PROGRESS REPORTS

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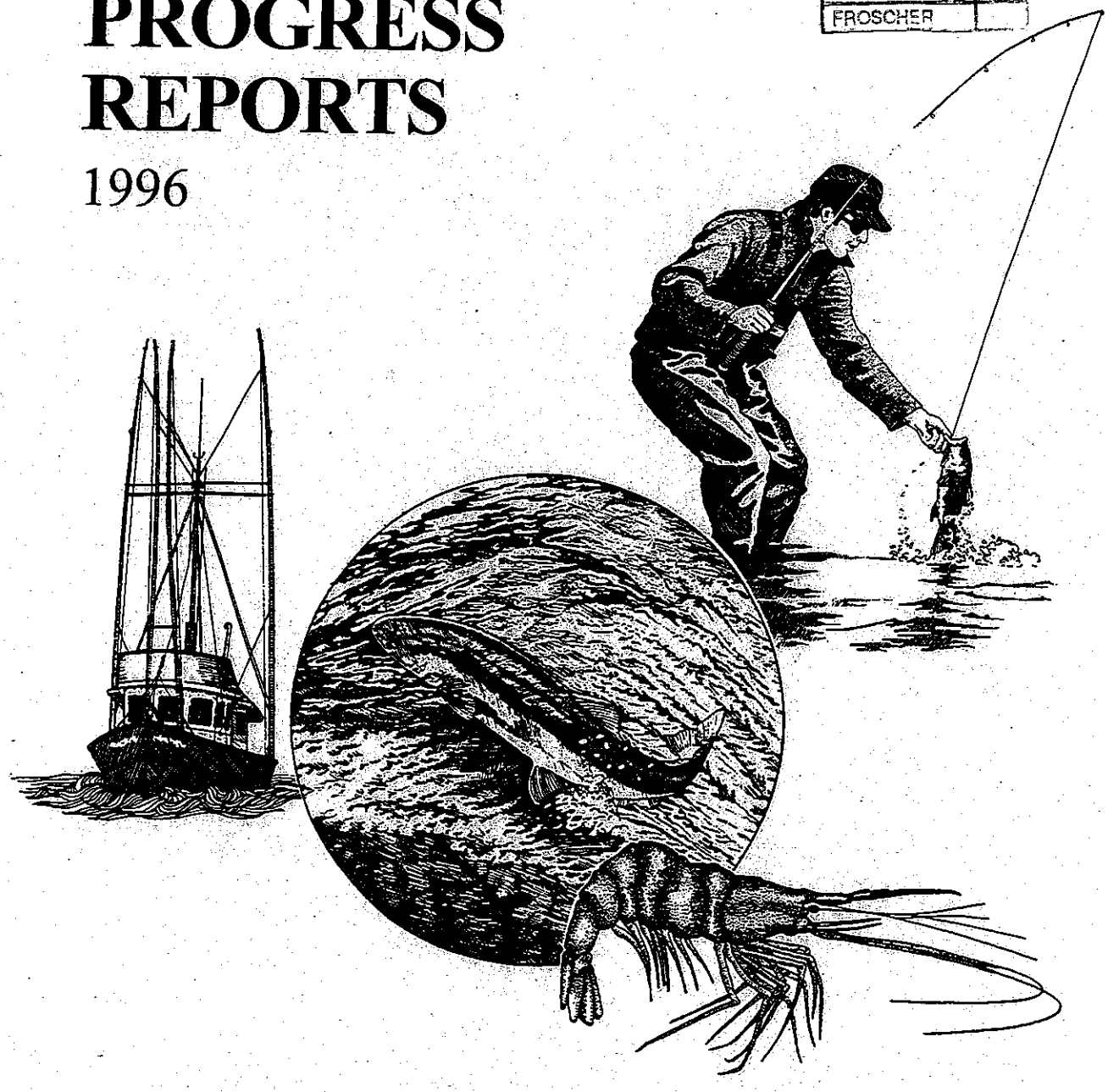

FISH DIVISION

Oregon Department of Fish and Wildlife

Summer Steelhead Creel Surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1995-96 Run Year

ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Summer Steelhead Creel Surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1995-96 Run Year

CONTRACT NUMBER: 14-48-0001-95560

PROJECT PERIOD: 1 April 1995 to 31 March 1996

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PREFACE

This report is for the funding period 1 April 1995 to 31 March 1996. The sampling period was from 1 September 1995 to 15 April 1996. 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 adults harvested during the 1995-96 run year are primarily from the 1992 and 1993 brood years. Results of creel surveys conducted prior to fall 1995 are reported in previous Lower Snake River Compensation Plan evaluation annual reports (Carmichael et al. 1986, 1988, 1989a, 1989b and 1991; Flesher et al. 1992, 1994a, 1994b, 1995 and 1996). The steelhead angling season surveyed in this report, during which only adipose-clipped fish could be kept, was open from 1 September 1995 to 15 April 1996 in the Grande Ronde and Imnaha basins.

ACKNOWLEDGMENTS

We would like to thank Dan Herrig for his review of the report, Mary Buckman for the statistical design and analysis of the data, Chris Vandenberg, Dagny Stine, Wes Stonecypher, Charlie Snow, and Tim Burns for their dedication in conducting the surveys. Also, from the Washington Department of Fish and Wildlife, we would like to thank Art Viola for coordinating and John Johnston for conducting the lower Grande Ronde survey during the spring. This project was financed by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan, Contract Number 14-48-0001-95560 as a cooperative agreement with the Oregon Department of Fish and Wildlife.

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2. Estimate total catch, catch rate, and number of fish harvested in summer steelhead fisheries in the Grande Ronde and Imnaha basins.

3. Estimate, by month, the percent of hatchery summer steelhead in the total catch.

4. Determine the length frequency, sex, and age-composition of fish that were caught.

5. Estimate, by tag code, the number of adipose-left ventral clipped plus coded-wire-tagged (AdLV+CWT) marked summer steelhead harvested.

6. Determine residence of anglers in summer steelhead fisheries in the Grande Ronde and Imnaha basins.

7. Examine the accuracy of the Imnaha River check station survey.

8. Examine alternative methods to estimate fishery statistics for spring fisheries with reduced field sampling effort in the upper Grande Ronde, Wallowa, and Imnaha rivers.

Accomplishments and Findings

On the lower Grande Ronde River, we estimated that 2,103 anglers fished for 10,856 hours from 1 September 1995 through 31 January 1996 and 16 February 1996 through 15 April 1996. They caught and released an estimated 387 wild and 263 hatchery steelhead and kept an estimated 300 hatchery steelhead. The catch rate index averaged 11 hours per fish. The percent of steelhead caught that were hatchery fish ranged from 15% in September 1995 to 78% in January 1996. Mean fork length (±95% confidence interval) of harvested hatchery steelhead was 598 mm (±10) for 1-ocean fish and 694 mm (±15) for 2-ocean fish. Age composition of harvested hatchery steelhead was 63% 1-ocean fish and 37% 2-ocean fish; the sex composition was 38% male and 62% female. Seventy-one percent of the anglers were from Union or Wallowa counties, 15% were from other Oregon counties, 7% were Washington residents, and 7% resided outside the states of Oregon and Washington.

On the upper Grande Ronde River, we estimated that 1,666 anglers fished for 4,578 hours from 16 February through 15 April 1996. They caught and released an estimated 77 wild and 17 hatchery steelhead and kept an estimated 210 hatchery steelhead. The catch rate index averaged 15 hours per fish. The percent of steelhead caught that were hatchery fish ranged from 70% in March to 100% in April. Mean fork length (±95% confidence interval) of

harvested hatchery steelhead was 595 mm (±10) for 1-ocean fish and 698 mm (±30) for 2-ocean fish. Age composition of harvested hatchery steelhead was 65% 1-ocean fish and 35% 2-ocean fish; the sex composition was 40% male and 60% female. Ninety-four percent of the anglers were from Union or Wallowa counties, 5% were from other Oregon counties, 0% were Washington residents, and 1% resided outside the states of Oregon and Washington.

On the Wallowa River, we estimated that 2,951 anglers fished for 18,444 hours from 1 February through 15 April 1996. They caught and released an estimated 167 wild and 214 hatchery steelhead and kept an estimated 495 hatchery steelhead. The catch rate index averaged 21 hours per fish. The percent of steelhead caught that were hatchery fish ranged from 78% in March to 88% in February. Mean fork length (±95% confidence interval) of harvested hatchery steelhead was 617 mm (±7) for 1-ocean fish and 699 mm (±15) for 2-ocean fish. Age composition of harvested hatchery steelhead was 58% 1-ocean fish and 42% 2-ocean fish; the sex composition was 44% male and 56% female. Seventy-four percent of the anglers were from Union or Wallowa counties, 23% were from other Oregon counties, 1% were Washington residents, and 2% resided outside the states of Oregon and Washington.

On the Imnaha River, we estimated that 588 anglers fished for 2,599 hours from 1 September through 15 November 1995 and 1 March through 15 April 1996. They caught and released an estimated 210 wild and 67 hatchery steelhead and kept an estimated 112 hatchery steelhead. The catch rate index averaged 7 hours per fish. The percent of steelhead caught that were hatchery fish ranged from 40% in October 1995 to 67% in September and November 1995. Mean fork length (±95% confidence interval) of harvested hatchery steelhead was 589 mm (±11) for 1-ocean fish and 699 mm (±19) for 2-ocean fish. Age composition of harvested hatchery steelhead was 42% 1-ocean fish and 58% 2-ocean fish; the sex composition was 28% male and 72% female. Seventy-three percent of the anglers were from Union or Wallowa counties, 20% were from other Oregon counties, 3% were Washington residents, and 4% resided outside the states of Oregon and Washington.

The recreational summer steelhead fishery during the 1995-96 run year exceeded the estimated historic fishery levels of angler effort, harvest, and catch rate for combined fisheries in the Grande Ronde and Imnaha basins (Flesher et al. 1995).

During the fall fishery on the Imnaha River, we found that only 61% of the anglers stopped at the check station. A high proportion of the anglers (73%) were of local origin. This data suggests that many Imnaha resident anglers are underrepresented in the angler survey.

In anticipation of reduced funding for this project, we examined alternative methods to estimate fishery statistics (*See* Objectives 1-6) for spring fisheries with a one-third reduction in field sampling effort in the Grande Ronde and Imnaha basins. We found good correlations between original creel survey estimates of harvest, catch, and angler effort with punch card harvest, total harvest divided by the percent harvested in the sampled catch (total catch), and catch rate multiplied by total catch (angler effort), respectively, for combined fisheries in the Grande Ronde and Imnaha basins. We found that catch rate is independent of angler effort within weekly intervals during a fishery but can be related significantly over the entire fishery

period. We found that the estimated monthly harvest of AdLV+CWT marked fish is significantly different and highly variable between creel survey and punch card estimates.

Management Implications and Recommendations

1. The 1995-96 summer steelhead fishery in the Grande Ronde and Imnaha basins was improved over the last two years and also exceeded historic fishery levels. This suggests that summer steelhead fisheries continue to be restored, at least in terms of numbers, under the original LSRCP objectives. Continued releases of hatchery steelhead smolts into both basins should maintain successful recreational fisheries in the Grande Ronde and Imnaha basins in the future. However, managers may want to consider modifying broodstock collection or smolt release strategies to match more closely the time and place of the current to the historic fishery.

2. The low percent of anglers (61%) that stopped at the Imnaha River check station during the fall fishery suggests that total catch, harvest, angler effort, and number of Imnaha resident anglers may have been underestimated at the check station. If the check station is operated in the future during the fall fishery, then the location of the check station and placement of additional signs should be considered. If the check station is to be operated during the spring fishery, another total angler count should be conducted to determine if these findings from the fall fishery are applicable in the spring. If so, then either replacing the check station with a roving survey or changing the location of the check station and placing additional check station signs should be considered.

3. In anticipation of reduced funding, alternative methods to estimate fishery statistics during spring fisheries including harvest, catch, catch rate, and angler effort, will be necessary. We suggest using punch card harvest data to estimate total harvest, total harvest divided by the percent harvested in the sampled catch to estimate total catch, and catch rate multiplied by total catch to estimate angler effort for combined spring fisheries in the Grande Ronde and Imnaha basins. During weekly time periods, we can target sampling times and locations to maximize numbers of anglers surveyed and harvested fish sampled without biasing catch rate. However, field sampling effort should reflect angler effort over the entire fishery period so as not to bias catch rate. We suggest using the number of AdLV+CWT marked fish harvested based on punch card harvest, although estimates were not well correlated with creel survey estimates. When punch card harvest data for specific reaches consistent with creel survey reaches within each basin become available (1993-1996 data), harvest estimates should be compared with creel survey estimates and trends interpreted accordingly.

INTRODUCTION

Summer steelhead (*Oncorhynchus mykiss*) fisheries in the Grande Ronde and Imnaha basins were closed in 1974. This closure was prompted by declining adult returns, as indicated by adult counts at Ice Harbor Dam on the Snake River (U.S. Army Corps of Engineers 1990) and low steelhead redd counts on index streams in the Grande Ronde and Imnaha basins (U.S. Fish and Wildlife Service 1991). 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 from construction of the four lower Snake River Dams built between 1962 and 1976. Thus, the focus of the LSRCP is above Lower Granite Dam (Rkm 173), the uppermost of the four lower dams on the Snake River. 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 basins (Carmichael 1989). Approximately 1.68 M smolts are released in Oregon each year during April and May in the Grande Ronde and Imnaha basins. These fish provide hatchery adult returns which 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 basins. The goal of the surveys is to provide annual harvest information needed to assess LSRCP compensation goals (Carmichael and Wagner 1983). In general, the number of summer steelhead in the recreational fishery has been restored, but the fishery is concentrated in different times and places (Flesher et al. 1995). This report summarizes results of creel surveys conducted during the fall of 1995 and the spring of 1996 in the Grande Ronde and Imnaha basins and compares these results with the historic fishery. We also examined the accuracy of the Imnaha River check station by making total angler counts in conjunction with operation of the check station. Finally, in anticipation of reduced funding for this project, we examined alternative methods to estimate fishery statistics (Objectives 1-6) for the spring fisheries. The survey on the lower Grande Ronde River will remain unchanged. The Grande Ronde and Imnaha basins encompass the major steelhead fisheries in Oregon that occur in streams which drain into the Snake River upstream of Lower Granite Dam.

STUDY AREA

Creel surveys on the Grande Ronde River were conducted on a 23.5 km section on the lower river from the Oregon-Washington state line (Rkm 62.3) to Wildcat Creek (Rkm 85.8) and an upper 39.2 km section from Highway 82 bridge at Island City (Rkm 255.6) to Meadow Creek (Rkm 294.8). The survey on the Wallowa River was conducted on a 49.4 km section from Minam State Park (Rkm 13.2) to the mouth of Trout Creek (Rkm 62.6) near Enterprise. Anglers who parked their vehicles at Minam State Park to fish just below the park were included in the survey. The survey on the Imnaha River was conducted on the lower 31.5 km from its confluence with the Snake River (Rkm 0) to the mouth of Big Sheep Creek (Rkm 31.5) near the town of Imnaha. These areas are shown in Figure 1.

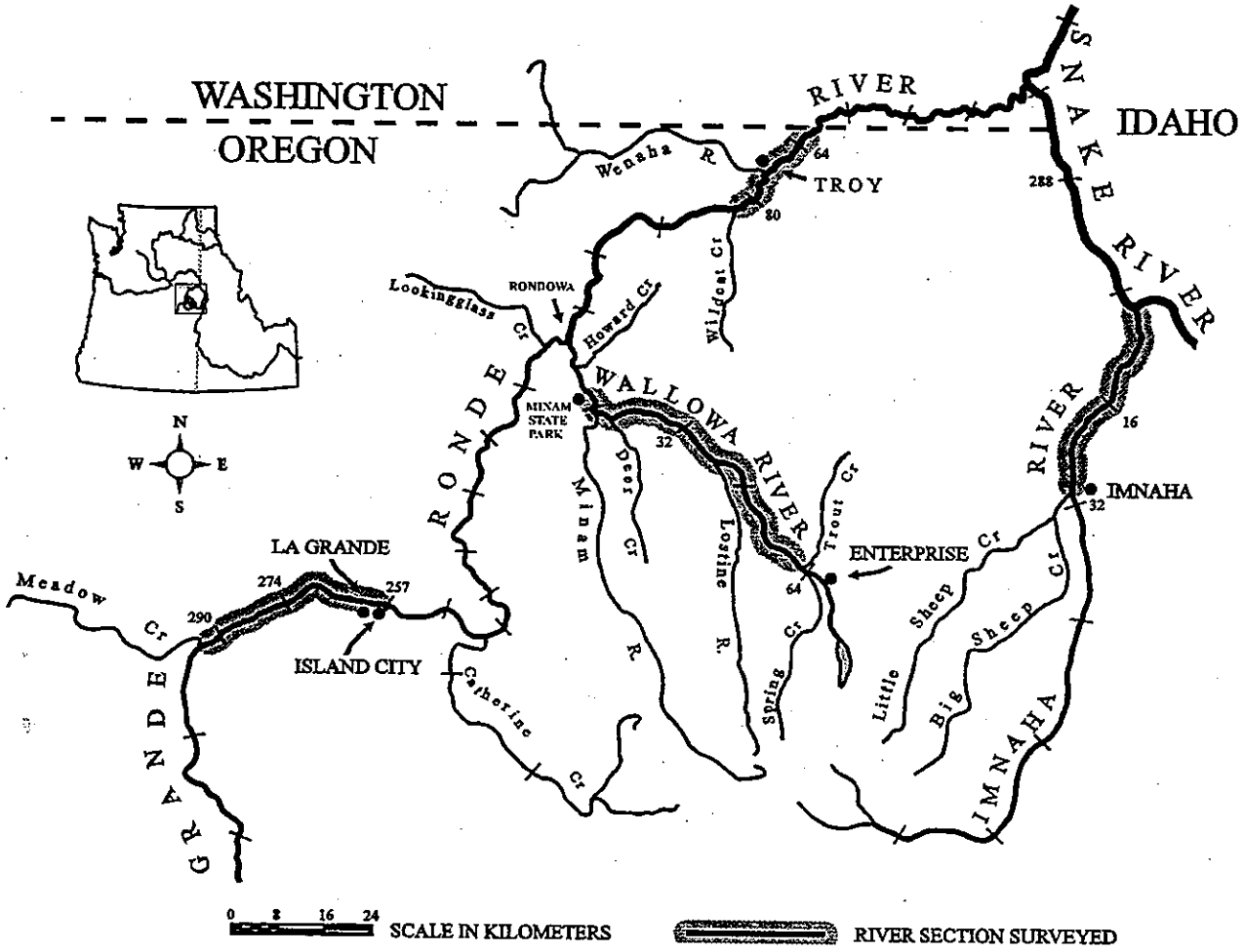

Figure 1. Map of northeastern Oregon showing where summer steelhead creel surveys were conducted in the Grande Ronde and Imnaha basins during the 1995-96 run year.

METHODS

Angler Surveys

Generally, we followed the methods described by Carmichael et al. (1989a). We sampled 50% of the weekends/holidays and 30% of the weekdays during each month of each survey. Initially, sample days were chosen randomly. They were then adjusted so that, as much as possible, weekend days and holidays were represented equally and weekdays were represented equally. Each sample day, beginning with a randomly selected start time, the creel surveyor conducted a pressure count which involved driving a vehicle along the entire survey route while tallying all anglers and vehicles every three hours. Between pressure counts, the surveyor interviewed anglers by recording a description of each angler or their vehicle and their residence, the number of hours they had fished, and the number and species caught. They also sampled all harvested fish recording fork length, sex, fin clip, and any external tags. If the fish was coded-wire-tagged, as indicated by an adipose fin-clip and left ventral fin-clip (AdLV+CWT), the surveyor excised the head behind the eye and placed it with an identification number in a plastic bag for later processing. The Imnaha River fishery was surveyed using a check station where the surveyor parked their vehicle in a highly visible location and set up an angler check station sign. The check station was designed so that anglers leaving the fishery area during a sample day would stop voluntarily and the surveyor would interview each angler and sample all harvested fish. From each creel survey, we estimated angler effort in hours and days, total catch, harvest, catch rate, the percent of hatchery fish in the catch, and the number of AdLV+CWT marked fish harvested (Carmichael et al. 1989a). Catch rate is an index, expressed as hours per fish, which results in lower catch rates reflecting better angling success. In addition, we determined the age and sex composition and mean fork length of harvested fish. The survey on the lower Grande Ronde River was from 1 September 1995 to 31 January 1996 and from 16 February to 15 April 1996. The survey on the Wallowa River was from 1 February to 15 April 1996. The survey on the upper Grande Ronde River was from 16 February to 15 April 1996. The survey on the Imnaha River was from 1 March to 15 April 1996.

Comparison to the Historic Fishery

To determine if the recreational steelhead fishery during the 1995-96 run year reached or exceeded historic fishery levels, we compared catch rate, harvest and angler effort estimates to historic median estimates from the Grande Ronde, Wallowa, and Imnaha rivers combined (Flesher et al. 1995).

Examine the accuracy of the Imnaha River Check Station

We checked the accuracy of the Imnaha River check station by examining the percent of total anglers that stopped at the check station. We made total counts of anglers on five sample days during the fall survey on the Imnaha River when the check station was operating. One surveyor drove continuously between the town of Imnaha (Rkm 31.5) and Cow Creek bridge (Rkm 6.6), making 4-7 counts daily, tallying and recording descriptions of all anglers and

their vehicles. The surveyor attempted to avoid contact with anglers so as not to influence whether they stopped at the check station as they left the fishery area. The check station surveyor also recorded descriptions of all anglers and their vehicles that stopped at the check station.

Estimation of Fishery Statistics with Reduced Field Sampling Effort

In anticipation of a one-third reduction in field sampling effort, and the need to answer Objectives 1-6, we developed an alternative strategy to sample spring fisheries in the Grande Ronde and Imnaha basins, and examined alternative methods to estimate harvest, total catch and angler effort using punch card data and lower Grande Ronde creel survey. We determined the relationship between original creel survey estimates and estimates from alternative methods. We also examined alternative methods to estimate catch rate and the number of AdLV+CWT marked steelhead harvested. Original methods have been described previously. The fall and spring survey on the lower Grande Ronde River will remain the same.

We developed an alternative strategy to sample spring fisheries using a one-third reduction in field sampling effort. One surveyor will conduct angler interviews in the Wallowa, Rondowa, upper Grande Ronde, Catherine Creek, and Imnaha creel survey areas, attempting to maximize the number of harvested fish sampled by regularly surveying fishery areas with high angler effort. The Wallowa River, which has consistently had the highest amount of angler effort and harvest (Flesher et al. 1996), will be surveyed each sample day and other survey areas a minimum of once each weekday and every other weekend. Two areas will be surveyed each sample day, and if time allows, an additional area(s) will be surveyed in the following order of priority: Imnaha, Rondowa, upper Grande Ronde, and Catherine Creek. Within a given area, consecutive surveys will alternate between time periods. During each sample day, the surveyor will drive along an entire survey route, interviewing all anglers, then proceed to the next area. The surveyor will sample 80% of the weekends (one randomly selected weekend off each month except in April) and 40-60% of the weekdays (two or three days off each week depending on their work schedule. The surveyor will work 40 hours per week, including 5 days per week (0800-1700) from 1 February to 1 March 1997 and 4 days per week (0700-1800) from 2 March to 15 April.

We examined the use of punch card harvest, and harvest from the lower Grande Ronde creel survey to estimate total harvest for combined fisheries. To estimate total catch, we examined the use of total harvest divided by the proportion of fish harvested in the sampled catch, and catch from the lower Grande Ronde creel survey. To estimate angler effort, we examined the use of total catch multiplied by catch rate, and angler effort from the lower Grande Ronde creel survey. We used linear regression analysis to determine the relationship between original creel survey estimates and estimates from alternative methods. We used statistical probability values (P) and correlation coefficients (r) to determine which alternative method should be used to estimate harvest, total catch, and angler effort. To estimate catch rate for spring fisheries, we examined the use of the sample catch rate from angler interviews. To determine whether sample catch rate is an unbiased estimate of overall catch rate, we examined the relationship between catch rate and angler effort during short time intervals (weekly) and over

an entire fishery. We used linear regression analysis and paired t-tests to determine the relationship between catch rate and angler effort. To estimate the number of AdLV+CWT marked steelhead harvested, we divided the number of harvested fish sampled by total harvest to obtain a sample rate (Schuck et al 1996). The number of each tag code harvested in the sample is then divided by the sample rate to obtain total harvest by tag code. We used linear regression analysis and paired t-tests to determine the relationship between original creel survey estimates and estimates using this alternative method. All relationships between estimates were considered significant if $P \leq 0.05$.

RESULTS

Angler Surveys

We sampled an average of 48.9% of the weekends/holidays and 29.9% of the weekdays during each month of each survey for a total of 168 sample days.

We estimated that 2,103 anglers fished for 10,856 hours on the lower Grande Ronde River. They caught and released 387 wild and 263 hatchery steelhead and kept 300 hatchery steelhead for a catch rate index of 11 hours per fish (Figures 2-6, Appendix A-1). The percent of steelhead caught that were hatchery fish ranged from 15% in September 1995 to 78% in January 1996 (Figure 7, Appendix B). Mean fork length (±95% confidence interval) of harvested hatchery steelhead ranged from 588 mm (±13) for 1-ocean females to 700 mm (±37) for 2-ocean males (Table 1). Age composition of harvested hatchery steelhead was 63% 1-ocean fish and 37% 2-ocean fish; the sex composition was 38% male and 62% female (Table 1). On the lower Grande Ronde River, anglers harvested an estimated 16 adipose-left ventral clipped plus coded-wire-tagged (AdLV+CWT) marked steelhead from our hatchery releases, an estimated 10 AdLV+CWT marked steelhead that were coded-wire-tagged by the National Marine Fisheries Service (NMFS) as smolts in the Snake River at Lower Granite Dam, and an estimated 6 AdLV+CWT marked steelhead that were strays from Washington Department of Fish and Wildlife releases in the Tucannon River, Washington (Table 2). Seventy-one percent of the anglers were from Union or Wallowa counties, 15% were from other Oregon counties, 7% were Washington residents and 7% resided outside the states of Oregon and Washington (Table 3).

On the upper Grande Ronde River, we estimated that 1,666 anglers fished for 4,578 hours. They caught and released 77 wild and 17 hatchery steelhead and kept 210 hatchery steelhead for a catch rate index of 15 hours per fish (Figures 2-6, Appendix A-2). The percent of steelhead caught that were hatchery fish ranged from 70% in March to 100% in April (Figure 7, Appendix B). Mean fork length (±95% confidence interval) of harvested hatchery steelhead ranged from 587 mm (±30) for 1-ocean females to 698 mm (±30) for 2-ocean females (Table 1). Age composition of harvested hatchery steelhead was 65% 1-ocean fish and 35% 2-ocean fish; the sex composition was 40% male and 60% female (Table 1). Anglers did not harvest any AdLV+CWT marked steelhead on the upper Grande Ronde River (Table

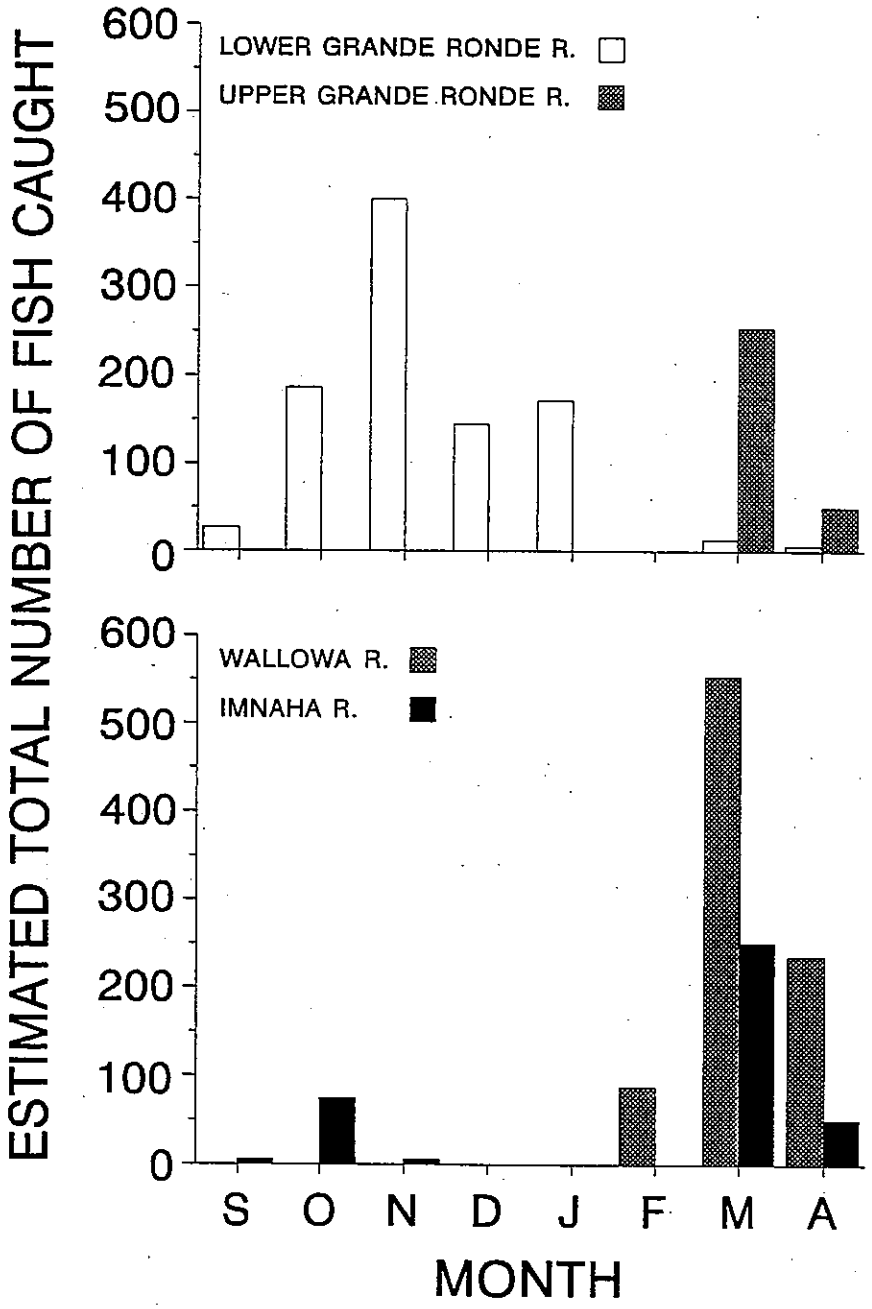

Figure 2. Estimated total catch of summer steelhead in the Grande Ronde and Imnaha basins during the 1995-96 run year. Survey areas and times include the lower Grande Ronde (1 September-31 January and 16 February-15 April), Wallowa (1 February-15 April), upper Grande Ronde (16 February-15 April), and Imnaha (1 March-15 April) rivers.

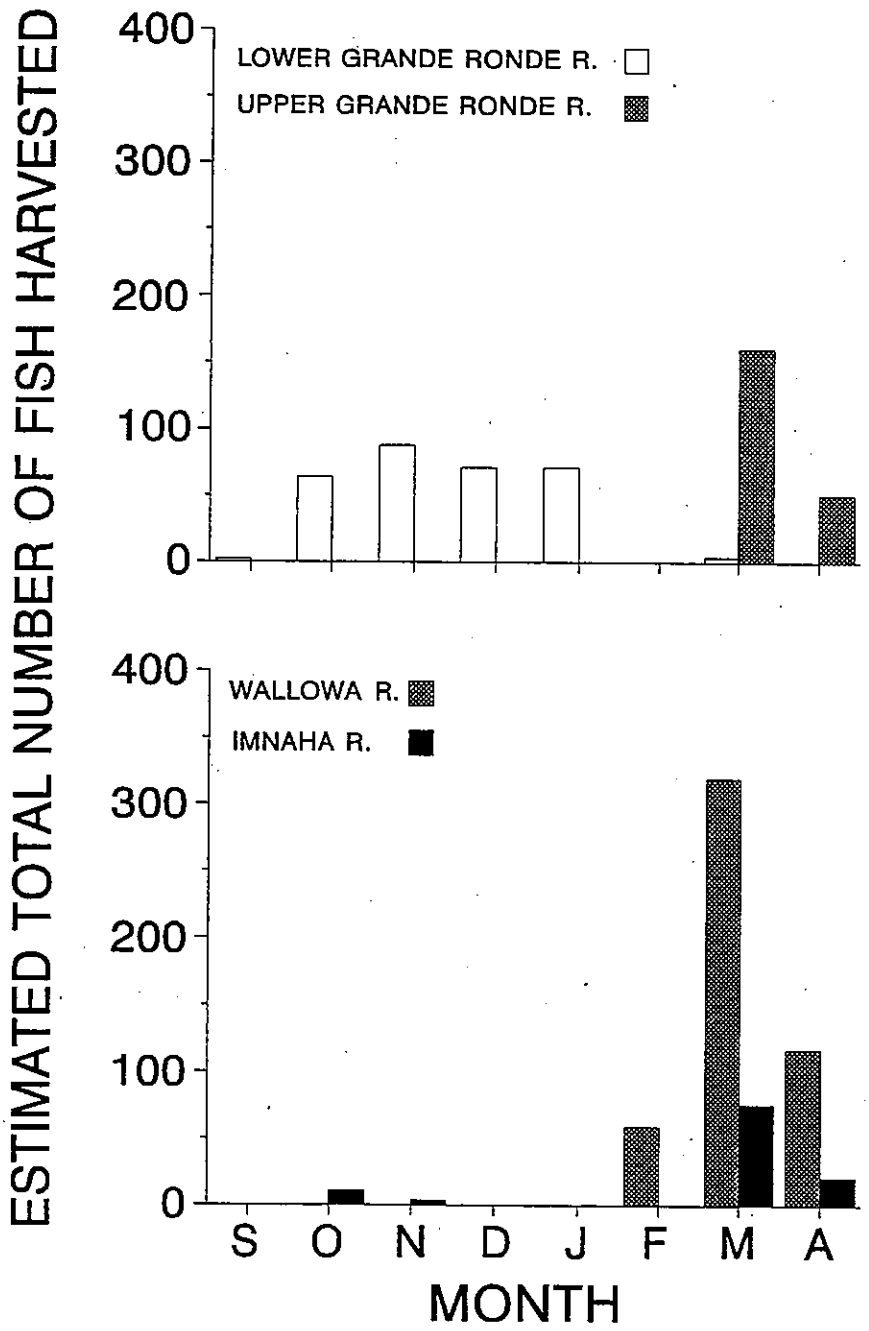

Figure 3. Estimated total harvest of summer steelhead in the Grande Ronde and Imnaha basins during the 1995-96 run year. Survey areas and times include the lower Grande Ronde (1 September-31 January and 16 February-15 April), Wallowa (1 February-15 April), upper Grande Ronde (16 February-15 April), and Imnaha (1 March-15 April) rivers.

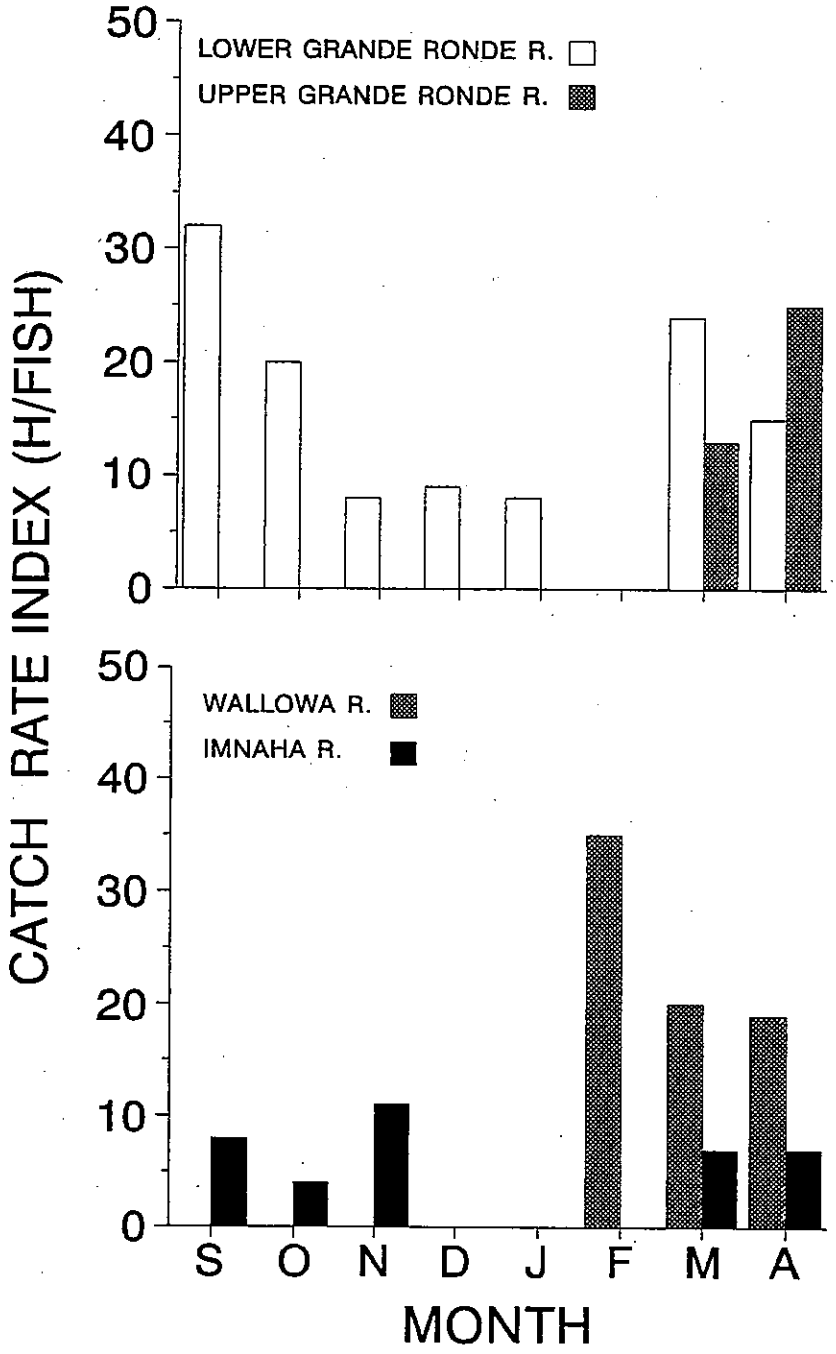

Figure 4. Estimated catch rate index (h/fish) for summer steelhead in the Grande Ronde and Imnaha basins during the 1995-96 run year. Survey areas and times include the lower Grande Ronde (1 September-31 January and 16 February-15 April), Wallowa (1 February-15 April), upper Grande Ronde (16 February-15 April), and Imnaha (1 March-15 April) rivers. Note: A lower catch rate index implies better angling success.

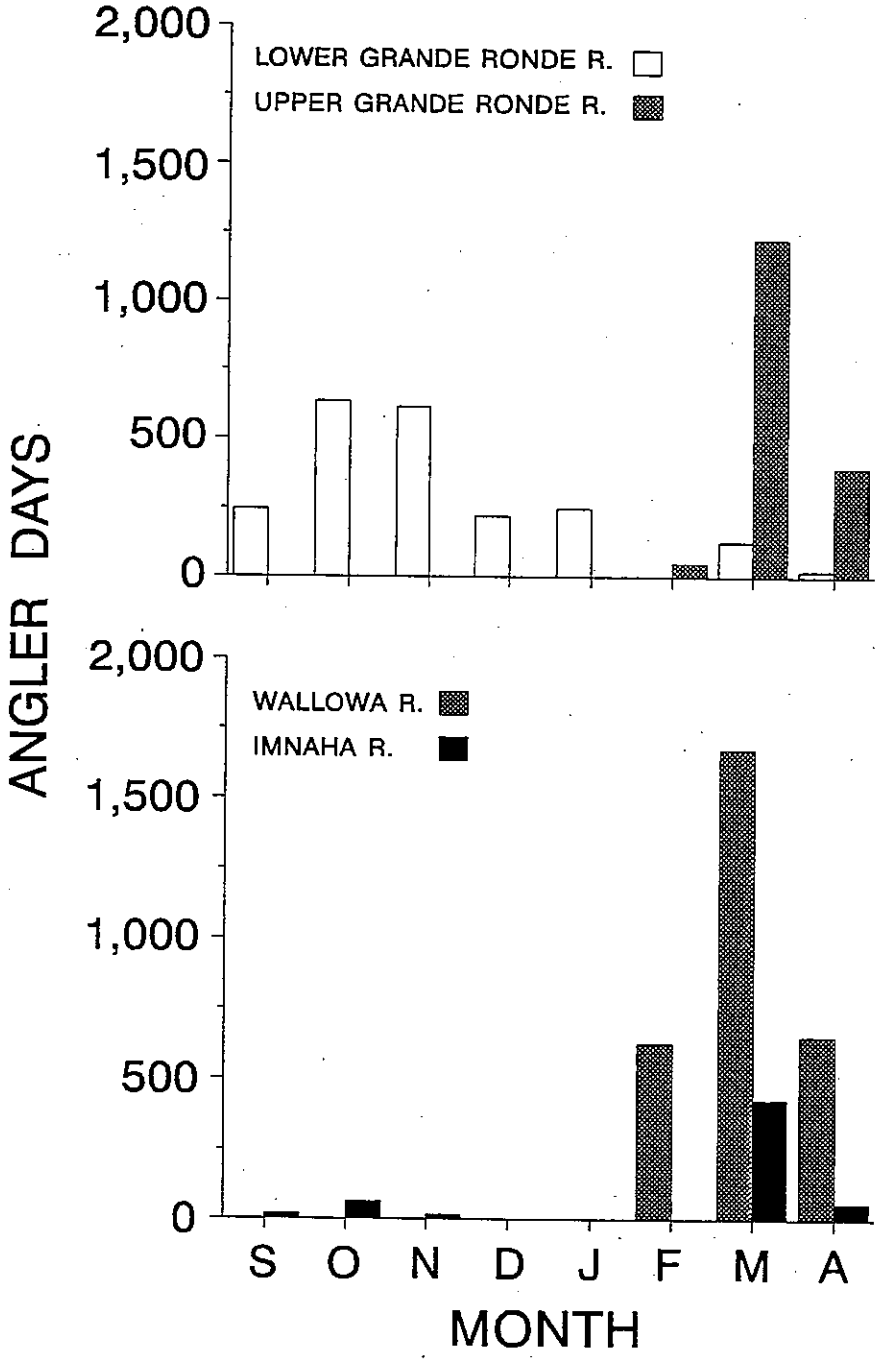

Figure 5. Estimated number of angler days for summer steelhead in the Grande Ronde and Imnaha basins during the 1995-96 run year. Survey areas and times include the lower Grande Ronde (1 September-31 January and 16 February-15 April), Wallowa (1 February-15 April), upper Grande Ronde (16 February-15 April), and Imnaha (1 March-15 April) rivers.

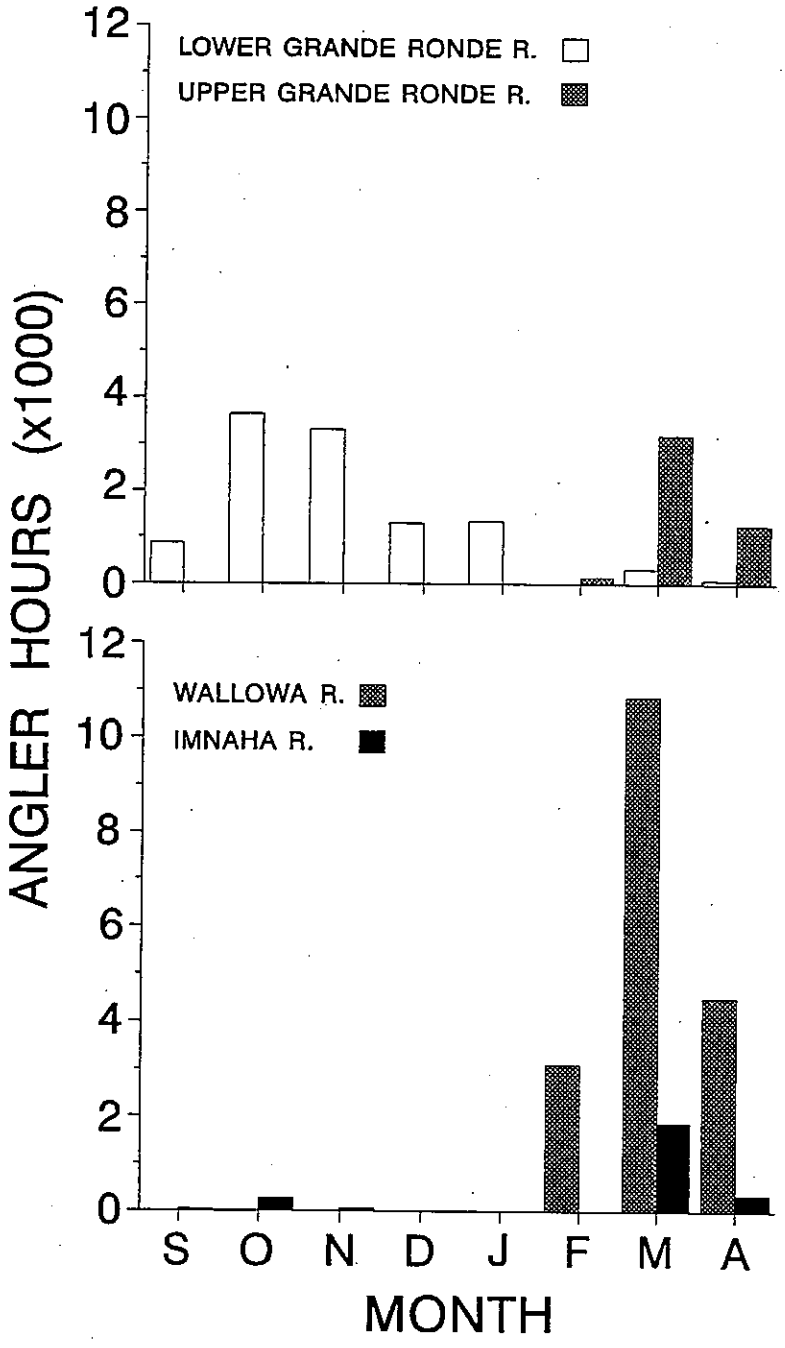

Figure 6. Estimated number of angler hours for summer steelhead in the Grande Ronde and Imnaha basins during the 1995-96 run year. Survey areas and times include the lower Grande Ronde (1 September-31 January and 16 February-15 April), Wallowa (1 February-15 April), upper Grande Ronde (16 February-15 April), and Imnaha (1 March-15 April) rivers.

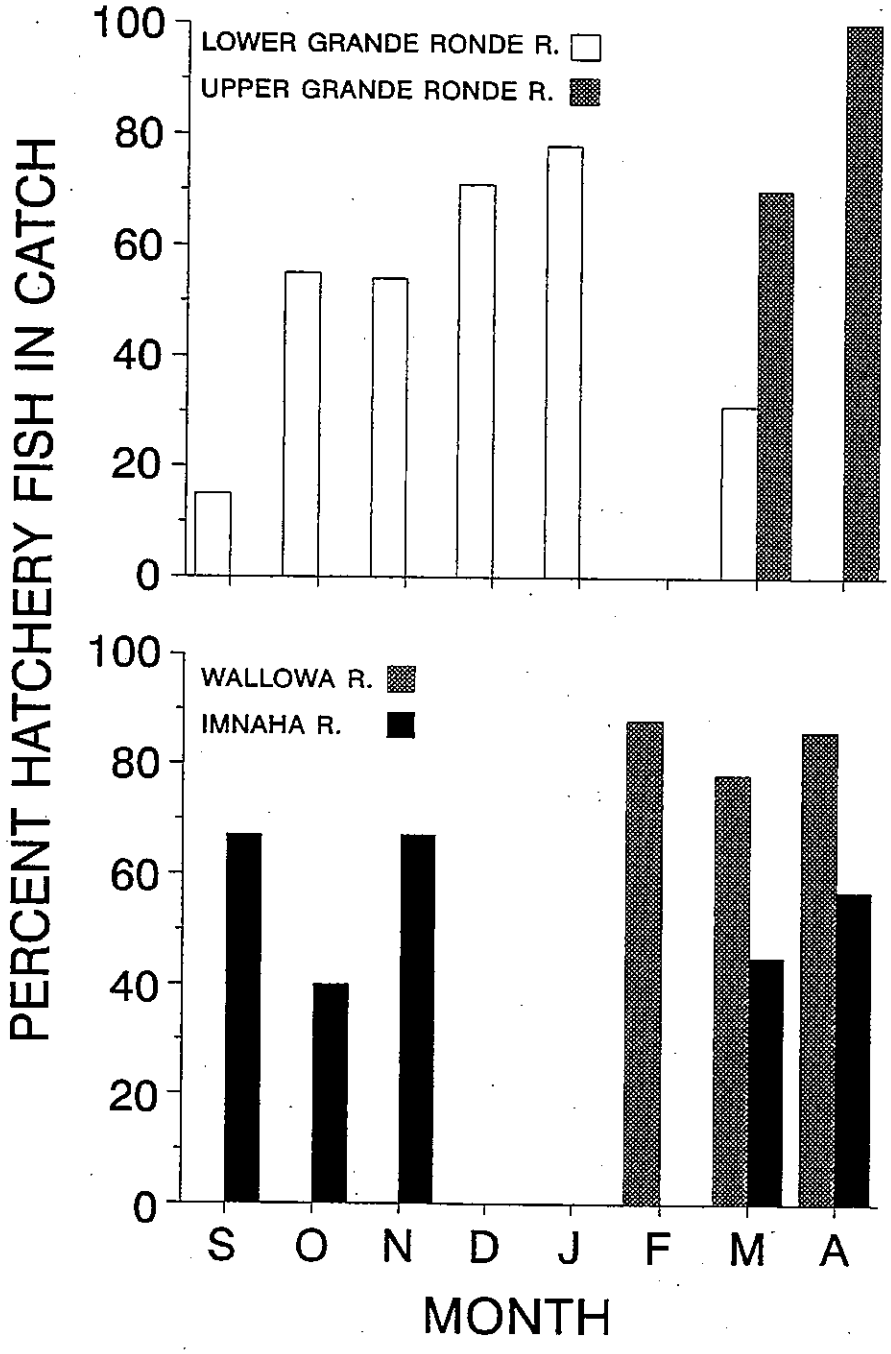

Figure 7. Estimated percentage of summer steelhead caught in the Grande Ronde and Imnaha basins during the 1995-96 run year that were hatchery fish. Survey areas and times include the lower Grande Ronde (1 September-31 January and 16 February-15 April), Wallowa (1 February-15 April), upper Grande Ronde (16 February-15 April), and Imnaha (1 March-15 April) rivers.

Table 1. Percent age composition and mean fork length of hatchery summer steelhead sampled in creel surveys in the Grande Ronde and Imnaha basins during the 1995-96 run year. Age estimated from length frequencies of AdLV+CWT marked hatchery returns in 1996. One-ocean fish are either 1:1 (years spent in freshwater prior to ocean migration:years spent in the ocean prior to spawning migration) or 2:1 and two-ocean fish are either 1:2 or 2:2. Mean fork length includes ±95% confidence interval.

Creel survey	Age composition (%)			Mean fork length (mm)			
area, sex	*N*	1-ocean	2-ocean	*N*	1-ocean	*N*	2-ocean
Lower Grande Ronde							
Male	24	75	25	18	611±13	6	700±37
Female	39	56	44	22	588±13	17	692±18
Total	63	63	37	40	598±10	23	694±15
Upper Grande Ronde							
Male	8	100	0	8	600±17	0	--
Female	12	42	58	5	587±30	7	698±30
Total	20	65	35	13	595±13	7	698±30
Wallowa							
Male	37	68	32	25	621±12	12	713±25
Female	47	51	49	24	613±7	23	691±19
Total	84	58	42	49	617±7	35	699±15
Imnaha							
Male	12	58	42	7	583±21	5	727±35
Female	31	35	65	11	592±15	20	692±22
Total	43	42	58	18	589±11	25	699±19

Table 2. Observed and expanded number of AdLV + CWT marked summer steelhead recovered in the Grande Ronde and Imnaha basins during the 1995-96 run year. No AdLV + CWT marked fish were recovered in the upper Grande Ronde River. Marked recoveries were expanded for the entire fishery.

Creel survey area	Tag code	Release site	Experimental group	Brood year	Number recovered	
					Observed	Expanded
Lower Grande Ronde	07 03 25	Deer Cr.	Acclimated	93	1	10
	07 03 30	Spring Cr.	Production	93	2	6
	23 24 42	--	NMFS[a]	93	1	10
	63 48 16	--	WDFW[b]	92	1	6
		--				
Wallowa	07 03 25	Deer Cr.	Acclimated	93	3	19
	07 03 26	Deer Cr.	Acclimated	93	2	10
	07 03 27	Deer Cr.	Direct Stream	93	3	21
	07 03 28	Deer Cr.	Direct Stream	93	3	14
	07 03 29	Spring Cr.	Production	93	2	9
	07 03 30	Spring Cr.	Production	93	1	5
	07 61 04	Deer Cr.	Direct Stream	92	3	19
	07 61 05	Deer Cr.	Direct Stream	92	1	7
	07 61 06	Spring Cr.	Production	92	1	4
Imnaha	07 03 22	L. Sheep Cr.	Acclimated	93	1	4
	07 03 24	L. Sheep Cr.	Direct Stream	93	1	4
	07 60 61	L. Sheep Cr.	Acclimated	92	1	4
	07 60 63	L. Sheep Cr.	Direct Stream	92	1	2
	07 61 01	L. Sheep Cr.	Direct Stream	92	2	7

[a] *Steelhead with tag code 23 24 42 were marked by National Marine Fisheries Service (NMFS) in the Snake River at Lower Granite Dam (Rkm 173), then barged and released in the Columbia River below Bonneville Dam at Rkm 227 on 02 June 1994.*

[b] *Steelhead with tag code 63 48 16 were released by Washington Department of Fish and Wildlife (WDFW) from Curl Lake (Rkm 66) on the Tucannon River, Washington, on 22 April 1993.*

Table 3. Residence of summer steelhead anglers interviewed during creel surveys in the Grande Ronde and Imnaha basins during the 1995-96 run year.

Creel survey area	Number of anglers	Percent			
		Union or Wallowa counties	Other Oregon counties	Washington	Other states
Lower Grande Ronde					
Fall	478	71	13	7	9
Spring	119	67	22	8	3
Total	597	71	15	7	7
Upper Grande Ronde	228	94	5	0	1
Wallowa	750	74	23	1	2
Imnaha					
Fall	35	48	46	0	6
Spring	186	78	15	3	4
Total	221	73	20	3	4

2). Ninety-four percent of the anglers were from Union or Wallowa counties, 5% were from other Oregon counties, 0% were Washington residents and 1% resided outside the states of Oregon and Washington (Table 3).

On the Wallowa River, we estimated that 2,951 anglers fished for 18,441 hours. They caught and released 167 wild and 214 hatchery steelhead and kept 495 hatchery steelhead for a catch rate index of 21 hours per fish (Figures 2-6, Appendix A-3). The percent of steelhead caught that were hatchery fish ranged from 78% in March to 88% in February (Figure 7, Appendix B). Mean fork length (±95% confidence interval) of harvested hatchery steelhead ranged from 613 mm (±7) for 1-ocean females to 713 (±25) mm for 2-ocean males (Table 1). Age composition of harvested hatchery steelhead was 58% 1-ocean fish and 42% 2-ocean fish; the sex composition was 44% male and 56% female (Table 1). On the Wallowa River, anglers harvested an estimated 108 AdLV+CWT marked steelhead from our hatchery releases (Table 2). Seventy-four percent of the anglers were from Union or Wallowa counties, 23% were from other Oregon counties, 1% were Washington residents and 2% resided outside the states of Oregon and Washington (Table 3).

On the Imnaha River, we estimated that 588 anglers fished for 2,599 hours. They caught and released 210 wild steelhead and kept 67 hatchery steelhead and kept 112 hatchery steelhead for a catch rate index of 7 hours per fish (Figures 2-6, Appendix A-4). The percent of steelhead caught that were hatchery fish ranged from 40% in October 1995 to 67% in September and November 1995 (Figure 7, Appendix B). Mean fork length (±95% confidence interval) of harvested hatchery steelhead ranged from 583 mm (±21) for 1-ocean males to 727 mm (±35) for 2-ocean males (Table 1). Age composition of harvested hatchery steelhead was 42% 1-ocean fish and 58% 2-ocean fish; the sex composition was 28% male and 72% female (Table 1). Anglers harvested an estimated 21 AdLV+CWT marked steelhead from our hatchery releases (Table 2). Seventy-three percent of the anglers were from Union or Wallowa counties, 20% were from other Oregon counties, 3% were Washington residents and 4% resided outside the states of Oregon and Washington (Table 3).

Angler effort (Figure 8) and harvest (Figure 9) increased as did total catch in both basins over the last two years. Catch rates were better, averaging 16 h/fish for Grande Ronde basin fisheries and 7 h/fish for the Imnaha basin fishery.

Comparison to the Historic Fishery

During the 1995-96 run year, the catch rate index was better than historically, the total hours of angler effort were greater than historically, and estimated harvest was greater than historically for the combined fishery on the Grande Ronde, Wallowa, and Imnaha rivers.

Examine the accuracy of the Imnaha River Check Station

In five sample days during the fall fishery on the Imnaha River, we found that only 19 out of 31 total anglers (61%) stopped at the check station.

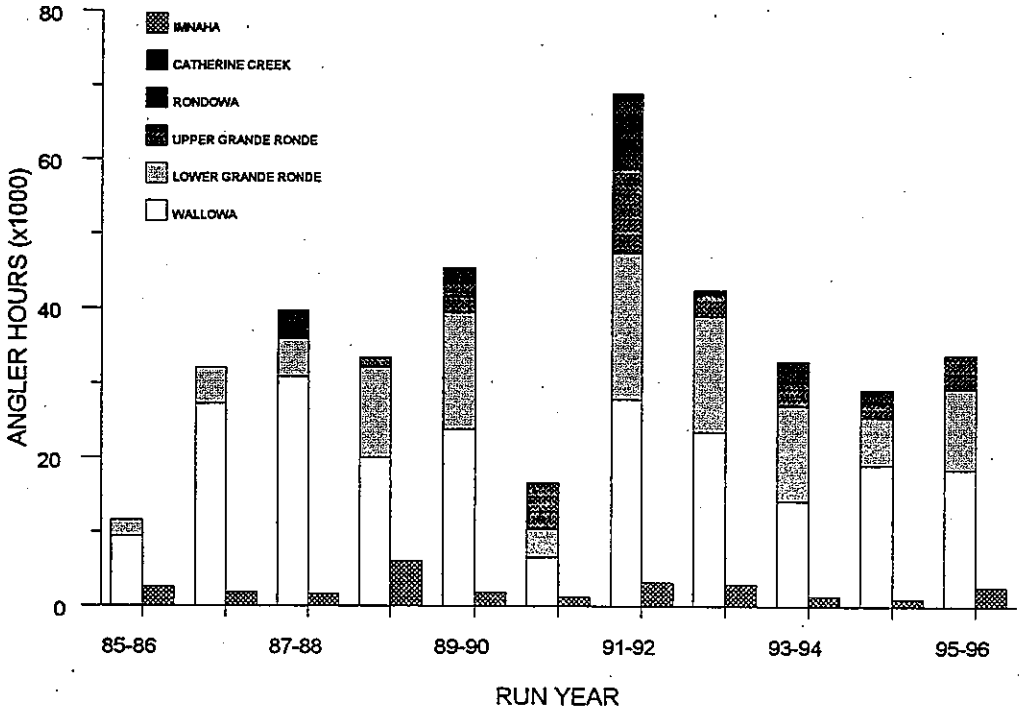

Figure 8. Angler effort for summer steelhead in the Grande Ronde and Imnaha basins for the 1985-86 to 1995-96 run years.

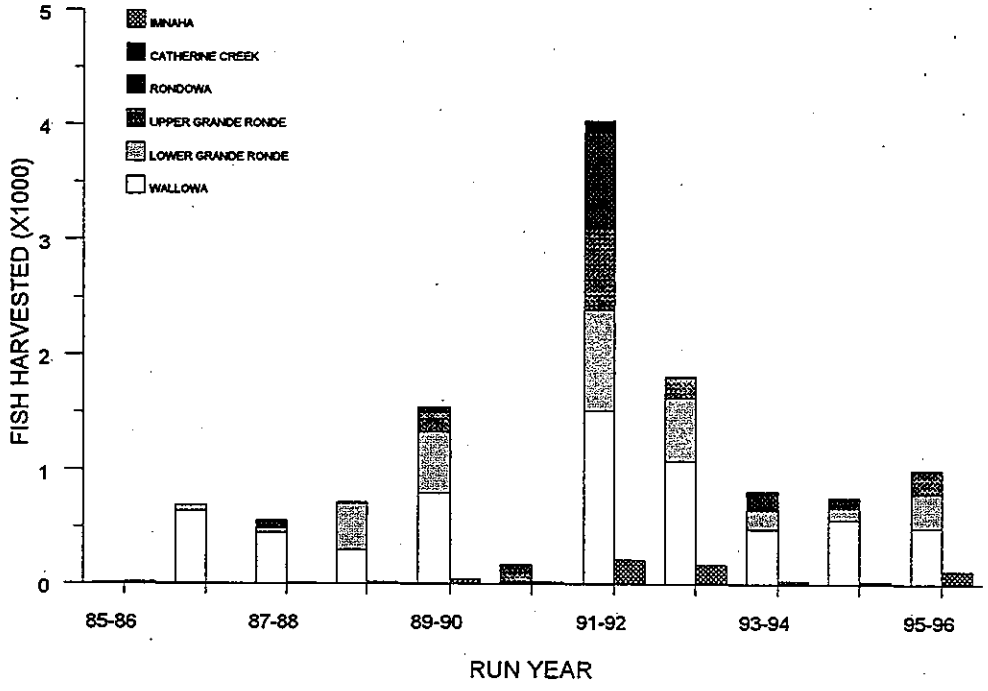

Figure 9. Number of hatchery summer steelhead harvested by recreational anglers in the Grande Ronde and Imnaha basins for the 1985-86 to 1995-96 run years.

Estimation of Fishery Statistics with Reduced Field Sampling Effort

We found that creel survey harvest from combined fisheries had a higher correlation with punch card harvest (Figure 10) than with harvest from the lower Grande Ronde survey (Figure 11). For punch card harvest, $P < 0.001$ and $r = 0.98$, and for the lower Grande Ronde harvest, $P = 0.008$ and $r = 0.85$. Therefore, we used punch card harvest as the estimate of total harvest in subsequent calculations. Next, we found that creel survey catch from combined fisheries had a higher correlation with total harvest divided by the proportion harvested in the sampled catch (Figure 12) than with catch from the lower Grande Ronde survey (Figure 13). For total harvest divided by the proportion harvested in the sample, $P = 0.001$ and $r = 0.95$, and for the lower Grande Ronde catch, $P = 0.008$ and $r = 0.85$. Therefore, we used total harvest divided by the proportion harvested in the sampled catch as the estimate of total catch in subsequent calculations. Finally, we found that creel survey angler effort had a higher correlation with catch rate multiplied by total catch (Figure 14) than with angler effort from the lower Grande Ronde survey (Figure 15). For catch rate multiplied by total catch, $P = 0.02$ and $r = 0.83$. For lower Grande Ronde angler effort, $P = 0.02$ and $r = 0.80$.

We found that catch rate was independent of angler effort within weekly time intervals. In some cases, however, catch rate and angler effort were related significantly over an entire fishery (Figure 16). For the 1994-95 and 1995-96 run years, $P = 0.94$ and 0.50 for the lower Grande Ronde, $P = 0.45$ and 0.10 for the upper Grande Ronde, $P = 0.82$ and 0.35 for the Wallowa, and $P = 0.45$ and 0.24 for the Imnaha fisheries. For the 1994-95 run year in the Wallowa River fishery, catch rate was significantly related to angler effort ($P = 0.03$). Therefore, catch rates are independent of angler effort within weekly intervals, but are significantly related over an entire fishery.

We found that the estimated number of AdLV+CWT marked fish harvested monthly from creel surveys is significantly different than the number based on punch card harvest (Figure 17). For the 1986-87 to 1993-94 run years, $P = 0.006$ and $r = 0.60$ for the lower Grande Ronde, $P = 0.023$ and $r = 0.60$ for the Wallowa, and $P = 0.009$ and $r = 0.80$ for the Imnaha fisheries.

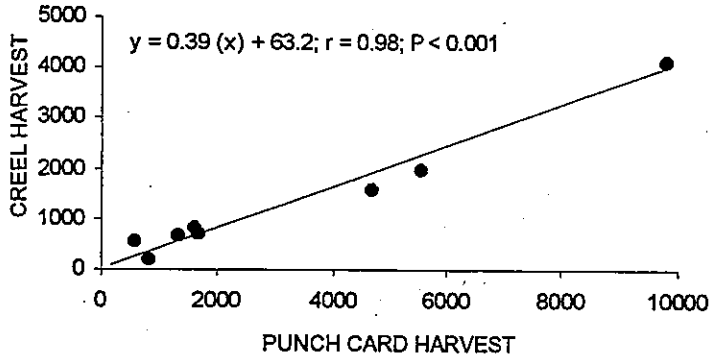

Figure 10. Relationship of punch card harvest and creel survey harvest for combined fisheries in the Grande Ronde and Imnaha basins for the 1986-87 to 1993-94 run years.

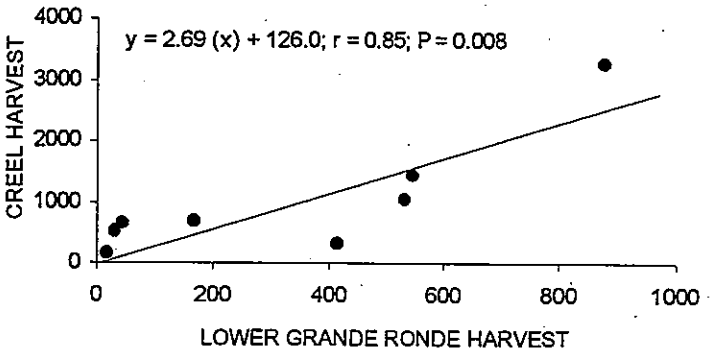

Figure 11. Relationship of lower Grande Ronde creel survey harvest and creel survey harvest for combined fisheries in the Grande Ronde and Imnaha basins for the 1986-87 to 1993-94 run years.

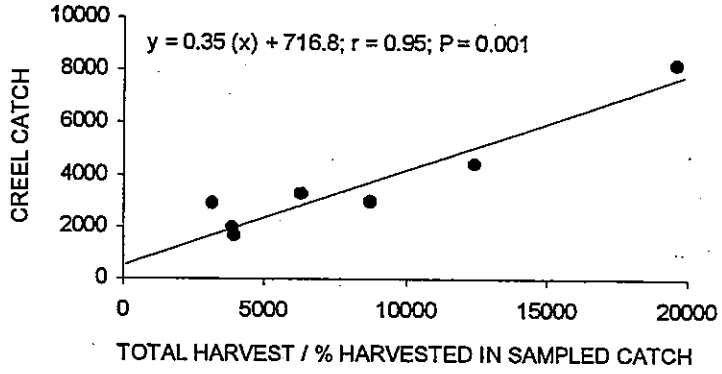

Figure 12. Relationship of total harvest divided by the proportion of fish harvested in the sampled catch and catch for combined fisheries in the Grande Ronde and Imnaha basins for the 1986-87 to 1993-94 run years. Excludes the 1990-91 run year due to catch and release only.

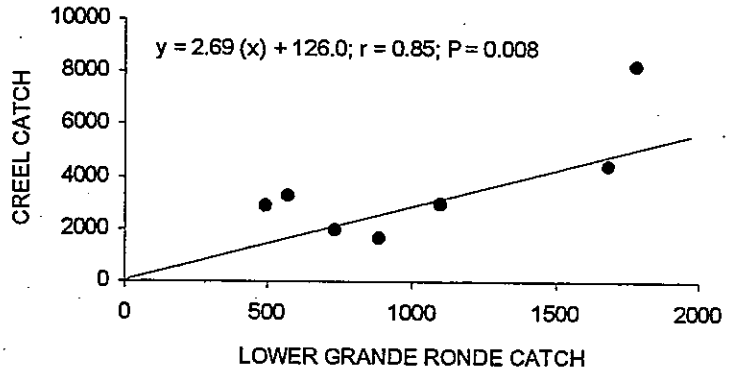

Figure 13. Relationship of lower Grande Ronde creel survey catch and catch for combined fisheries in the Grande Ronde and Imnaha basins for the 1986-87 to 1993-94 run years. Excludes the 1990-91 run year due to catch and release only.

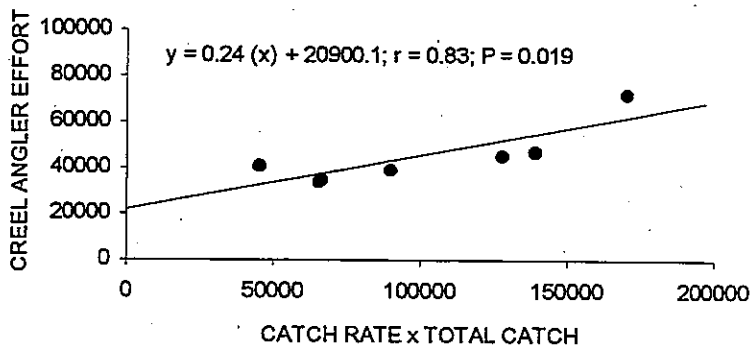

Figure 14. Relationship of catch rate (hours/fish) multiplied by total catch and angler effort for combined fisheries in the Grande Ronde and Imnaha basins for the 1986-87 to 1993-94 run years. Excludes the 1990-91 run year due to catch and release only.

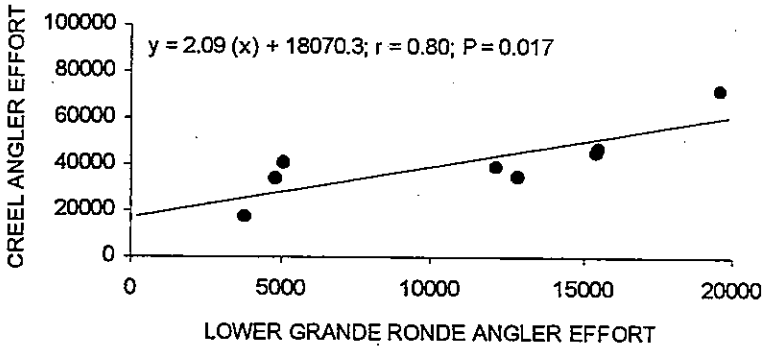

Figure 15. Relationship of lower Grande Ronde creel survey angler effort and angler effort for combined fisheries in the Grande Ronde and Imnaha basins for the 1986-87 to 1993-94 run years.

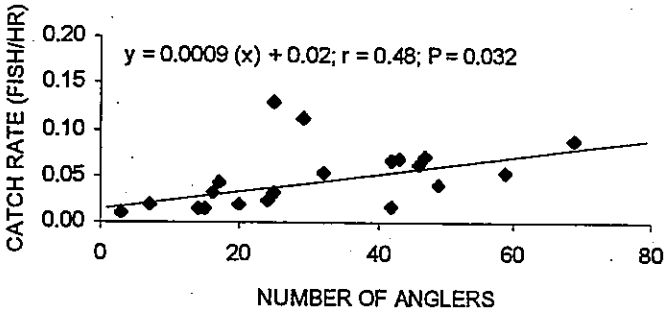

Figure 16. Catch rate (fish/hr) during periods of high and low angler effort on the Wallowa River during the 1994-95 run year.

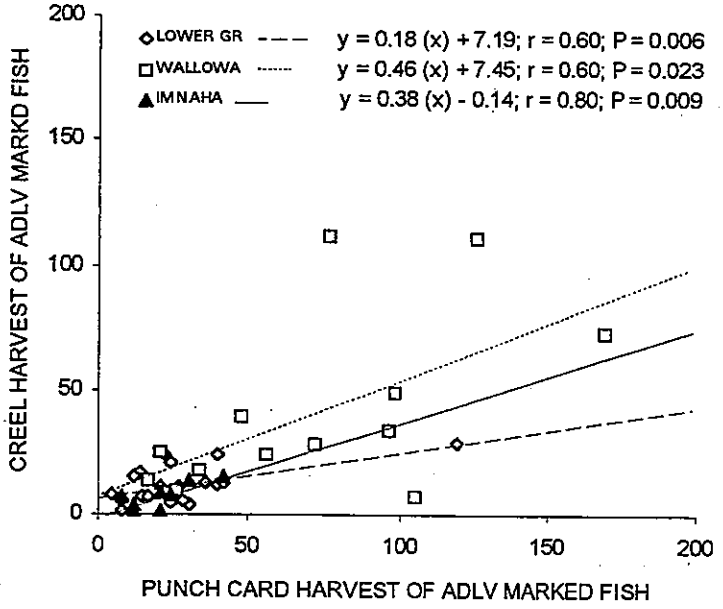

Figure 17. Comparison of monthly punch card and creel survey harvest of AdLV+CWT marked steelhead in the Grande Ronde and Imnaha basins for the 1986-87 to 1993-94 run years.

DISCUSSION

Angler Surveys

The summer steelhead fisheries in the Grande Ronde and Imnaha basins during the 1995-96 run year were larger and more successful than in the last two years. The success of the fishery was probably due, in part, to higher hatchery adult returns than in recent years (Whitesel et al. in preparation). The percent of hatchery fish in the catch increased over the past two years in all fisheries.

Comparison to the Historic Fishery

The 1995-96 steelhead fishery exceeded historic levels of catch rate and angler effort, and exceeded historic levels of harvest for combined fisheries in the Grande Ronde and Imnaha basins. Catch rate and angler effort were 11% and 19% higher than historic values, respectively. Harvest was 1.3 times higher than the predicted historic harvest (Flesher et al. 1995).

Examine the accuracy of the Imnaha River Check Station

The angler check station on the Imnaha River maybe underestimating angler effort, catch, and harvest by as much as 40%. This was indicated by our findings during the fall, probably because many anglers reside within the fishery area below the check station. Thus, to increase our accuracy, we may need to modify the survey methods. However, these findings may not be applicable to the spring fishery. The spring fishery tends to have high harvest and effort and be composed predominately of anglers who live outside the survey area, who would pass the check station when fishing is completed each day. If the Imnaha River check station is operated in the future during the spring fishery, we recommend that the accuracy check be repeated. During the fall, we should consider placing additional signs in the area and changing the location of the check station, or replacing the check station with a roving angler survey.

Estimation of Fishery Statistics with Reduced Field Sampling Effort

Our findings indicate that we can estimate total harvest for spring fisheries using punch card data, which should provide for a less variable estimate of total harvest than if we used the lower Grande Ronde harvest data when compared to previous creel survey harvest estimates. The method using total harvest (from punch cards) and the percent of fish harvested in the sample catch to estimate total catch for spring fisheries should also provide for a less variable estimate of total catch than if we used the lower Grande Ronde catch data. By using total catch and catch rate, we can estimate angler effort for spring fisheries. Again, this method should provide for a less variable estimate of angler effort than if we used the lower Grande Ronde angler effort data. For catch rate within weekly time intervals, we found that we can target sampling times and locations to maximize the number of anglers surveyed without biasing our estimates of catch rate. However, we also found that over an entire fishery, sampling effort should reflect angler effort to avoid catch rate bias. We found that the

relationship between harvest estimates of AdLV+CWT marked fish from creel surveys and estimates using punch card harvest data is not well defined. However, if we sample a higher percent of harvested fish during spring fisheries, under our proposed alternative sampling strategy, the estimated number of AdLV+CWT harvested based on punch card data should be less variable.

In summary, to answer Objectives 1-6, we recommend estimating harvest, total catch, and angler effort based on punch card harvest data for spring fisheries. The sample catch rate should be an unbiased estimate of catch rate for spring fisheries if sampling effort reflects angling effort over the entire fishery period. We also recommend estimating the number of AdLV+CWT marked steelhead harvested by tag code for spring fisheries by calculating a sample rate, then divide the number sampled of each tag code by total harvest, although these estimates did not correlate well with original creel survey estimates. As in previous creel surveys, the percent of hatchery fish in the catch, the length frequency, sex, and age-composition of harvested fish, and residence of anglers can be estimated from data collected during angler interviews. Only recently (beginning in 1993) has punch card harvest been separated into specific fishery areas (i.e. upper Grande Ronde, lower Grande Ronde, lower Wallowa at Rondowa and upper Wallowa fisheries). When punch card and creel survey harvest data for specific reaches within each basin become available (1993-1996), total harvest estimates could be revised.

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Appendix A-1. Fishery statistics for summer steelhead on the lower Grande Ronde River during the 1995-96 run year. Statistics include ±95% confidence interval except for catch rate when expressed as h/fish. Only adipose-marked fish were harvested.

Month, day type	Sample size		Total hours	Total catch	Total harvest	Catch rate		Angler days
	Days	Anglers				fish/h	(h/fish)	
September:								
Weekday	6	27	427±309	5±8	0	0.012±0.019	(85)	133±96
Weekend	5	50	440±177	22±11	2±4	0.048±0.025	(20)	112±45
Total	11	77	867±356	27±13	2±4	0.030±0.016	(32)	245±101
October:								
Weekday	7	93	1761±527	93±47	31±37	0.053±0.027	(19)	352±105
Weekend	5	106	1887±175	94±30	33±21	0.050±0.016	(20)	280±26
Total	12	199	3648±556	187±56	64±42	0.052±0.015	(20)	632±96
November:								
Weekday	5	61	2200±2184	252±102	51±51	0.114±0.046	(9)	416±413
Weekend	5	79	1108±418	148±47	37±20	0.133±0.043	(7)	196±74
Total	10	140	3308±2224	400±112	88±55	0.121±0.034	(8)	612±411
December:								
Weekday	6	28	806±842	110±118	49±53	0.136±0.146	(7)	119±124
Weekend	6	34	488±328	35±17	22±12	0.070±0.034	(14)	99±67
Total	12	62	1294±904	145±119	71±55	0.111±0.092	(9)	218±152
January:								
Weekday	6	33	773±324	96±56	44±61	0.124±0.072	(8)	158±66
Weekend	5	57	563±188	76±31	27±15	0.135±0.055	(7)	89±30
Total	11	90	1336±375	172±64	71±62	0.129±0.048	(8)	247±69
February:								
Weekday	4	1	2	0	--	--(--)		1
Weekend	1	0	--	--	--	--(--)		--
Total	5	1	2	0	--	--(--)		1
March:								
Weekday	6	11	219±130	9±25	0	0.042±0.086	(24)	95±56
Weekend	5	9	95±48	4±8	4	0.045±0.081	(24)	31±16
Total	11	20	314±139	13±26	4	0.043±0.065	(24)	126±56
April:								
Weekday	3	7	69±38	6±6	0	0.079±0.090	(12)	19±10
Weekend	2	1	18	0	--	--(--)		3
Total	5	8	87±38	6±6	0	0.063±0.072	(15)	22±10
Grand total	77	597	10856±2522	950±187	300±108	0.087±0.017	(11)	2103±489

Appendix A-2. Fishery statistics for summer steelhead on the upper Grande Ronde River during the 1995-96 run year. Statistics include ±95% confidence interval except for catch rate when expressed as h/fish. Only adipose-marked fish were harvested.

Month, day type	Sample size Days	Anglers	Total hours	Total catch	Total harvest	Catch rate fish/h	(h/fish)	Angler days
February:								
Weekday	3	8	64±89	0	--	--(--)		23±32
Weekend	2	8	71±67	0	--	--(--)		26±25
Total	5	16	135±111	0	--	--(--)		49±40
March:								
Weekday	6	93	2126±817	121±68	83±60	0.057±0.032	(18)	762±293
Weekend	5	73	1063±231	133±41	77±32	0.125±0.038	(8)	462±100
Total	11	166	3189±849	254±80	160±68	0.080±0.025	(13)	1224±326
April:								
Weekday	3	25	863±403	38±20	38±20	0.044±0.023	(23)	289±135
Weekend	2	21	391±55	12±16	12±16	0.031±0.041	(33)	104±15
Total	5	46	1254±406	50±26	50±26	0.040±0.020	(25)	393±127
Grand total	21	228	4578±948	304±84	210±72	0.066±0.018	(15)	1666±345

Appendix A-3. Fishery statistics for summer steelhead on the Wallowa River during the 1995-96 run year. Statistics include ±95% confidence interval except for catch rate when expressed as h/fish. Only adipose-marked fish were harvested.

Month, day type	Sample size Days	Anglers	Total hours	Total catch	Total harvest	Catch rate fish/h	(h/fish)	Angler days
February:								
Weekday	5	70	1576±868	44±26	27±26	0.028±0.017	(36)	354±195
Weekend	5	95	1519±835	44±22	32±24	0.029±0.015	(35)	273±150
Total	10	165	3095±1204	88±34	59±35	0.028±0.011	(35)	627±244
March:								
Weekday	6	224	6618±844	380±108	203±76	0.057±0.016	(17)	935±119
Weekend	5	211	4238±1089	173±80	116±67	0.041±0.019	(24)	737±189
Total	11	435	10856±1377	553±134	319±101	0.051±0.012	(20)	1672±212
April:								
Weekday	3	66	2406±1731	156±69	80±42	0.065±0.029	(15)	383±276
Weekend	2	84	2087±688	79±35	37±28	0.038±0.017	(26)	269±89
Total	5	150	4493±1863	235±77	117±50	0.052±0.017	(19)	652±270
Grand total	26	750	18444±2611	876±159	495±118	0.048±0.009	(21)	2951±418

Appendix A-4. Fishery statistics for summer steelhead on the Imnaha River during the 1995-96 run year. Statistics include ±95% confidence interval except for catch rate when expressed as h/fish. Only adipose-marked fish were harvested.

Month, day type	Sample size		Total hours	Total catch	Total harvest	Catch rate		Angler days
	Days	Anglers				fish/h	(h/fish)	
September:								
Weekday	6	2	39	4	0	0.090	(10)	15
Weekend	5	2	8	2	0	0.238 ± 0.420	(4)	4
Total	11	4	47	6	0	0.114 ± 0.068	(8)	19
October:								
Weekday	7	11	181 ± 130	66 ± 66	6 ± 13	0.365 ± 0.228	(3)	39 ± 28
Weekend	5	13	88 ± 21	9 ± 12	5 ± 8	0.102 ± 0.077	(10)	25 ± 6
Total	12	24	269 ± 132	75 ± 67	11 ± 15	0.279 ± 0.155	(4)	64 ± 31
November:								
Weekday	3	1	7	0	--	--(--)		2
Weekend	2	6	56 ± 26	6 ± 8	4	0.108 ± 0.103	(9)	16 ± 7
Total	5	7	63 ± 26	6 ± 8	4	0.096 ± 0.092	(11)	18 ± 7
March:								
Weekday	6	75	1179 ± 558	169 ± 99	46 ± 40	0.143 ± 0.071	(7)	258 ± 122
Weekend	5	85	687 ± 53	82 ± 37	30 ± 16	0.119 ± 0.038	(8)	170 ± 13
Total	11	160	1866 ± 561	251 ± 106	76 ± 43	0.134 ± 0.047	(7)	428 ± 129
April:								
Weekday	3	4	65	15	7	0.225	(4)	15
Weekend	2	22	289 ± 194	36 ± 22	14 ± 11	0.125 ± 0.053	(8)	44 ± 30
Total	5	26	354 ± 194	51 ± 22	21 ± 11	0.143 ± 0.044	(7)	59 ± 32
Grand total	44	221	2599 ± 609	389 ± 128	112 ± 47	0.149 ± 0.038	(7)	588 ± 138

Appendix B. The percent of summer steelhead caught by month in the Grande Ronde and Imnaha basins during the 1995-96 run year that were hatchery fish. Total catch is shown in parentheses.

Creel survey area	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Lower Grande Ronde	15(27)	55(187)	54(400)	71(145)	78(172)	--(0)	31(13)	--(0)
Upper Grande Ronde	--(--)	--(--)	--(--)	--(--)	--(--)	--(0)	70(254)	100(50)
Wallowa	--(--)	--(--)	--(--)	--(--)	--(--)	88(88)	78(553)	86(235)
Imnaha	67(6)	40(75)	67(6)	--(--)	--(--)	--(--)	45(251)	57(51)

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