6
MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS.....	14
REFERENCES.....	21
APPENDICES.....	25

LIST OF FIGURES

<u>Number</u>		<u>Page</u>
1.	Map of northeastern Oregon showing where summer steelhead creel surveys were conducted in the Grande Ronde and Imnaha river basins during the 2017-18 run year.....	3
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 2017-18 run year ...	8
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 2017-18 run year ...	8
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 2017-18 run year	9
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 2017-18 run year	10
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 2017-18 run year	10
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 2017-18 run year that were marked	11
8.	Angler effort (in hours) for summer steelhead in spring fishery areas (upper Grande Ronde and Wallowa rivers, Catherine Creek, and Rondowa), the lower Grande Ronde River, and the Imnaha River for the 1985-86 to 2017-18 run years.....	16
9.	Number of hatchery summer steelhead harvested by recreational anglers in spring fishery areas (upper Grande Ronde and Wallowa rivers, Catherine Creek, and Rondowa), the lower Grande Ronde River, and the Imnaha River for the 1985-86 to 2017-18 run years.	16

LIST OF FIGURES (continued)

<u>Number</u>		<u>Page</u>
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 2016-17 run years	20
11.	Relation between angler harvest tag (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 2017 for the lower Grande Ronde, and 1986-1996, 1999-2017 for the Imnaha fishery areas).....	20

LIST OF TABLES

<u>Number</u>		<u>Page</u>
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 2017-18 run year	12
2.	Residence of summer steelhead anglers interviewed during creel surveys in the Grande Ronde and Imnaha river basins during the 2017-18 run year	12
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 2017-18 run year	13
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 2017-18 run years.....	17
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 2016-17 run years.....	18
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 2017-18 run years	19

LIST OF APPENDICES

<u>Number</u>		<u>Page</u>
A-1.	Fishery statistics for summer steelhead on the lower Grande Ronde River during the 2017-18 run year	26
A-2.	Catch rate ($\pm 95\%$ confidence intervals) for summer steelhead at Rondowa during the 2017-18 run year	27
A-3.	Catch rate ($\pm 95\%$ confidence intervals) for summer steelhead on the Wallowa River during the 2017-18 run year.....	27
A-4.	Fishery statistics for summer steelhead in Section 1 (Fence Creek to town of Imnaha) of the Imnaha River during the 2017-18 run year.....	28
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 2017-18 run year	28
A-6.	Fishery statistics for summer steelhead in Big Sheep Creek (mouth to Little Sheep Creek) in the Imnaha River basin during the 2017-18 run year	29
B.	Percent of marked hatchery summer steelhead caught during each survey month in the Grande Ronde and Imnaha river basins during the 2017-18 run year	30
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 2016-17 run year	32
C-2.	Estimated catch of summer steelhead in spring fisheries in the Grande Ronde basin for the 2016-17 run year	33
C-3.	Estimated angler effort (hours) for summer steelhead in spring fisheries in the Grande Ronde basin for the 2016-17 run year.....	34
D.	A summary of the methodology including the statistical design and associated formulas used to estimate angler effort, total catch, harvest, and catch rate for the lower Grande Ronde summer steelhead fishery. Also includes a review of the stratified random sampling design used for the survey	35

SUMMARY

Analysis of creel survey data for the 2017-18 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 second year in a row. Angler effort on the lower Grande Ronde River (8,540 hrs) was lower than was observed during the previous season and about 60% of average (14,634 hrs) since we began surveys during the 1985-86 run year, while harvest in 2017-18 (417 fish) was just over 50% of average (779 fish). On the Imnaha River angler effort (2,158 hrs) was higher than the previous two years but only 54% of average (3,992 hrs), and harvest (22 fish) was the lowest observed since the mid-1990's. Anglers experienced below average fishing success in the Imnaha as catch rates were 14 hrs/fish, but similar to the average catch rates in all other NE Oregon fisheries.

The total catch of wild steelhead in the lower Grande Ronde River for the 2017-18 run year was 313 fish, below the average of 894 fish. Wild fish comprised 33% of total catch, similar to the 34% observed in the previous year, whereas in the prior 6 years wild steelhead were at least 50% of the catch. On the Imnaha, wild fish were 42% 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 2016-17 run year, summarized in the appendices. Based on creel and harvest card data, combined total catch in those areas was 805 fish, total harvest was 327 fish, and total effort was 5,935 hours. Angler effort, catch and harvest were the lowest observed since surveys began in 1985. Low adult returns coupled with high and muddy flows in the spring of 2017 may best explain the poor fishing success in these fisheries in the 2016-2017 run year.

Seventy-nine percent of anglers that participated in Imnaha basin fisheries were local residents. In Grande Ronde basin locations local residents comprised 46 to 67%. Out-of-state persons comprised 0 to 22% of the anglers, depending on location.

The 2017-18 fishing season was the third year in which regulation changes allowed anglers to target steelhead through the end of April. The end dates of our 2017-18 creel survey remained unchanged from prior seasons on the lower Grande Ronde (31 March) and Wallowa (15 April) rivers. The regulation change likely will not meaningfully affect total catch and harvest on the lower Grande Ronde River, since fishing effort there is typically low in April. This is the first year we surveyed through 30 April on the Imnaha River. We did not encounter any anglers during the six 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. Thus, if

funding is available, creel surveys in the Imnaha and Wallowa rivers in late April are still 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 Imnaha stock Big Sheep direct stream releases. 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.

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 (Flesher et al. 1994). This report summarizes results of creel surveys conducted during the fall of 2017 and the spring of 2018 in the Grande Ronde and Imnaha river basins. In addition, this report contains estimates of total effort, catch, and harvest for all the spring fisheries in the Grande Ronde river basin, information that was not available for inclusion in the 2016-17 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 2017-18 steelhead angling

season in the Grande Ronde and Imnaha river basins was open from 1 September 2017 to 30 April 2018.

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 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

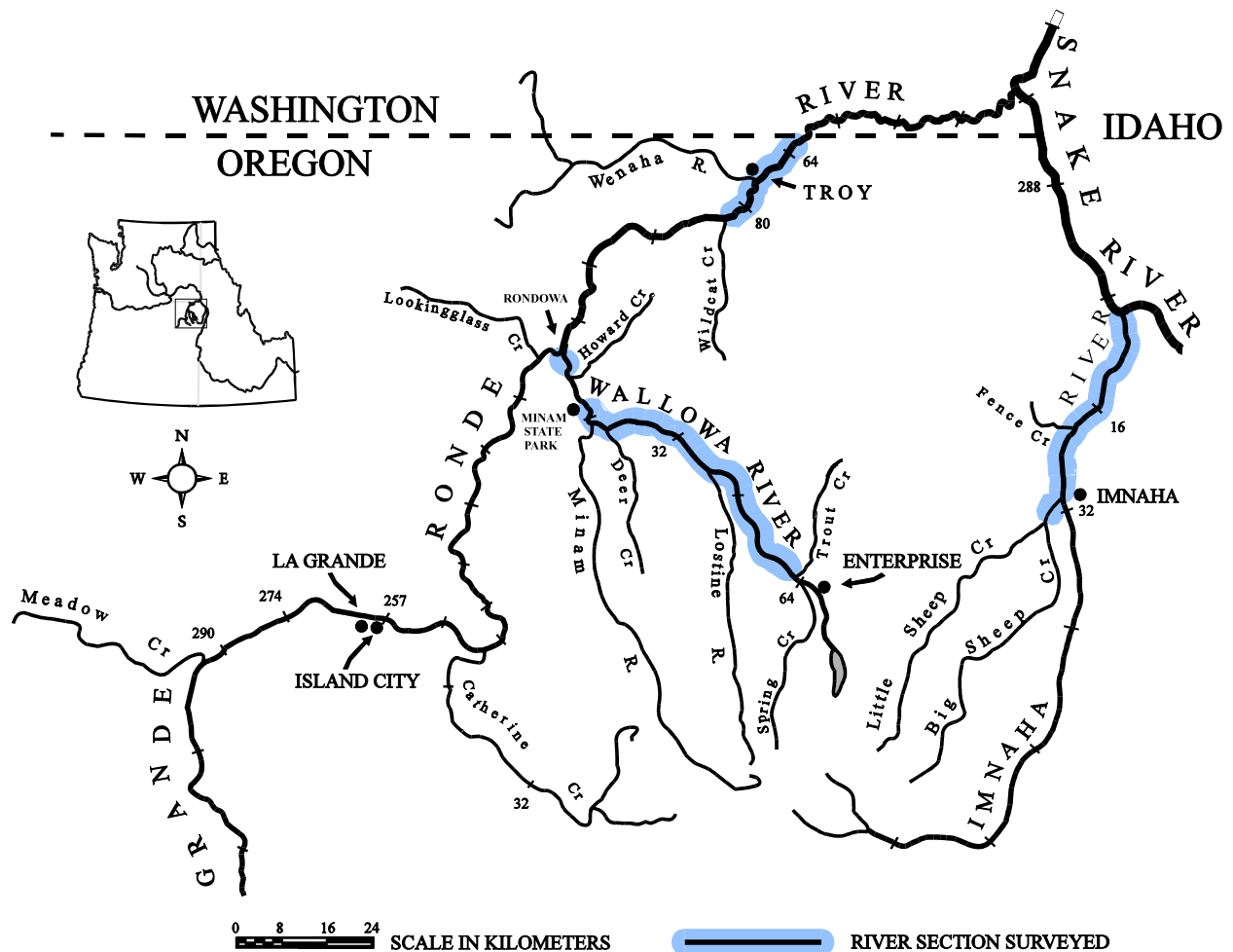


Figure 1. Map of northeastern Oregon showing where summer steelhead creel surveys were conducted in the Grande Ronde and Imnaha river basins during the 2017-18 run year.

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

In August 2019, the statistical creel program that expands sample data from the lower Grande Ronde fishery to estimate angler effort, catch, harvest, catch rate, and number of coded wire tag recoveries for the entire fishery, formerly conducted in SAS (programmed output using SAS software, SAS Institute 1988-2019), was re-written in R programming language (R Core Team, 2017). Similarly, in October 2020, the SAS software-based output for the Imnaha creel data was also re-written in R programming language. The statistical design and formulas used in the R programs for the lower Grande Ronde creel survey remain unchanged from previous years and analyses, and are described in Appendix D, including a review of the stratified random sampling design used for the survey. For the lower Grande Ronde River survey, we used the methodology described by Carmichael et al. (1988). Starting in 2013 and continuing through the present creel season, the survey on the lower Grande Ronde River has been conducted from 1 September to 31 March, rather than surveying through the 15 April fishery closure. Although the fishing season has now been extended to 30 April (beginning in 2016), we still do not creel in April because prior years of data show consistently low angler effort in April. 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 a description of each angler, 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, and any external tags. If a hatchery fish, as indicated by an adipose (Ad) clip, was coded-wire-tagged (CWT), as indicated by either a left or right ventral fin-clip (AdLV or AdRV) or by use of a wire detector (Northwest Marine Technology, handheld wand detector), 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 were conducted from 1 February through 30 April 2018. 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. The steelhead season was extended from April 15 to April 30 beginning in 2016 to increase angling opportunities. 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 2018. 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, 2018 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 24 February, we surveyed five days each week (Sunday – Saturday) from 0900-1800 hours. From 25 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 AdLV+CWT, AdRV+CWT, AdRV-only, and Ad+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 and it is believed 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 2016-2017. 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).

Figures 8, 9, 10, and 11, and Table 6 also include data from creel surveys conducted on the upper Grande Ronde River from 1989 to 2002 and Catherine Creek in 1992, 1993, and 1997 to 1999, and were originally reported on in Carmichael et al. (1989, 1990), and Flesher et al. (1991, 1992, 1993, 1994, 1995, 1996, 1997, 1999, 2000, 2001, 2004a, and 2004b).

ACCOMPLISHMENTS AND FINDINGS

On the lower Grande Ronde River from 1 September 2017 to 31 March 2018, we sampled 56.5% of the weekends and holidays (39 days) and 33.6% of the weekdays (48 days) for a total of 87 sample days. On the Wallowa River from 1 February to 15 April 2018, we sampled 73.9% of the weekends and holidays (17 days) and 33.3% of the weekdays (17 days) for a total of 34 sample days. During the same time period at Rondowa, we sampled 47.8% of the weekends and holidays (11 days) and 11.8% of the weekdays (6 days) for a total of 17 sample days. On the Imnaha River and Big Sheep Creek from 1 February to 30 April 2018, we sampled 55.6% of the weekends and holidays (15 days) and 29.0% of the weekdays (18 days) for a total of 33 sample days. Tables in Appendix A provide more details on sampling effort by fishing location.

We estimated a total of 1,684 angler days and 8,540 hours were spent on the lower Grande Ronde River during the 2017-18 season. Anglers caught and released 313 wild and 206 hatchery steelhead, and harvested 417 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% (September 2017) to 70% (November 2017 and January 2018, Figure 7, Appendix Table B). Eighty-six percent of harvested hatchery steelhead spent one year in freshwater and one year in saltwater (hereafter designated 1:1), and 14% spent one year in freshwater and two years in saltwater (designated 1:2), (Table 1). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 602 (± 6) mm for age 1:1, and 683 (± 15) mm for age 1:2. Sex ratio was 56% male and 44% female. Forty-six percent of the anglers on the lower Grande Ronde River were local Oregon residents, 32% were non-local Oregon residents, 7% were Washington State residents and 15% resided outside the states of Oregon and Washington (Table 2). On the lower Grande Ronde River, anglers harvested an estimated 64 Ad+CWT, AdLV+CWT, or AdRV+CWT marked steelhead from our hatchery releases (Table 3).

At Rondowa, the catch rate index averaged 12 hours per fish (Figure 4, Appendix Table A-2). The percent of steelhead caught that were hatchery origin ranged from 33% in March to 100% in February (Figure 7, Appendix Table B). Only two fish were sampled from the Rondowa reach. Age composition of harvested hatchery steelhead was 50% 1:1 and 50% 1:2 (Table 1). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 600 mm for age 1:1 and 770 mm for age 1:2. Sex ratio was 50% male and 50% female. Sixty-seven percent of the anglers at Rondowa were local Oregon residents, and 33% were non-local Oregon resident anglers (Table 2). At Rondowa, we estimated that anglers did not harvest any Ad+CWT, AdLV+CWT, or AdRV+CWT marked steelhead from our hatchery releases (Table 3).

On the Wallowa River, the catch rate index averaged 11 hours per fish (Figure 4, Appendix Table A-3). The percent of steelhead caught that were hatchery origin ranged from 76% in March to 85% in February (Figure 7, Appendix Table B). Age composition of harvested hatchery steelhead was 86% 1:1 and 14% 1:2 (Table 1). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 598 (± 5) mm for age 1:1 and 683 (± 21) mm for age 1:2. Sex ratio was 50% male and 50% female. Fifty-three percent of the anglers on the Wallowa River were local Oregon residents, 38% were non-local Oregon residents, 3% were Washington State residents and 6% resided outside the states of Oregon and Washington (Table 2). On the Wallowa River, we sampled 5 Ad+CWT, AdLV+CWT or AdRV+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 Imnaha River and Big Sheep Creek (no anglers were counted on Big Sheep Creek during the 2017-18 season), we estimated a total of 559 angler days and 2,158 hours were spent on the Imnaha River. Anglers caught and released 103 wild and 119 hatchery steelhead, and harvested 22 hatchery steelhead for an average catch rate index of 14 hours per fish (Figures 2-6, Appendix Tables A-4, A-5, and A-6). The percent of steelhead caught that were hatchery origin ranged from 56% (February 2018 in Section 2 - mouth to Fence Creek) to 67% (March 2018 in Section 2; Figure 7,

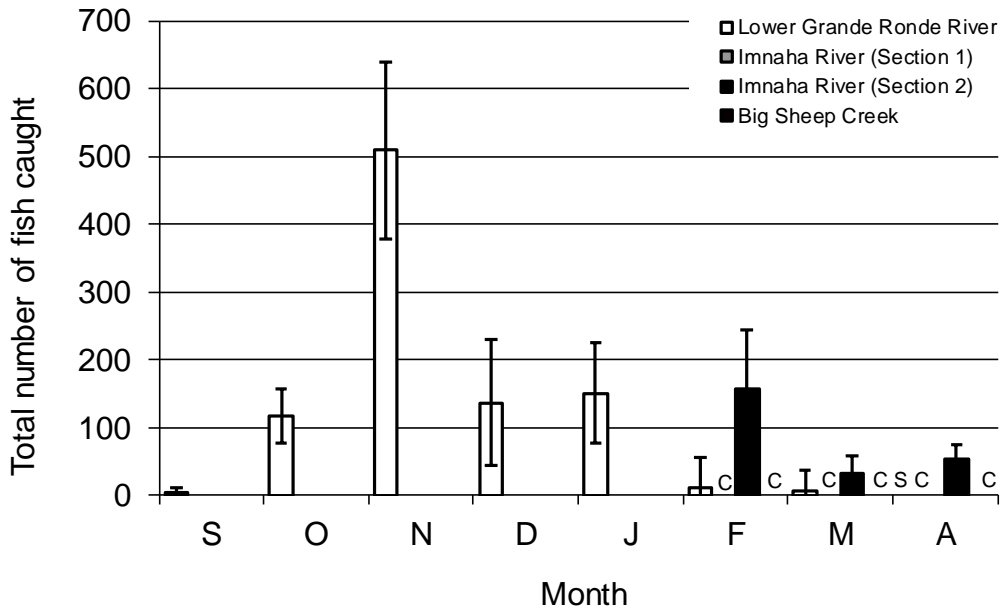


Figure 2. Estimated total catch of summer steelhead (vertical bars show 95% confidence intervals) on the lower Grande Ronde River, two sections of the Imnaha River, and Big Sheep Creek during the 2017-18 run year. "C" indicates no catch and "S" indicates no survey. Surveys were conducted from 1 September 2017 to 31 March 2018 on the lower Grande Ronde River, and from 1 February to 30 April 2018 on the Imnaha River and Big Sheep Creek.

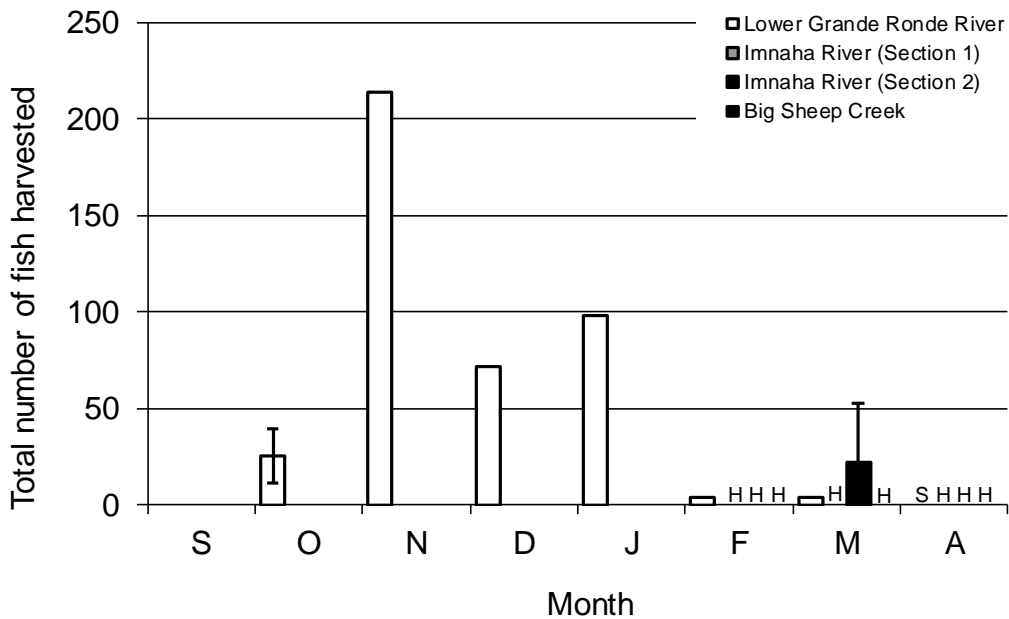


Figure 3. Estimated total harvest of summer steelhead (vertical bars show 95% confidence intervals) on the lower Grande Ronde River, two sections of the Imnaha River, and Big Sheep Creek during the 2017-18 run year. "H" indicates no harvest and "S" indicates no survey. Surveys were conducted from 1 September 2017 to 31 March 2018 on the lower Grande Ronde River, and from 1 February to 30 April 2018 on the Imnaha River and Big Sheep Creek.

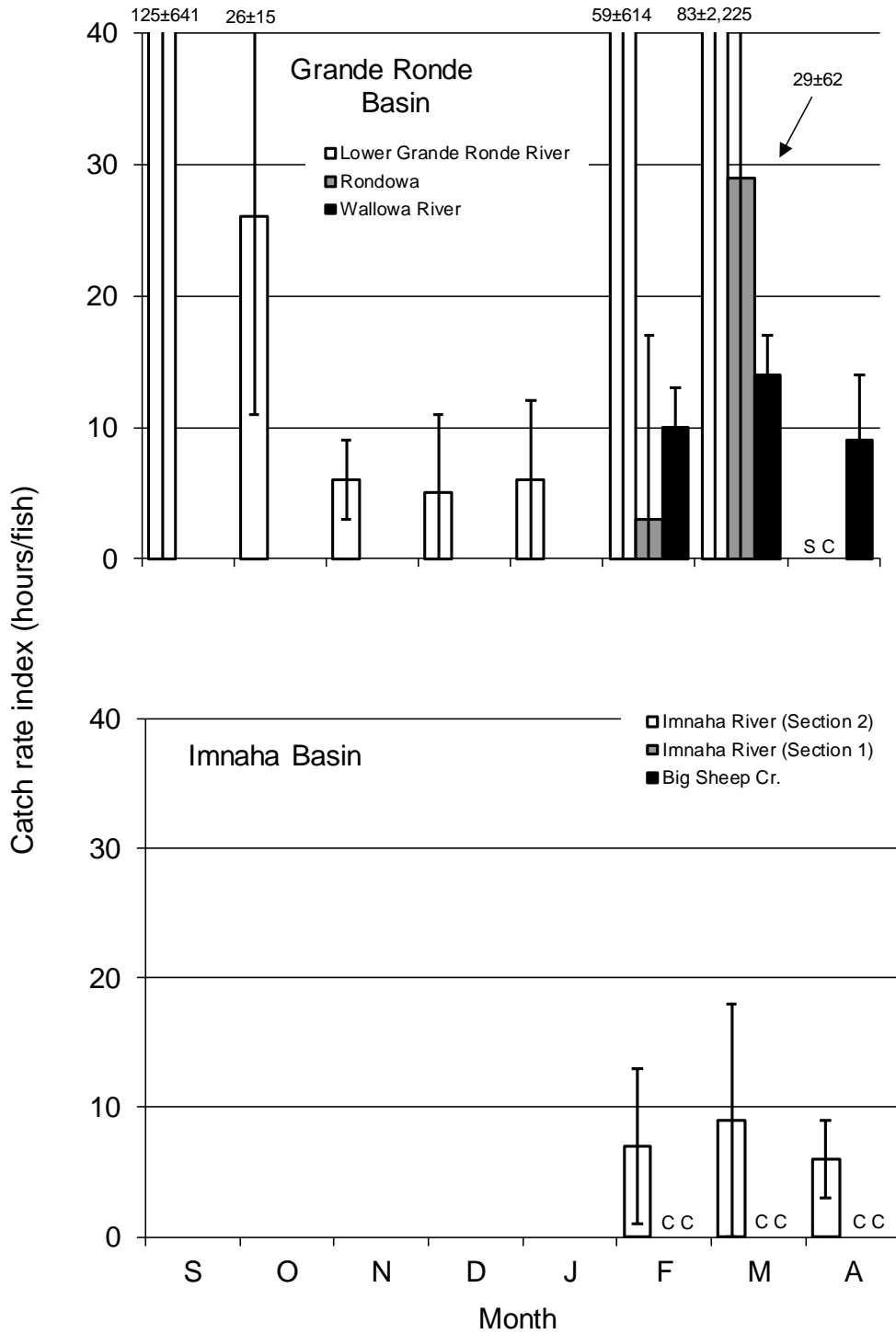


Figure 4. Estimated catch rate index (hours/fish) for summer steelhead (vertical bars show 95% confidence intervals) in the Grande Ronde and Imnaha river basins during the 2017-18 run year. "S" indicates no survey and "C" indicates no catch. Survey areas and times include the lower Grande Ronde River (1 September 2017 - 31 March 2018), and Rondowa, and Wallowa River (1 February - 15 April 2018), and two sections of the Imnaha River, and Big Sheep Creek (1 February - 30 April 2018). Note: A lower catch rate index implies better angling success.

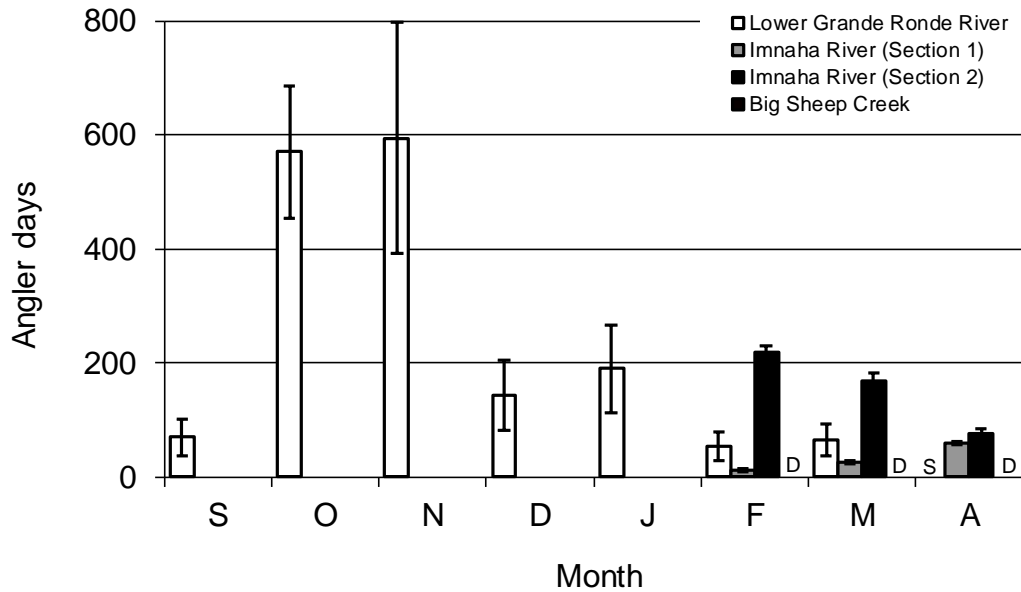


Figure 5. Estimated number of angler days for summer steelhead (vertical bars show 95% confidence intervals) on the lower Grande Ronde River, two sections of the Imnaha River, and Big Sheep Creek during the 2017-18 run year. "S" indicates no survey and "D" indicates no angler days. Surveys were conducted from 1 September 2017 to 31 March 2018 on the lower Grande Ronde River, and from 1 February to 30 April 2018 on the Imnaha River and Big Sheep Creek.

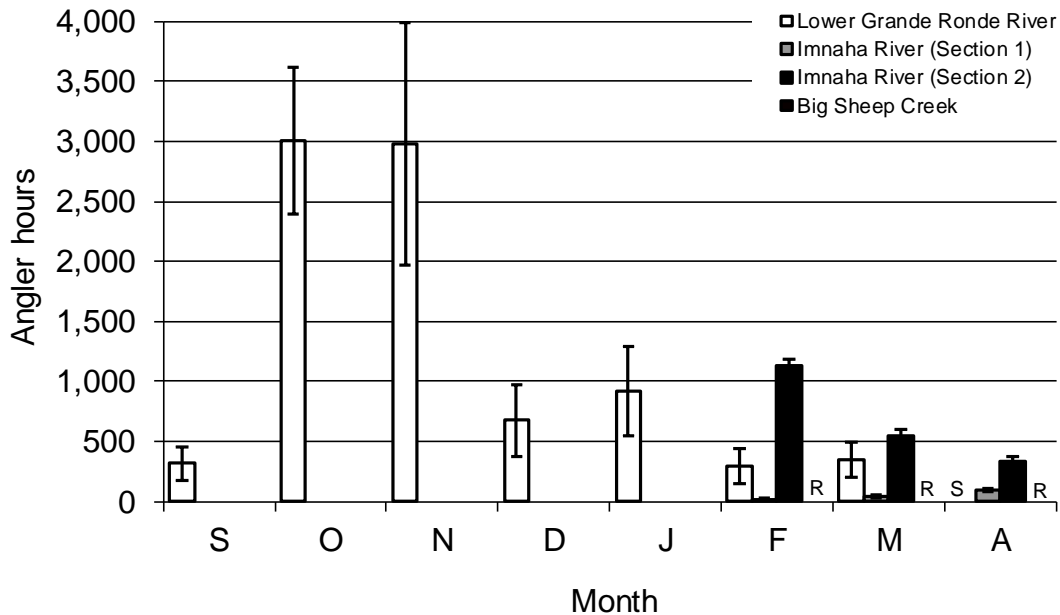


Figure 6. Estimated number of angler hours for summer steelhead (vertical bars show 95% confidence intervals) on the lower Grande Ronde River, two sections of the Imnaha River, and Big Sheep Creek during the 2017-18 run year. "S" indicates no survey and "R" indicates no angler hours. Surveys were conducted from 1 September 2017 to 31 March 2018 on the lower Grande Ronde River, and from 1 February to 30 April 2018 on the Imnaha River and Big Sheep Creek.

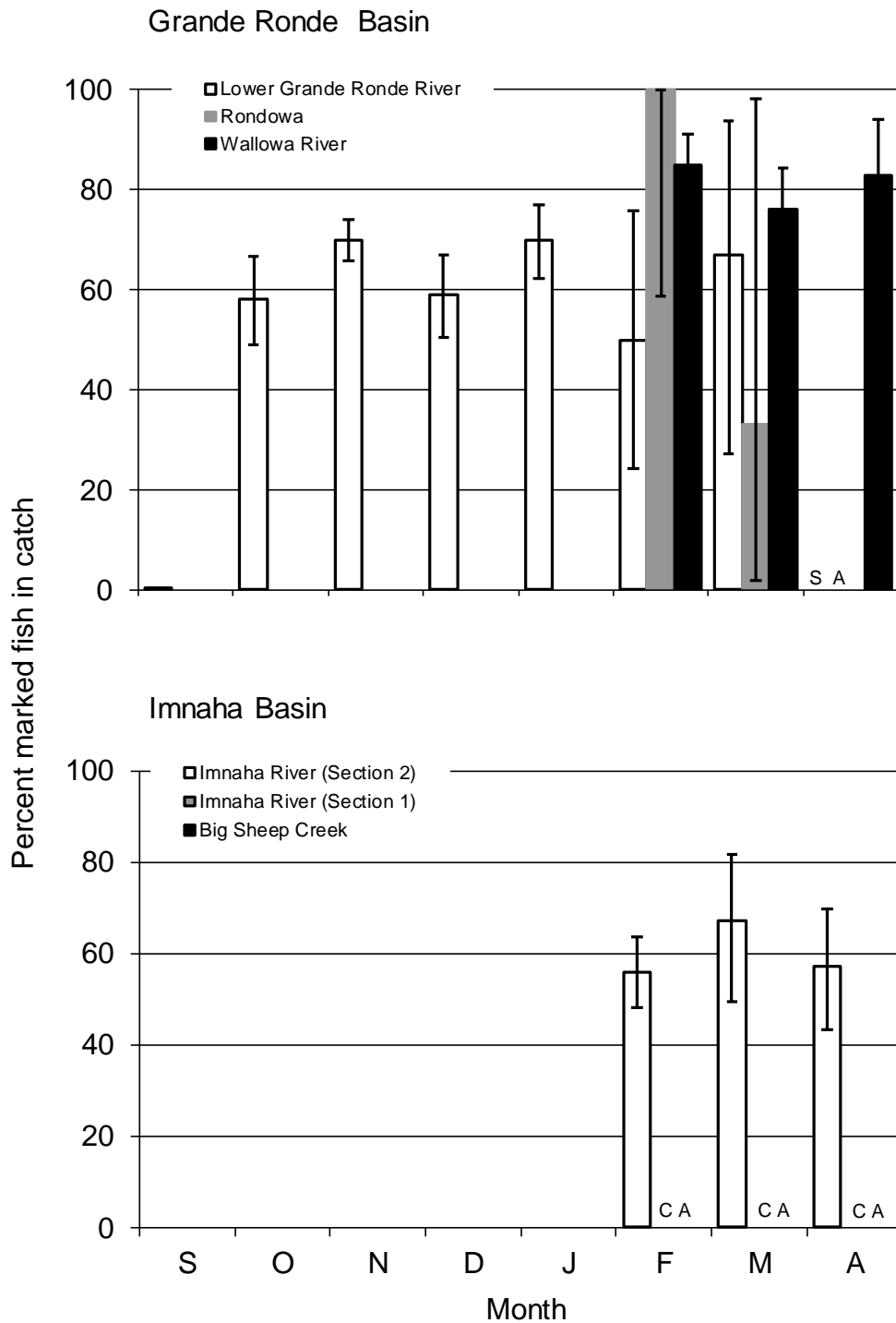


Figure 7. Estimated percent of summer steelhead caught (vertical bars show 95% confidence intervals; using a binomial distribution) in the Grande Ronde and Imnaha river basins during the 2017-18 run year that were marked. "S" indicates no survey, "C" indicates no catch, and "A" indicates no anglers. All unmarked fish were considered to be wild. Survey areas and times include the lower Grande Ronde River (1 September 2017 - 31 March 2018), and Rondowa, and Wallowa River (1 February - 15 April 2018), and two sections of the Imnaha River, and Big Sheep Creek (1 February - 30 April 2018).

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 2017-18 run year. Age composition and mean fork length by age are estimated from fork lengths of harvested fish and age-length keys developed from hatchery returns to Wallowa Hatchery in 2018 and Little Sheep Creek Facility (for the Imnaha River basin including the Imnaha River and Big Sheep Creek) in 2017 and 2018. 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	1:3	N	1:1	N	1:2	N	1:3
Lower GR R.										
Males	67	94	6	0	60	607 \pm 9	4	698 \pm 57	0	-
Females	52	75	25	0	37	592 \pm 7	12	678 \pm 16	0	-
Total	119	86	14	0	97	602 \pm 6	16	683 \pm 15	0	-
Rondowa.										
Males	1	100	0	0	1	600	0	-	0	-
Females	1	0	100	0	0	-	1	770	0	-
Total	2	50	50	0	1	600	1	770	0	-
Wallowa R.										
Males	55	93	7	0	50	604 \pm 8	4	693 \pm 76	0	-
Females	55	80	20	0	43	592 \pm 5	11	679 \pm 24	0	-
Total	110	86	14	0	93	598 \pm 5	15	683 \pm 21	0	-
Imnaha R. basin										
Males	1	100	0	0	0	-	0	-	0	-
Females	1	100	0	0	0	-	0	-	0	-
Total	2	100	0	0	0	-	0	-	0	-

Table 2. Residence of summer steelhead anglers interviewed during creel surveys in the Grande Ronde and Imnaha river basins during the 2017-18 run year. Local Oregon resident anglers were from Union and Wallowa counties. Big Sheep Creek was sampled but no anglers were counted during the 2017-18 season.

Creel survey area	Number of anglers	Percent			
		Local Oregon resident anglers	Non-local Oregon resident anglers	Washington resident anglers	Other out-of-state anglers
Lower GR River	547	46	32	7	15
Rondowa	21	67	33	0	0
Wallowa River	531	53	38	3	6
Imnaha River	87	79	9	1	11

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 2017-18 run year. Recoveries were expanded for the entire fishery.

Creel survey area	Tag code	Release site	Experimental group ^a	Brood Year	Number recovered	
					Observed	Expanded ^b
Lower Grande Ronde River	09 08 06	Spring Cr.	Fall Brood/April	2014	1	6
	09 09 64	Spring Cr.	Fall B/Vol/May	2015	1	6
	09 09 65	Spring Cr.	Fall Brood/April	2015	5	14
	09 09 66	Spring Cr.	Production/April	2015	1	2
	09 09 67	Spring Cr.	Production/April	2015	2	4
	09 09 68	Spring Cr.	Prod/Vol/May	2015	1	2
	09 09 69	Spring Cr.	Production/April	2015	2	8
	09 09 70	Cottonwood	Reciprocal/April	2015	1	3
	09 09 72	Deer Cr.	Fall Brood/April	2015	4	19
Wallowa River	09 08 14	Deer Cr.	Production/April	2014	1	ND
	09 09 66	Spring Cr.	Production/April	2015	2	ND
	09 09 67	Spring Cr.	Production/April	2015	1	ND
	09 09 68	Spring Cr.	Prod/Vol/May	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. 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.

Appendix Table B). Only two fish were recorded coming through the check station but were not sampled on the Imnaha River in spring of 2018. Age composition of harvested hatchery steelhead was 100% 1:1 (Table 1). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was unknown. Sex ratio was unknown but estimated to be 50% male and 50% female based on sex ratio of hatchery returns. Seventy-nine percent of the anglers on the Imnaha River were local Oregon residents, 9% were non-local Oregon residents, 1% were Washington State residents and 11% resided outside the states of Oregon and Washington (Table 2). On the Imnaha River, we estimated that anglers did not harvest any Ad+CWT or AdLV+CWT marked steelhead from our hatchery releases (Table 3).

Angler effort on the lower Grande Ronde was the lowest observed since the mid-1990's and about 60% of average since we began surveys over 30 years ago, while the Imnaha was higher than the previous two years but only 54% of average (Figure 8).

Harvest on the lower Grande Ronde was slightly higher than the previous year but only about half the average since we began surveys, while the Imnaha was the lowest observed since the mid-1990's and only 12% of the average harvest since surveys began in 1985 (Figure 9 and Table 4). Total catch (harvested and released) on the lower Grande Ronde was higher than the previous year but the second lowest observed since the late 1990's, and only 37% of the 10-year average. Similarly, total catch was higher than the previous two years but third lowest on the Imnaha River since the mid-1990's, and only 18% of the 10-year average. Catch and release of wild steelhead this year on the lower Grande Ronde was 33% of the total catch, which was the lowest

proportion observed in almost 10 years, whereas on the Imnaha wild fish was less than 50% 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 2016-17 run year on the Wallowa, as determined by angler harvest card data that is available after a one-year delay, were the lowest observed since surveys began in 1985, while at Rondowa, these same metrics were the lowest observed since the mid-1990's (Table 5).

Catch rates in 2017-18 were lower in all Grande Ronde basin steelhead fisheries except for the lower Grande Ronde which was higher when compared to the previous year, and were similar to the overall average since surveys began in 1985 in all fisheries except for the Imnaha fishery (Table 6). The percent of local resident anglers participating in summer steelhead fisheries was lowest on 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 2016-17 were 93 fish at Rondowa, 149 fish in the Wallowa River and 85 fish in the middle Grande Ronde River, for a total harvest estimate of 327 fish in the Grande Ronde basin, excluding the lower Grande Ronde River (Figure 9, Appendix Table C-1). We estimated 12 coded-wire-tagged fish were harvested at Rondowa and 23 coded-wire tagged fish were harvested in the Wallowa River in run year 2016-17. Total catch estimates for spring steelhead fisheries in run year 2016-17 were 280 fish at Rondowa, 334 fish in the Wallowa River, and 191 fish in the middle Grande Ronde River, for a total catch estimate of 805 fish in the Grande Ronde basin, excluding the lower Grande Ronde River (Appendix Table C-2). Angler effort for run year 2016-17 was estimated to be 977 hours at Rondowa, 3,156 hours in the Wallowa River, and 1,802 hours in the middle Grande Ronde River, for a total effort estimate of 5,935 hours in the Grande Ronde basin, excluding the lower Grande Ronde River (Appendix Table C-3).

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

The 2018 adult Wallowa stock steelhead returns to Wallowa Hatchery and Big Canyon Facility (2,610 adults, to be reported in the 2018 Annual Progress Report) was well below the 10-year average (from 2008-2017) of 4,407 adults. Our fisheries data indicate that with the below average run, angler participation on the lower Grande

Ronde River was the lowest observed since the mid-1990's. Both this year and last, total catch, harvest and catch rates were reflective of the low run and were similar to the late 1990s. For the second consecutive year, these low catch and catch rate estimates were due partly to the lowest catch of wild steelhead since the mid 1990's. Similarly, the Imnaha stock steelhead return to Little Sheep Creek Facility was 944 adults, below the 10-year average return of 1,335 adults, and with the exception of the previous two years, angler effort, catch and harvest were the lowest observed since the mid-to-late 1990s. Low adult returns coupled with high and muddy river conditions during the spring may best explain the poor fishing success on the lower Grande Ronde and Imnaha rivers.

Catch rates reflected the lower than average adult return and low angler effort in all fisheries surveyed, although catch rates were similar to the overall average of approximately 10 hours per fish, except for the Imnaha which was 14 hours per fish, which suggests that anglers still had some success during the season. Catch and release of wild steelhead are part of the catch rate formula and for this year on the Imnaha and this year and last on the lower Grande Ronde, the percent of wild steelhead in the total catch dropped below 50%, at 42% on the Imnaha, and 33% and 32% on the lower Grande Ronde for this year and last. These drops in the percent of wild fish in the catch contributed to the lower than usual overall catch rates 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 2017-18 fishing season was the third year in which regulation changes allowed anglers to target steelhead through the end of April, and the end dates of our 2017-18 creel survey remained unchanged from prior seasons for the lower Grande Ronde (31 March) and the Wallowa (15 April); however this was the first 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 six 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 Rondowa fisheries for the 2017-18 run year will be reported in the 2018-19 annual creel report.

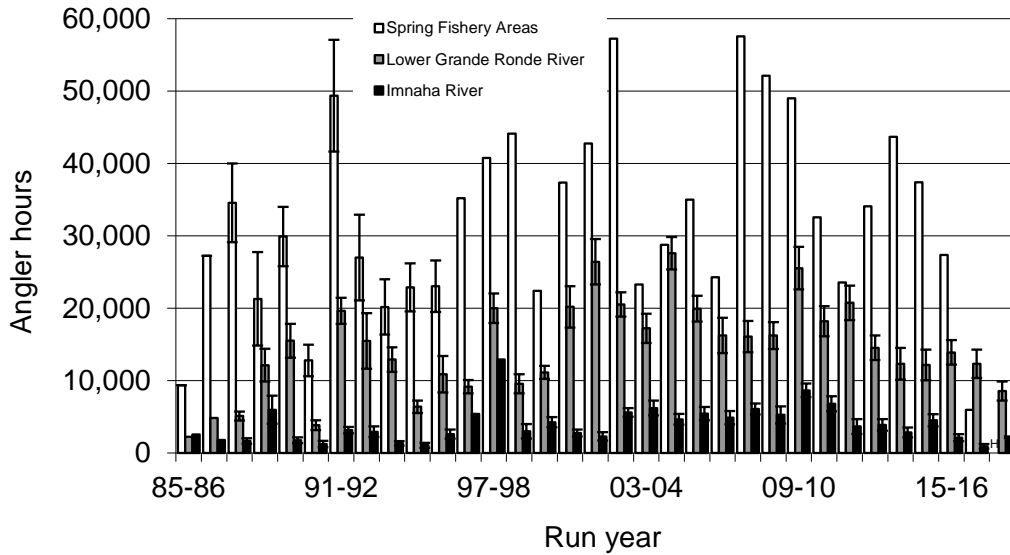


Figure 8. Angler effort (in hours) for summer steelhead in spring fishery areas (upper Grande Ronde and Wallowa rivers, Catherine Creek, and Rondowa), the lower Grande Ronde River, and the Imnaha River for the 1985-86 to 2017-18 run years. Not shown are 266, 61, 82, 57, 62, 97, 18, 0, and 0 angler hours on Big Sheep Creek (Imnaha basin) for the 09-10 through 17-18 run years, respectively. “H” 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.

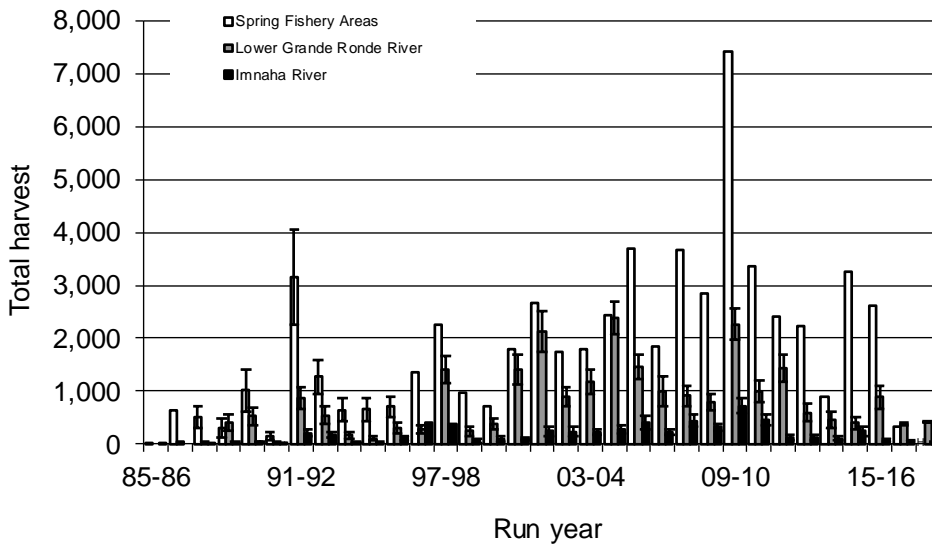


Figure 9. Number of hatchery summer steelhead harvested by recreational anglers in spring fishery areas (upper Grande Ronde and Wallowa rivers, Catherine Creek, and Rondowa), the lower Grande Ronde River, and the Imnaha River for the 1985-86 to 2017-18 run years. Not shown are 8, 0, 0, 0, 0, 6, 2, 0, and 0 hatchery fish harvested on Big Sheep Creek (Imnaha basin) for the 09-10 through 17-18 run years, respectively. “H” 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 2017-18 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
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 2016-17 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			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
Average	886	512	422	1,820	885	640	515	2,040

^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 2017-18 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	-
Average	10 \pm 2	20 \pm 5	21 \pm 24	10 \pm 5	11 \pm 3	9 \pm 2	8 \pm 11

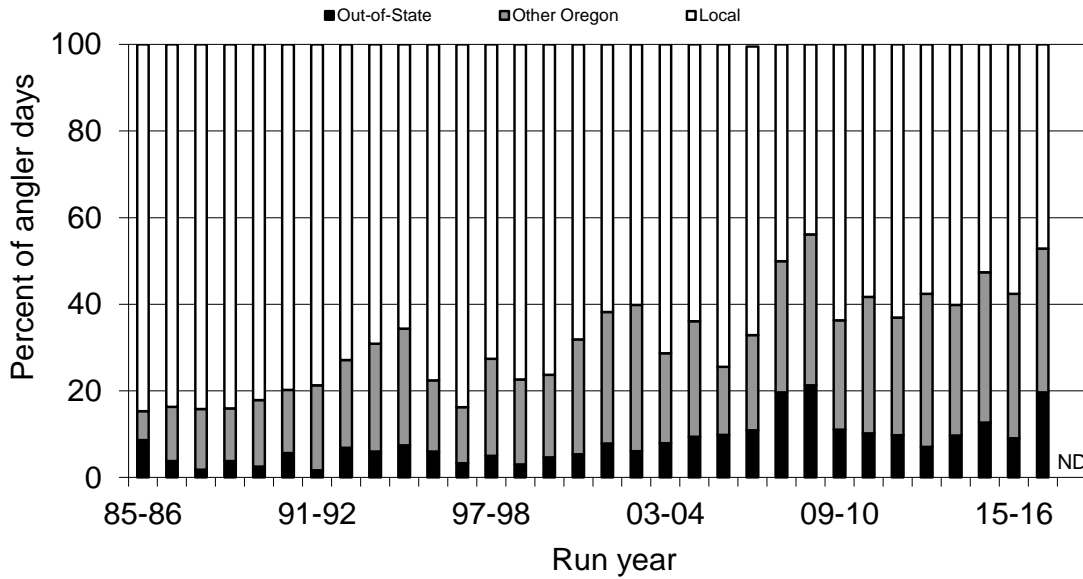


Figure 10. Percent of local resident angler days (Union or Wallowa county residents), non-local Oregon resident angler days, and out-of-state angler days for summer steelhead fisheries in the Grande Ronde and Imnaha river basins for the 1985-86 to 2016-17 run years. ND indicates not determined until statewide annual harvest card data become available.

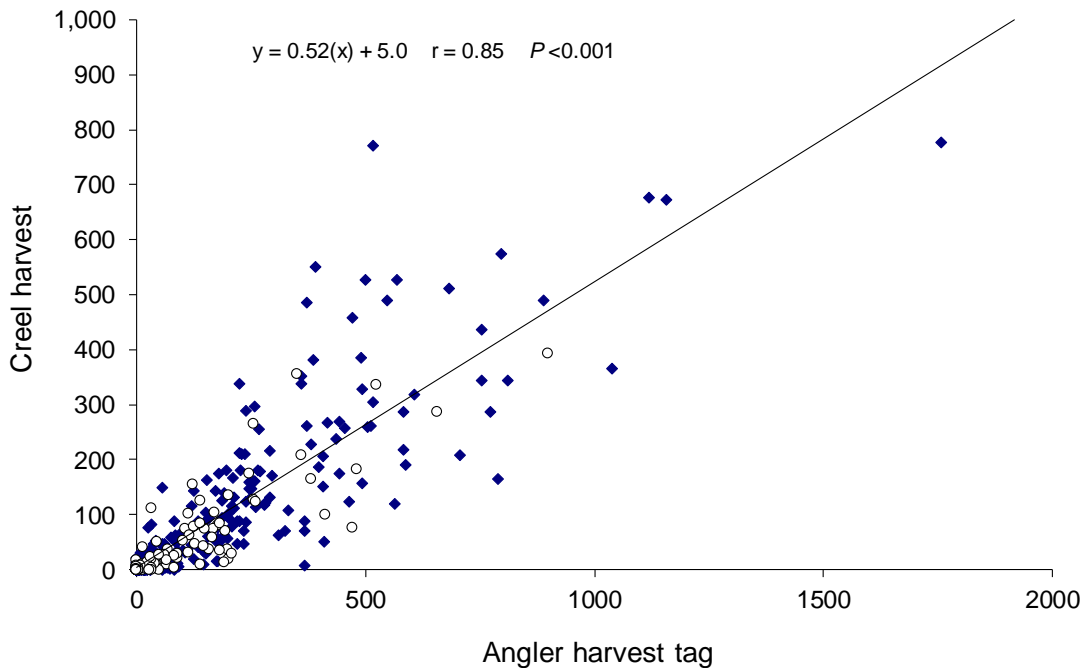


Figure 11. Relation between angler harvest card (punch card) and creel survey harvest for summer steelhead fisheries in the Grande Ronde (◆) and Imnaha (○) river basins for years when harvest estimates for specific reaches were available (1993-1996 for the upper Grande Ronde and Wallowa, 1994-1995 for Rondowa, 1992-1993 for Catherine Creek, 1993-spring 2017 for the lower Grande Ronde, and 1986-1996, 1999-2017 for the Imnaha fishery areas).

REFERENCES

- Carmichael, R.W. 1989. Lower Snake River Compensation Plan - Oregon Evaluation Studies, Five-Year Study Plan. Oregon Department of Fish and Wildlife, Fish Research Project, Portland.
- Carmichael, R.W., M.W. Flesher, and R.T. Messmer. 1989. Summer steelhead creel surveys in the Grande Ronde, Wallowa, and Imnaha Rivers for the 1988-89 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Carmichael, R.W., M.W. Flesher, and R.T. Messmer. 1990. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1989-90 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFF1-91-12, Annual Progress Report, Portland.
- Carmichael, R.W., R.T. Messmer, and B.A. Miller. 1987. Lower Snake River Compensation Plan - Oregon Evaluation Studies. Oregon Department of Fish and Wildlife, Fish Research Project FRI/LSR-88-16, Annual Progress Report, Portland.
- Carmichael, R.W., B.A. Miller, and R.T. Messmer. 1986. Lower Snake River Compensation Plan - Oregon Evaluation Studies. Oregon Department of Fish and Wildlife, Fish Research Project FRI/LSR-86-35, Annual Progress Report, Portland.
- Carmichael, R.W., B.A. Miller, and R.T. Messmer. 1988. Summer steelhead creel surveys in the Grande Ronde, Wallowa, and Imnaha Rivers for the 1987-88 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-LSR-89-02, Annual Progress Report, Portland.
- Carmichael, R.W., and E.J. Wagner. 1983. Evaluation of Lower Snake River Compensation Plan Facilities in Oregon. Oregon Department of Fish and Wildlife, Fish Research Project 14-16-0001-83269, Annual Progress Report, Portland.
- Clarke, L.R., M. W. Flesher, and R. W. Carmichael. 2014. Hatchery steelhead smolt release size effects on adult production and straying. *North American Journal of Aquaculture* 76:39-44.
- Flesher, M.W., R.W. Carmichael, and R.T. Messmer. 1991. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1990-91 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFF1-92-09, Annual Progress Report, Portland.
- Flesher, M.W., M.A. Buckman, R.W. Carmichael, R.T. Messmer, and T.A. Whitesel. 1992. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1991-92 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFF1-LSR-94-07, Annual Progress Report, Portland.

- Flesher, M.W., M.A. Buckman, R.W. Carmichael, R.T. Messmer, and T.A. Whitesel. 1993. Summer steelhead creel surveys on the Grande Ronde, Wallowa and Imnaha Rivers for the 1992-93 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFF1-LSR-94-14, Annual Progress Report, Portland.
- Flesher, M.W., M.A. Buckman, R.W. Carmichael, R.T. Messmer, and T.A. Whitesel. 1994. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1993-94 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and T.A. Whitesel. 1995. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1994-95 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and T.A. Whitesel. 1996. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1995-96 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and T.A. Whitesel. 1997. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1996-97 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and T.A. Whitesel. 1999. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1997-98 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, T.A. Whitesel, and J.R. Ruzycki. 2000. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1998-99 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and J.R. Ruzycki. 2001. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1999-2000 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and J.R. Ruzycki. 2004a. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 2000-01 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, La Grande.

- Flesher, M.W., R.W. Carmichael, and J.R. Ruzycki. 2004b. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 2001-02 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, La Grande.
- Flesher, M.W., R.W. Carmichael, and G.C. Grant. 2005. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2002-03 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, and G.C. Grant. 2007. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2003-04 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, G.C. Grant, and L.R. Clarke. 2008a. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2004-05 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., G.C. Grant, RW. Carmichael, and L.R. Clarke. 2008b. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2005-06 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, and L.R. Clarke. 2009. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2006-07 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, and L.R. Clarke. 2010. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2007-08 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, and L.R. Clarke. 2011. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2008-09 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, and L.R. Clarke. 2012. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2009-10 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.

- Flesher, M.W., S.M. Warren, R.W. Carmichael, and L.R. Clarke. 2013. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2010-11 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., S.M. Warren, R.W. Carmichael, and L.R. Clarke. 2014. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2011-12 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, and L.R. Clarke. 2015. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2012-13 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, and L.R. Clarke. 2016. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2013-14 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., R.W. Carmichael, and L.R. Clarke. 2017. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2014-15 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem.
- Flesher, M.W., and L.R. Clarke. 2018. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2015-16 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem
- Flesher, M.W., L.R. Clarke, and M. Jones. 2019. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2016-17 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Salem
- Oregon Department of Fish and Wildlife. District Annual Reports, La Grande and Wallowa Districts (1949-1974), Fish Division, Portland.
- R Core Team. 2017. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>.
- USACOE (U.S. Army Corps of Engineers). 1996. Annual Fish Passage Report. Portland and Walla Walla District, Portland.

APPENDIX A

Fishery Statistics for the 2017-18 run year

Appendix Table A-1. Fishery statistics for summer steelhead on the lower Grande Ronde River during the 2017-18 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 ^a	Total harvest ^b	Catch rate ^a		Angler days
	Days	Anglers				fish/h	h/fish	
September:								
Weekday	7	15	232 \pm 132	3 \pm 8	0	0.012 \pm 0.036	83 \pm 249	48 \pm 27
Weekend	6	11	85 \pm 50	0 \pm 2	0	0 \pm 0.019	-	21 \pm 12
Total	13	26	317 \pm 142	3 \pm 9	0	0.008 \pm 0.041	125 \pm 641	69 \pm 31
October:								
Weekday	8	109	2,094 \pm 552	85 \pm 37	12 \pm 14	0.040 \pm 0.018	25 \pm 11	407 \pm 101
Weekend	5	75	918 \pm 317	33 \pm 13	13	0.036 \pm 0.015	28 \pm 12	164 \pm 57
Total	13	184	3,012 \pm 611	118 \pm 40	25 \pm 14	0.039 \pm 0.023	26 \pm 15	571 \pm 116
November:								
Weekday	6	61	1,550 \pm 986	311 \pm 123	118	0.200 \pm 0.079	5 \pm 2	314 \pm 200
Weekend	6	113	1,430 \pm 244	198 \pm 47	96	0.138 \pm 0.032	7 \pm 2	280 \pm 48
Total	12	174	2,980 \pm 1,016	509 \pm 131	214	0.180 \pm 0.086	6 \pm 3	594 \pm 203
December:								
Weekday	7	28	382 \pm 223	85 \pm 88	52	0.222 \pm 0.229	5 \pm 5	89 \pm 52
Weekend	6	30	294 \pm 196	52 \pm 34	20	0.175 \pm 0.116	6 \pm 4	53 \pm 35
Total	13	58	676 \pm 297	137 \pm 94	72	0.205 \pm 0.257	5 \pm 6	142 \pm 62
January:								
Weekday	7	24	479 \pm 287	92 \pm 56	66	0.191 \pm 0.117	5 \pm 3	93 \pm 56
Weekend	6	48	438 \pm 240	59 \pm 49	32	0.134 \pm 0.112	7 \pm 6	97 \pm 53
Total	13	72	917 \pm 374	151 \pm 75	98	0.173 \pm 0.162	6 \pm 6	190 \pm 77
February:								
Weekday	6	2	59	0	0	-	-	12
Weekend	5	17	234 \pm 143	12 \pm 43	4	0.052 \pm 0.177	19 \pm 65	41 \pm 25
Total	11	19	293 \pm 143	12 \pm 43	4	0.017 \pm 0.177	59 \pm 614	53 \pm 26
March:								
Weekday	7	3	207	0	0	0 \pm 0.215	-	41
Weekend	5	11	138 \pm 148	6 \pm 32	4	0.044 \pm 0.245	23 \pm 128	24 \pm 26
Total	12	14	345 \pm 148	6 \pm 32	4	0.012 \pm 0.326	83 \pm 2255	65 \pm 28
Grand total	87	547	8,540 \pm 1,302	936 \pm 190	417 \pm 14	0.090 \pm 0.038	11 \pm 5	1,684 \pm 257

^a Confidence intervals shown with a total catch or catch rate of 0 are based on an extrapolation for within day variance on days where only one angler interview was obtained.

^b In some instances, no confidence interval is available because the combined variance of the proportion of hatchery fish kept, and total hatchery fish caught was undefined.

Appendix Table A-2. Catch rate ($\pm 95\%$ confidence intervals) for summer steelhead at Rondowa during the 2017-18 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	1	0	-	-
Weekend	4	3	0.324 \pm 1.456	3 \pm 14
Total	5	3	0.324 \pm 1.456	3 \pm 14
March:				
Weekday	4	4	0.120 \pm 0.382	8 \pm 27
Weekend	5	14	-	-
Total	9	18	0.034 \pm 0.072	29 \pm 62
April:				
Weekday	1	0	-	-
Weekend	2	0	-	-
Total	3	0	-	-
Grand total	17	21	0.085 \pm 0.118	12 \pm 16

Appendix Table A-3. Catch rate ($\pm 95\%$ confidence intervals) for summer steelhead on the Wallowa River during the 2017-18 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	6	65	0.140 \pm 0.062	7 \pm 3
Weekend	8	163	0.089 \pm 0.033	11 \pm 4
Total	14	228	0.102 \pm 0.029	10 \pm 3
March:				
Weekday	6	116	0.064 \pm 0.023	16 \pm 6
Weekend	6	135	0.080 \pm 0.027	13 \pm 4
Total	12	251	0.072 \pm 0.018	14 \pm 3
April:				
Weekday	5	36	0.103 \pm 0.075	10 \pm 7
Weekend	3	16	0.127 \pm 0.132	8 \pm 8
Total	8	52	0.111 \pm 0.064	9 \pm 5
Grand total	34	531	0.089 \pm 0.016	11 \pm 2

Appendix Table A-4. Fishery statistics for summer steelhead in Section 1 (Fence Creek to town of Imnaha) of the Imnaha River during the 2017-18 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	Total harvest	Catch rate		Angler days
	Days	Anglers				fish/h	h/fish	
February:								
Weekday	6	0	0	0	0	-	-	0
Weekend	5	2	18 \pm 2	0	0	-	-	12 \pm 1
Total	11	2	18 \pm 2	0	0	-	-	12 \pm 1
March:								
Weekday	6	1	28 \pm 2	0	0	-	-	19 \pm 1
Weekend	4	1	11 \pm 1	0	0	-	-	7 \pm 1
Total	10	2	39 \pm 2	0	0	-	-	26 \pm 1
April:								
Weekday	6	1	60 \pm 4	0	0	-	-	40 \pm 3
Weekend	6	2	30 \pm 3	0	0	-	-	20 \pm 2
Total	12	3	90 \pm 5	0	0	-	-	60 \pm 3
Grand total	33	7	147 \pm 6	0	0	-	-	98 \pm 4

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 2017-18 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	Total harvest	Catch rate		Angler Days
	Days	Anglers				fish/h	h/fish	
February:								
Weekday	6	15	760 \pm 49	143 \pm 84	0	0.188 \pm 0.111	5 \pm 3	143 \pm 9
Weekend	5	25	368 \pm 33	15 \pm 19	0	0.041 \pm 0.053	24 \pm 31	75 \pm 7
Total	11	40	1,128 \pm 60	158 \pm 87	0	0.141 \pm 0.123		218 \pm 12
March:								
Weekday	6	9	215 \pm 19	33 \pm 24	22 \pm 31	0.054 \pm 0.110	6 \pm 4	99 \pm 9
Weekend	4	24	333 \pm 44	0	0	-	-	69 \pm 9
Total	10	33	548 \pm 48	33 \pm 24	22 \pm 31	0.109 \pm 0.110	9 \pm 9	168 \pm 15
April:								
Weekday	6	1	103 \pm 7	20	0	0.193	5	25 \pm 2
Weekend	6	15	232 \pm 38	33 \pm 22	0	0.144 \pm 0.093	7 \pm 5	50 \pm 8
Total	12	16	335 \pm 39	53 \pm 22	0	0.177 \pm 0.093	6 \pm 3	75 \pm 9
Grand total	33	89	2,011 \pm 86	244 \pm 92	22 \pm 31	0.140 \pm 0.038	7 \pm 2	461 \pm 20
Sec.1 + 2	33	96	2,158 \pm 86	244 \pm 92	22 \pm 31	0.070 \pm 0.038	14 \pm 8	559 \pm 22

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 2017-18 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	Total harvest	Catch rate		Angler Days
	Days	Anglers				fish/h	h/fish	
February								
Weekday	6	0	0	0	0	-	-	0
Weekend	5	0	0	0	0	-	-	0
Total	11	0	0	0	0	-	-	0
March:								
Weekday	6	0	0	0	0	-	-	0
Weekend	4	0	0	0	0	-	-	0
Total	10	0	0	0	0	-	-	0
April:								
Weekday	6	0	0	0	0	-	-	0
Weekend	6	0	0	0	0	-	-	0
Total	12	0	0	0	0	-	-	0
Grand total	33	0	0	0	0	-	-	0

APPENDIX B

Percent of Summer Steelhead That Were Marked Hatchery Fish and Caught during the 2017-18 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 2017-18 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(3)	58(118)	70(509)	59(137)	70(151)	50(12)	67(6)	-
Rondowa	-	-	-	-	-	100(6)	33(3)	-(0)
Wallowa River	-	-	-	-	-	85(96)	76(79)	83(24)
Imnaha River (Section 1)	-	-	-	-	-	-(0)	-(0)	-(0)
Imnaha River (Section 2)	-	-	-	-	-	56(158)	67(33)	57(53)
Big Sheep Cr.	-	-	-	-	-	-(0)	-(0)	-(0)

APPENDIX C

Fishery Statistics for Spring Fisheries for the 2016-17 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 2016-17 run year. Total harvest = 0.520 (harvest card) + 4.369. 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 number of 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	28	49	0	0	14	54	0		
Sampled fish	0	0	0	0	0	0	8	0		
Total harvest	-	19	30	-	-	12	32	-	93	
Sample rate	-	-	-	-	-	-	4.0	-		
expansion										
09 08 11						0	1	0	1	4
09 08 13						0	1	0	1	4
09 27 45						0	1	0	1	4
Wallowa (235)										
Angler harvest cards	0	7	49	14	14	41	61	0		
Sampled fish	0	0	0	0	0	27	56	4		
Total harvest	-	8	30	12	12	27 ^a	56 ^a	4	149	
Sample rate	-	-	-	-	-	1.0	1.0	1.0		
expansion										
09 07 71						1	0	0	1	1
09 07 76						0	1	0	1	1
09 07 79						0	5	1	6	6
09 07 80						5	4	0	9	9
09 08 11						0	1	0	1	1
09 27 45						0	5	0	5	5
Wenaha (184)										
Angler harvest cards	0	0	0	0	0	0	0	0		
Total harvest	-	-	-	-	-	-	-	-	0	
Middle Grande Ronde (232)										
Angler harvest cards	0	7	139	0	0	0	0	0		
Total harvest	-	8	77	-	-	-	-	-	85	
Total Grande Ronde harvest (excluding lower Grande Ronde)									327	

^a Sampled fish was higher than total harvest, therefore sampled harvest = total harvest.

Appendix Table C-2. Estimated catch of summer steelhead in spring fisheries in the Grande Ronde basin for the 2016-17 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								
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
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	-	-	-	-	-	5	8	-	13
Sampled catch	-	-	-	-	-	10	28	-	38
Total harvest	-	19	30	-	-	12	32	-	93
Total catch	-	56	88	-	-	24	112	-	280
Wallowa									
Sampled harvest	-	-	-	-	-	27	56	4	87
Sampled catch	-	-	-	-	-	47	122	26	195
Total harvest	-	8	30	12	12	27	56	4	149
Total catch	-	18	67	27	27	47	122	26	334
Wenaha									
Sampled harvest	-	-	-	-	-	-	-	-	-
Sampled catch	-	-	-	-	-	-	-	-	-
Total harvest	-	-	-	-	-	-	-	-	0
Total catch	-	-	-	-	-	-	-	-	0
Middle Grande Ronde									
Sampled harvest	-	-	-	-	-	-	-	-	-
Sampled catch	-	-	-	-	-	-	-	-	-
Total harvest	-	8	77	-	-	-	-	-	85
Total catch	-	18	173	-	-	-	-	-	191
Total Grande Ronde catch (excluding lower Grande Ronde)									805

^a Wallowa data were used for the upper Grande Ronde, middle Grande Ronde, and Catherine Creek; lower Grande Ronde data, in Flesher et al. 2019, 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 2016-17 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								
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Upper Grande Ronde									
Catch rate	-	-	-	-	-	-	-	-	-
Total catch	-	-	-	-	-	-	-	-	0
Angler effort	-	-	-	-	-	-	-	-	0
Catherine Creek									
Catch rate	-	-	-	-	-	-	-	-	-
Total catch	-	-	-	-	-	-	-	-	0
Angler effort	-	-	-	-	-	-	-	-	0
Rondowa									
Catch rate	-	-	-	-	-	0.137	0.415	-	0.271
Total catch	-	56	88	-	-	24	112	-	280
Angler effort	-	207	325	-	-	175	270	-	977
Wallowa									
Catch rate	-	-	-	-	-	0.062	0.166	0.074	0.106
Total catch	-	18	67	27	27	47	122	26	334
Angler effort	-	170	632	255	255	758	735	351	3,156
Wenaha									
Catch rate	-	-	-	-	-	-	-	-	-
Total catch	-	-	-	-	-	-	-	-	0
Angler effort	-	-	-	-	-	-	-	-	0
Middle Grande Ronde									
Catch rate	-	-	-	-	-	-	-	-	-
Total catch	-	18	173	-	-	-	-	-	191
Angler effort	-	170	1,632	-	-	-	-	-	1,802
Total Grande Ronde angler effort (excluding lower Grande Ronde)									5,935

^a Wallowa data were used for the upper Grande Ronde, middle Grande Ronde, and Catherine Creek; lower Grande Ronde data, in Flesher et al. 2019, were used for the Wenaha.

APPENDIX D

A summary of the methodology including the statistical design and associated formulas used to estimate angler effort, total catch, harvest, and catch rate for the Grande Ronde summer steelhead fishery. Also includes a review of the stratified random sampling design used for the survey. These methods are essentially unchanged from those described in Carmichael et al. (1988) but some calculations have been clarified or explicitly described that were unclear in the original document (written by Michelle Jones, ODFW fisheries biometrician).

Analysis

The total recreational catch is estimated using catch-rates estimated from angler interview data and the total effort estimated from pressure count data. Sampling days were selected using a stratified random sampling design in which strata include day type (weekend/holiday or weekday) and river section (upper or lower). Indices for species, river section, and mark type have been left off equations for clarity.

Daily estimates

Angler interviews were used to estimate daily catch rates in each river section:

$$\hat{R}_d = \frac{\sum_{a=1}^{A_d} c_{d,a}}{\sum_{a=1}^{A_d} e_{d,a}}, \text{ where}$$

c_a is the total observed catch for angler a in interview data on the d^{th} day

$e_{d,a}$ is the total observed number of hours for angler a in interview data on the d^{th} day

A_d Total anglers sampled in interviews on day d

The within-day variance ($\sigma_{\hat{R}_d}^2$) was calculated using the squared deviance between each of the individual observed catch rates and the daily estimated average,

$$\sigma_{\hat{R}_d}^2 = \frac{\sum_{a=1}^{A_d} (c_a - \hat{R}_d)^2}{A_d - 1}.$$

In cases where a single angler was interviewed, the within-day variance cannot be calculated and the average within-day variance across all days of the specified river location was substituted in subsequent calculations.

Pressure count data was used to estimate daily total effort for each day ($\hat{e}_{d,AUC}$) by river section using an area-under-the-curve estimator, i.e.,

$$\hat{e}_{d,AUC} = 0.5[(t_1 - t_{start})p_1 + (t_2 - t_1)(p_1+p_2) + (t_3 - t_2)(p_3 + p_2) + (t_4 - t_3)(p_4+p_3) + (t_5 - t_4)(p_5+p_4) + (t_{end} - t_5)p_5], \text{ where}$$

t_{start} is the legal start of fishing day

t_{end} is the legal end of fishing day

$t_1, t_2, t_3 \dots$ is the time each pressure count occurred

$p_1, p_2, p_3 \dots$ is the observed number of anglers at each pressure count

Total effort was assumed to be 0 at the legal start and end of the fishing day.

In cases where pressure counts were missing at the beginning or end of a sample day the counts were extrapolated by creating a linear relationship between the start (or end) of the fishing day and the first (or last) observed pressure count (see figure).

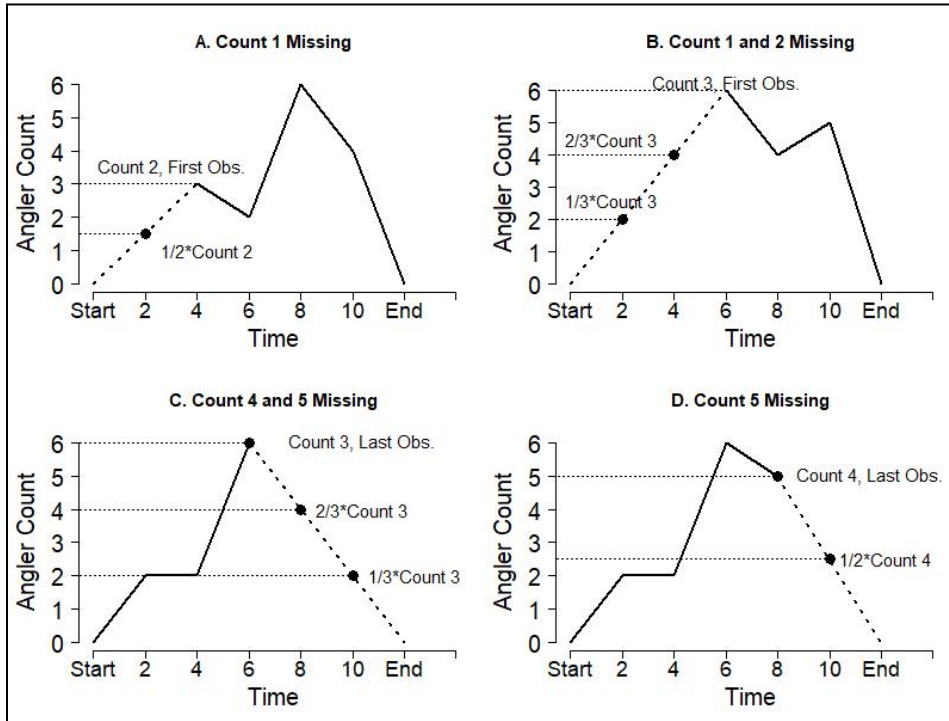


Figure: Example extrapolations used to account for missing pressure counts on days with missing data.

Effort estimates were compared to the total effort observed in the interview data and topped up in cases where the observations exceeded the estimate to match procedures in the historical time-series. Here, we note that the historical practice of topping-up estimates may create a positive bias leading to an overestimation of effort.

The product of the daily effort estimates and daily catch rates are used to estimate total daily catch, \hat{c}_d , in each river section.

$$\hat{c}_d = \hat{e}_{d,AUC} \hat{R}_d.$$

The within-day variance of fish caught among anglers ($\sigma_{c,a}^2$) is calculated directly from the deviance of observed fish caught by each angler (c_a) and the mean observed fish caught per angler (\bar{c}_d):

$$\sigma_{c,a}^2 = \frac{\sum_a^{A_d} (c_a - \bar{c}_d)^2}{A_d - 1}, \text{ where}$$

\bar{c}_d is the mean catch among anglers on day d

Strata-level estimates

Daily estimates of catch on sampling days were summed and expanded across all days in each strata. The ratio of the total effort across all sampling days and the total effort on days with at least one angler interviewed was used to adjust for sampling days with effort counts but no interviews.

$$\hat{C}_s = \frac{D_s}{d_s} * \frac{\sum \hat{e}_{d,AUC}}{\sum \hat{e}_{d|int}} \sum_1^{d_s} \hat{e}_{d,AUC} \hat{R}_d, \text{ where}$$

$\hat{e}_{d|int}$ is the effort estimate given at least one angler was interviewed,

d_s is the total number of days sampled in strata s , and

D_s is the total number of days in strata s .

The strata-level variance $VAR(\hat{C}_s)$ is calculated as:

$$V(C_s) = D_s^2 \left(1 - \frac{d_s}{D_s}\right) \left(\frac{\sum^{D_s} \hat{e}_{d,AUC}}{\sum^{D_s} \hat{e}_{d|int}}\right)^2 \frac{\sigma_{c,d}^2}{d_s} + 2 \frac{D_s}{d_s} \sum^{D_s} \hat{e}_{AUC}^2 \left(1 - \frac{\hat{e}_{d|int}}{\hat{e}_{d,AUC}}\right) \frac{\sigma_{r,d}^2}{A_d}, \text{ where}$$

$$\sigma_{c,d}^2 = \frac{\sum_a^{A_d} \left((\sum_a^{A_d} c_a) - \bar{c} \right)^2}{d_s - 1},$$

\bar{c} is the average number fish caught per day in strata s .

Strata-level effort, \hat{E}_s , was also calculated as a summation of daily estimates expanded over all days in the strata, i.e.,

$$\hat{E}_s = \frac{D_s}{d_s} \sum_1^{d_s} \hat{e}_{d,AUC}.$$

The strata-level variance ($V(\hat{E}_s)$) was scaled up from the within-strata variance across days ($\sigma_{e_d}^2$),

$$V(\hat{E}_s) = D_s^2 \left(1 - \frac{D_s}{d_s}\right) \frac{\sigma_{e_d}^2}{d_s}, \text{ where}$$

$$\sigma_{e_d}^2 = \left(\frac{1}{d_s - 1}\right) \sum_1^{d_s} (\hat{E}_s - \hat{e}_{d,AUC})^2.$$

Catch-rate at the strata-level is estimated from the estimated total catch and estimated total effort, i.e.,

$$\hat{R}_S = \frac{\hat{c}_S}{\hat{E}_S}$$

With variance

$$V(\hat{R}_S) = \frac{1}{\hat{e}_{d,AUC}^2} \left(1 - \frac{d_s}{D_s}\right) \frac{\sigma_{c,d}^2}{d_s} + \frac{\sum e_{d,auc}^2 \frac{\hat{e}_{d,AUC}^{-e_{d,s}} \sigma_{r,d}^2 / A_d}{\hat{e}_{d,AUC}}}{d_s \hat{e}_{d,AUC}^2 D_s}$$

Estimated Catch by mark-type & end fate

In addition to the total catch, the catch is also estimated by mark type (marked or unmarked) and end fates (kept or released). Estimates by marking type and end-fate are generated using the proportions observed in the catch to create a weighted mean scaled by daily effort.

Fish documented in the interview data are categorized by whether they were kept or released by marking groups and a series of catch proportions observed for each day are calculated.

$$p_{k,d} = \frac{\sum_{a=1}^{A_d} k_{d,a}}{\sum_{a=1}^{A_d} c_{d,a}}$$

$p_{k,d}$: Proportion of catch kept by anglers on day d

$k_{d,a}$ is the total number of fish kept by angler a on day d

$c_{d,a}$ Total catch for angler a in interview data on day d

$$p_{ur,d} = \frac{\sum_{a=1}^{A_d} ur_a}{\sum_{a=1}^{A_d} c_a}$$

$p_{ur,d}$ Proportion of the total catch that was unmarked fish subsequently released on day d

$$p_{umr,d} = \frac{\sum_{a=1}^{A_d} mr_a}{\sum_{a=1}^{A_d} c_a}$$

$p_{umr,d}$ Proportion of the total catch that was marked fish subsequently released on day d

The variance for each proportion is calculated from the binomial distribution.

$$Var(p_{k,d}) = \frac{p_{k,d}(1-p_{k,d})}{\sum_{a=1}^{A_d} c_a}$$

$$Var(p_{ur,d}) = \frac{p_{ur,d}(1-p_{ur,d})}{\sum_{a=1}^{A_d} c_a}$$

$$Var(p_{mr,d}) = \frac{p_{mr,d}(1-p_{mr,d})}{\sum_{a=1}^{A_d} c_a}$$

Strata-wide proportions were estimated as the mean daily observed proportion weighted by the proportion of the total strata effort in each day.

$$\hat{P}_{k,S} = \frac{\sum_{d=1}^{d=D_s} p_{k,d} \hat{e}_{d,AUC}}{\sum \hat{e}_{d,AUC}},$$

$$\hat{P}_{ur,S} = \frac{\sum_{d=1}^{d=D_s} p_{ur,d} \hat{e}_{d,AUC}}{\sum \hat{e}_{d,AUC}},$$

$$\hat{P}_{mr,S} = \frac{\sum_{d=1}^{d=D_s} p_{mr,d} \hat{e}_{d,AUC}}{\sum \hat{e}_{d,AUC}}$$

The variance for each strata-wide proportion is scaled from the within and among day variance.

$$Var(\hat{P}_{k,S}) = \frac{D_s - d_s}{D_s} * \frac{1}{d_s * \bar{e}_d^2} * \left(\sum \hat{e}_{d,AUC} p_{k,d} \right)^2 - 2p_S \sum e_{e,AUC}^2 p_{k,d} + \frac{P_{k,S}^2 \sum \hat{e}_{d,AUC}^2}{d_s - 1} \right) + \frac{1}{d_s * D_s * \bar{e}_d^2} \sum^{D_s} \sigma_{p,k,d}^2$$

Strata-wide proportions are then used to allocate total catch across mark types, i.e.

$$\hat{C}_{K,S} = \hat{P}_{k,S} \hat{C}_S,$$

$$\hat{C}_{ur,S} = \hat{P}_{ur,S} \hat{C}_S,$$

$$\hat{C}_{mr,S} = \hat{P}_{mr,S} \hat{C}_S, \text{ where}$$

$\hat{C}_{K,S}$ is the total fish kept in strata s

$\hat{C}_{ur,S}$ is the total fish unmarked and released in strata s

$\hat{C}_{mr,S}$ is the total fish marked and released in strata s

The variance for the total catch for each category of fish (unmarked released, kept, marked released) is calculated from the standard variance equation for the product of two random variables:

$$V(\hat{C}_{k,S}) = \hat{P}_{k,S}^2 VAR(\hat{C}_S) + \hat{C}_S^2 Var(\hat{P}_{k,S}) - Var(\hat{P}_{k,S})VAR(\hat{C}_S)$$

$$V(\hat{C}_{mr,S}) = \hat{P}_{mr,S}^2 VAR(\hat{C}_S) + \hat{C}_S^2 Var(\hat{P}_{mr,S}) - Var(\hat{P}_{mr,S})VAR(\hat{C}_S)$$

$$V(\hat{C}_{ur,S}) = \hat{P}_{ur,S}^2 VAR(\hat{C}_S) + \hat{C}_S^2 Var(\hat{P}_{ur,S}) - Var(\hat{P}_{ur,S})VAR(\hat{C}_S)$$

In some cases the product of the variances was greater than the first two factors causing the standard error to be undefined. In these cases no confidence intervals are provided.

Estimators for a Stratified Random Sample

The east region creels uses a series of stratified random sampling designs to get estimates by month, gear-type, marking groups, and across weekend/weekdays. The estimators for stratified random sampling are listed below and should be referenced in conjunction with each of the programs that produces final outputs using east region creel data.

Table 1: Stratified mean estimator with variance

<p>Strata Mean: $\hat{u}_h = \sum_{j=1}^{n_h} \frac{x_{h,j}}{n_h}$, where $x_{h,j}$ is the jth observation in strata h</p> <p>n_h is the total number of individuals sampled in strata h</p>	<p>Strata Variance: $V(\hat{u}_h) = \frac{(N_h - n_h)}{N_h} * \frac{\sigma_h^2}{n_h}$, where N_h is the total strata size</p> <p>n_h is the total number of individuals sampled in strata h</p> <p>σ_h^2 is the within-strata variance</p>
<p>Note: $\frac{(N_h - n_h)}{N_h}$ is the complement of the sampling fraction, $\frac{n_h}{N_h}$, or the total proportion of individuals in the strata surveyed</p>	
<p>Overall Mean: $\hat{u}_{Total} = \sum_{h=1}^L W_h \hat{u}_h$, where</p> <p>$L$ is the total number of strata</p> <p>W_h is the proportion of the population that falls in strata L, i.e. $\frac{N_h}{N}$</p>	<p>Total Variance $V(\hat{u}_{Total}) = \sum_{h=1}^L W_h^2 V(\hat{u}_h)$ $= \sum_{h=1}^L W_h^2 \frac{(N_h - n_h)}{N_h} * \frac{\sigma_h^2}{n_h}$, where</p> <p>$L$ is the total number of strata</p> <p>W_h is the proportion of the population that falls in strata L, i.e. $\frac{N_h}{N}$</p> <p>N_h is the total strata size</p> <p>n_h is the total number of individuals sampled in strata h</p> <p>σ_h^2 is the within-strata variance</p>
<p>Note: $\frac{(N_h - n_h)}{N_h}$ is the complement of the sampling fraction, $\frac{n_h}{N_h}$, or the total proportion of individuals in the strata surveyed</p>	

Table 2: Stratified Total estimator with variance

Overall Total:

$$\hat{T} = \sum_{h=1}^L N_h \hat{u}_h, \text{ where}$$

L is the total number of strata
 N_h is the total strata size
 \hat{u}_h is the estimated strata mean

Variance Population Total

$$\begin{aligned} V(\hat{u}_{Total}) &= \sum_{h=1}^L V(\hat{T}_h) \\ &= \sum_{h=1}^L N_h^2 V(\hat{u}_h) \\ &= \sum_{h=1}^L N_h^2 \frac{(N_h - n_h)}{N_h} * \frac{\sigma_h^2}{n_h}, \text{ where} \end{aligned}$$

L is the total number of strata
 N_h is the total strata size
 n_h is the total number of individuals sampled in strata h
 σ_h^2 is the within-strata variance
 \hat{T}_h is the estimated strata total

Note: $\frac{(N_h - n_h)}{N_h}$ is the complement of the sampling fraction, $\frac{n_h}{N_h}$, or the total proportion of individuals in the strata surveyed