Investigations into the Life History of Naturally Produced Spring Chinook Salmon and Summer Steelhead in the Grande Ronde River Subbasin

Annual Report 2014

BPA Project # 1992-026-04
Report covers work performed under BPA contracts # 60987 and 64286
Report was completed under BPA contracts # 64286 and 68144
1/1/2014 - 12/31/2014

Brian C. Jonasson
Edwin R. Sedell
Shelley K. Banks
Alan B. Garner
Christopher Horn
Kasey L. Bliesner
Joshua W. Dowdy
Francis W. Drake
Scott D. Favrot
Justin M. Hay
Nicole A. McConnell
Joel P. Ophoff
Bradley C. Power
James R. Ruzycki
Richard W. Carmichael

Oregon Department of Fish and Wildlife
La Grande, OR, 97850

March 2015

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

Table of Contents

List of Figures

List of Figures (continued)

List of Figures (continued)

List of Figures (continued)

List of Tables

List of Tables (continued)

ABSTRACT

Juvenile Spring Chinook Salmon and Summer Steelhead Life History Monitoring

We determined migration timing, abundance, and survival of juvenile spring Chinook salmon *Oncorhynchus tshawytscha* and steelhead *Oncorhynchus mykiss* using rotary screw traps at five locations in the Grande Ronde River Subbasin. In Catherine Creek, we estimated 30,791 juvenile spring Chinook salmon and 25,939 steelhead migrated from upper rearing areas, and 58% of the Chinook salmon and 21% of the steelhead migrated in fall. In Lostine River, we estimated 68,046 juvenile spring Chinook salmon and 22,094 steelhead migrated from upper rearing areas, and 74% of the Chinook salmon and 72% of the steelhead migrated in fall. In Minam River, we estimated 70,074 juvenile spring Chinook salmon and 48,605 steelhead migrated from upper rearing areas, and 74% of the Chinook salmon and 46% of the steelhead migrated in fall. In upper Grande Ronde River, we estimated 32,842 juvenile spring Chinook salmon and 19,774 steelhead migrated from upper rearing areas, and 50% of the Chinook salmon and 18% of the steelhead migrated in fall. In middle Grande Ronde River, we estimated 56,469 juvenile spring Chinook salmon and 132,413 juvenile steelhead migrated from the Upper Grande Ronde Watershed.

Combining abundance estimates and survival estimates with estimates of spawners, obtained from Lower Snake River Compensation Plan - Oregon Evaluation Project, we estimate smolts per spawner, which is an indicator for the Viable Salmonid Population (VSP) parameter, productivity. We estimated that in Catherine Creek the number of spring Chinook salmon smolt equivalents leaving Catherine Creek was 20,494 for the 2014 migratory year (2012 brood year), for productivity of 32 smolts per spawner. We estimated that in Lostine River the number of spring Chinook salmon smolt equivalents leaving Lostine River was 61,259 for the 2012 brood year, for productivity of 36 smolts per spawner. We estimated that in Minam River the number of spring Chinook salmon smolt equivalents leaving Minam River was 38,706 for the 2012 brood year, for productivity of 62 smolts per spawner. We estimated that in upper Grande Ronde River the number of spring Chinook salmon smolt equivalents leaving upper Grande Ronde River was 27,278 for the 2012 brood year, for productivity of 71 smolts per spawner.

In 2014, we saw relatively high numbers of juvenile spring Chinook salmon from all of our study streams, resulting from the high number of spawners in 2012, continuing the increasing trend in juvenile migrants. We continue to see smaller juvenile spring Chinook salmon at higher spawner densities, which results in lower survival to Lower Granite Dam. The lower survival of the out-migrants results in low estimates of smolts/spawner, one indicator of the VSP parameter productivity. The higher number of spawners, whether of hatchery or natural origin, produced more total migrants but produced lower numbers of smolts per spawner, due to reduced survival rates of smolts. Habitat restoration projects funded by BPA and Bureau of Reclamation in the Upper Grande Ronde River watershed are addressing habitat capacity which should, in turn, result in an increase in productivity, such as smolts/spawner.

Steelhead emigrant abundance was above the trend line in all four streams we have been monitoring since 2000. In the future, this project will combine the out-migrant estimates, age

structure, and survival rates to quantify the number of smolts by age and relate to the appropriate number of spawners to estimate smolts/spawner, a VSP indicator of productivity.

Steelhead Spawner Surveys

We conducted 119 surveys in the Upper Grande Ronde River (UGRR) basin and 73 surveys in the Joseph Creek basin from 17 March through 11 June 2014 to determine summer steelhead *Oncorhynchus mykiss* redd abundance and adult escapement for these two populations. We sampled 29 random, spatially-balanced sites throughout the UGRR basin encompassing 61.3 km (6.9%) of an estimated 892 km of available steelhead spawning habitat. In Joseph Creek, we surveyed 25 sites encompassing 51.8 km (13.5%) of the 384 km of available spawning habitat. During these surveys we observed 65 steelhead redds and 19 live steelhead in the UGRR basin and 130 redds and 18 live steelhead in the Joseph Creek basin. We observed two carcasses in Joseph Creek basin and no carcasses in the UGRR basin.

On 18.7 km of Deer Creek, 18 redds, five live steelhead, and three carcasses were observed during five survey visits. A total of 48 wild-origin adult steelhead were passed above a permanent weir on Deer Creek, resulting in a 2.67 fish:redd ratio for the 2014 spawning season.

Abundance of Steelhead Spawners at the Population Level

Using the fish:redd ratio extrapolated from Deer Creek surveys, adult steelhead escapement estimates for the UGRR and Joseph Creek basins were 2,512 (95% C.I.: 1,538–3,487) and 2,522 (95% C.I.: 1,744–3,300) respectively. Escapement estimates in the UGRR sub-basin had been relatively stable from 2008-2012, but showed a substantial decrease in 2013. Estimates from 2014 rebounded from this low, but still were lower than the long term average. The UGRR estimate was roughly half of it's running average over that period of time. This was the third GRTS-based steelhead spawning ground survey in Joseph Creek, and estimates were the highest we have observed through this project.

Steelhead and Chinook Salmon Parr Surveys, Parr Density, and Distribution.

Salmonids were observed at all 60 of the surveyed CHaMP sites in 2014. Steelhead were found at all 60 sites, Chinook salmon at 29, and bull trout *Salvelinus confluentus* at only eight sites.

In the UGRR sub-basin, Chinook were usually the dominant salmonid in mainstem snorkel survey, with counts in the hundreds, while counts were in the dozens for tributaries. There were fewer tributary observations of Chinook in 2014 than in previous years. In total, 4,586 juvenile Chinook were observed during snorkel surveys.

Steelhead were more widely distributed than Chinook, with individuals observed at all sites in 2014. Counts were higher than Chinook, with 5,563 individuals observed. Steelhead counts were much higher than in previous years, but this is an artifact of a change in methods. Previously , only steelhead >70mm in length were counted. In 2014, we counted all steelhead that could be positively identified.

Catherine Creek and UGRR had the highest densities of Chinook, similar to previous years. Steelhead densities were highest in lower Fly Creek and Catherine Creek.

Juvenile Chinook salmon and steelhead density estimates, were significantly higher (Kruskal-Wallis with Dunn's Test, $p<0.05$) in pools than fastwater units or runs (Appendix Table B-26). There was no statistically significant difference between densities in fastwater units compared to runs.

Introduction

The goal of this project is to investigate the critical habitat, abundance, migration patterns, survival, and alternate life history strategies exhibited by spring Chinook salmon and summer steelhead juveniles from distinct populations in the Grande Ronde River and Imnaha River subbasins (Figures 1 and 2). This project will provide information on abundance of spring Chinook salmon and steelhead parr , estimates for egg-to-migrant survival for spring Chinook salmon and migrant survival for steelhead, estimate the Viable Salmonid Population (VSP) Indicator smolts per spawner for four populations of spring Chinook salmon, and assess stream conditions in selected study streams. This study provides a means for long term monitoring of juvenile salmonid production in the Grande Ronde and Imnaha River subbasins that is essential for assessing the success of restoration and enhancement efforts including hatchery supplementation and habitat improvement. As hatchery supplementation of spring Chinook salmon continues in the Grande Ronde Subbasin, we will monitor abundance of migrants, life history characteristics, and survival to various life stages to provide data to the Lower Snake River Compensation Plan - Oregon Evaluation project to determine the effectiveness of this management action.

This project coordinates and collaborates with many projects, including Columbia River Intertribal Fish Commission (CRITFC) and their project 2009-004-00 Monitoring Recovery Trends in Key Spring Chinook Habitat Variables and Validation of Population Viability Indicators, the Columbia Habitat and Monitoring Program (CHaMP) project 2011-006-00, and Lower Snake River Compensation Plan - Oregon Evaluation project. This project provides data for the Interior Columbia Technical Recovery Team (ICTRT) spring Chinook salmon life cycle model.

Objectives for FY14:

1. Document the in-basin migration patterns and estimate abundance of spring Chinook salmon juveniles in Catherine Creek and the upper Grande Ronde, Minam, and Lostine rivers.

2. Determine overwinter mortality and the relative success of fall (early) migrant and spring (late) migrant life history strategies for spring Chinook salmon from tributary populations in Catherine Creek and the upper Grande Ronde, and Lostine rivers, and the relative success of fall (early) migrant and spring (late) migrant life history strategies for spring Chinook salmon from the Minam River.

3. Estimate and compare smolt survival probabilities at main stem Columbia and Snake River dams for migrants from five local, natural populations of spring Chinook salmon in the Grande Ronde River and Imnaha River subbasins.

4. Document the annual migration patterns for spring Chinook salmon juveniles from five local, natural populations in the Grande Ronde River and Imnaha River subbasins: Catherine Creek, Upper Grande Ronde, Lostine, Minam, and Imnaha rivers.

5. Document patterns of movement and estimate abundance of juvenile steelhead from tributary populations in Catherine Creek, the upper Grande Ronde, Lostine and the Minam rivers including migration timing, and duration.

6. Estimate and compare survival probabilities to main stem Columbia and Snake River dams for summer steelhead from four tributary populations: Catherine Creek and the upper Grande Ronde, Lostine, and Minam rivers.

7. Describe aquatic habitat conditions, using water temperature and discharge, in Catherine Creek and the upper Grande Ronde, Lostine, and Minam rivers.

8. Estimate reach survival through the Grande Ronde Valley of Chinook salmon migrants from Catherine Creek.

9. Estimate adult steelhead escapement to the Upper Grande Ronde and Joseph Creek populations.

10. Estimate density and distribution of steelhead parr from the Upper Grande Ronde population and Chinook salmon parr from the Upper Grande Ronde and Catherine Creek populations.

The project addresses the following strategy questions associated with Fish Population Status Monitoring:

- Assess the status and trend of juvenile abundance and productivity of natural origin fish populations.
  What are the status and trend of juvenile abundance and productivity of fish populations?

- Assess the status and trend of spatial distribution of fish populations.
  What are the status and trend of spatial distribution of fish populations?

- Assess the status and trend of diversity of natural and hatchery origin fish populations.
  What are the status and trend of diversity of natural and hatchery origin fish populations?

The focal species are Snake River Spring/Summer Chinook salmon and Snake River steelhead.

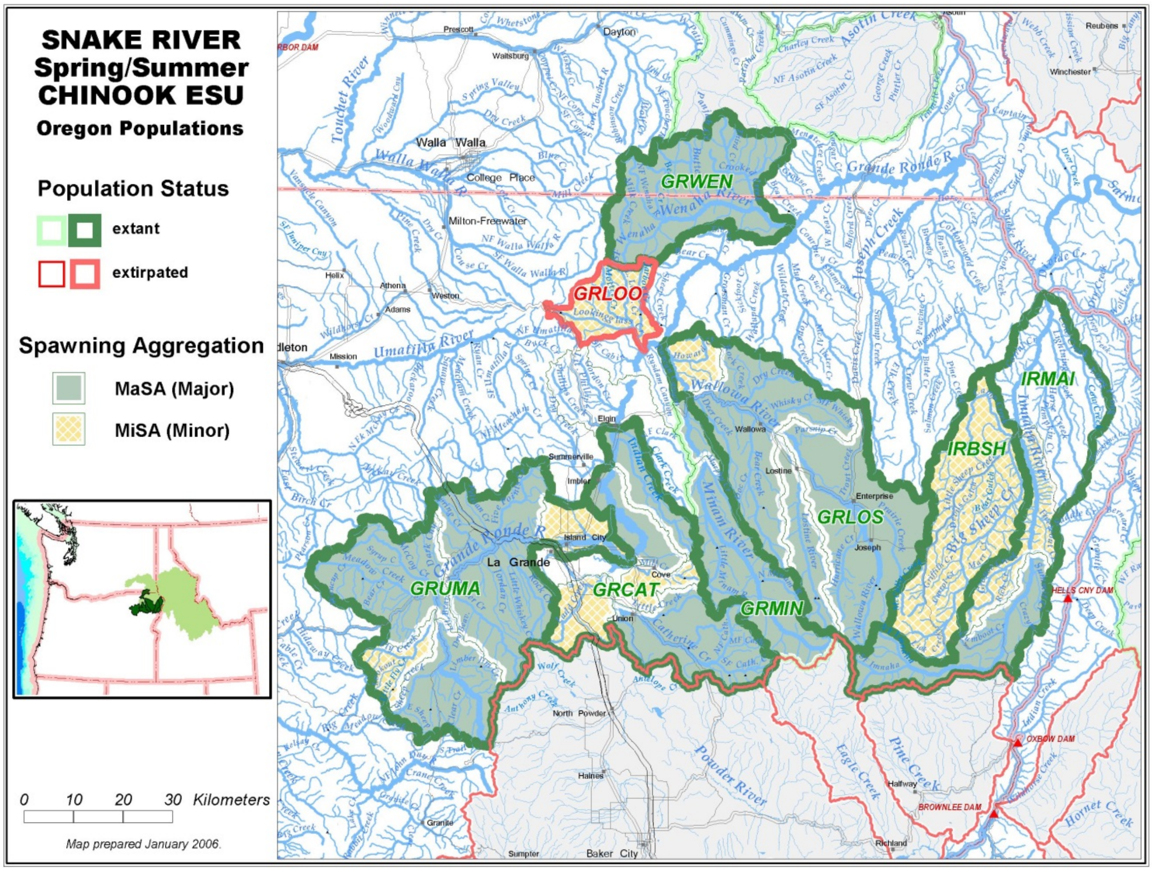


Figure 1. Map of the Grande Ronde-Imnaha spring Chinook salmon MPG with individual Chinook salmon populations identified. This project monitors these populations within this MPG: Upper Grande Ronde River (GRUMA), Catherine Creek (GRCAT), Minam River (GRMIN), Lostine River (GRLOS), and Imnaha River (IRMAI).

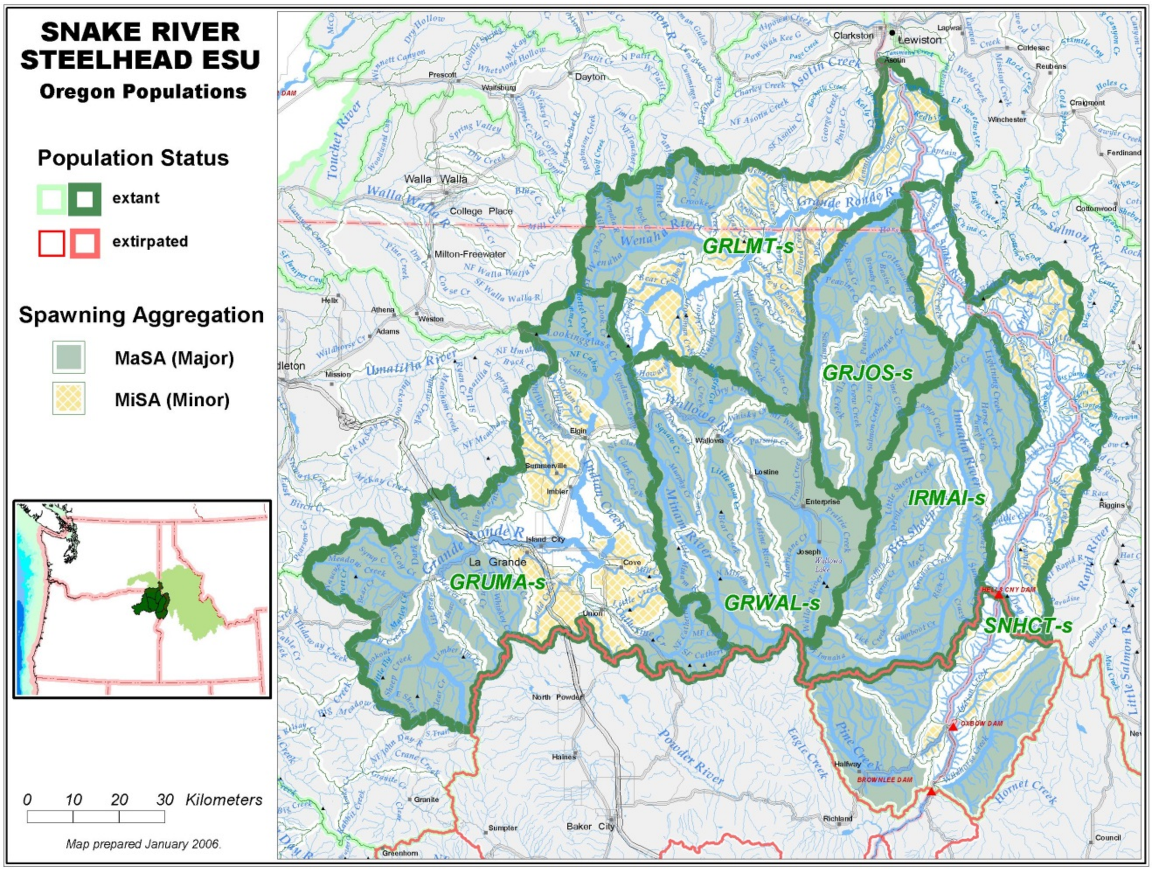


Figure 2. Map of the Grande Ronde-Imnaha steelhead MPG with individual steelhead populations identified. This project monitors these populations within this MPG: Upper Grande Ronde River (GRUMA-s), Wallowa River (GRWAL-s), and Joseph Creek (GRJOS-s).

Juvenile Spring Chinook Salmon and Summer Steelhead Life History Monitoring

Introduction

Numerous enhancement activities, including hatchery supplementation and habitat restoration, have been undertaken to recover spring Chinook salmon populations in Grande Ronde River Subbasin. Supplementation programs have been initiated by Oregon Department of Fish and Wildlife, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe using endemic broodstock from Catherine Creek and Lostine and upper Grande Ronde rivers. This study provides a means for long term monitoring of juvenile salmonid production in the Grande Ronde and Imnaha River subbasins that is essential for assessing the success of restoration and enhancement efforts including hatchery supplementation and habitat improvement. As hatchery supplementation of spring Chinook salmon continues in the Grande Ronde Subbasin, we will monitor abundance of migrants, life history characteristics, and survival to various life stages to determine the effectiveness of this management action.

Methods

Life history of spring Chinook salmon and summer steelhead (1992-026-04): http://www.monitoringmethods.org/Protocol/Details/217

The locations of the rotary screw traps are shown in Figure 3.

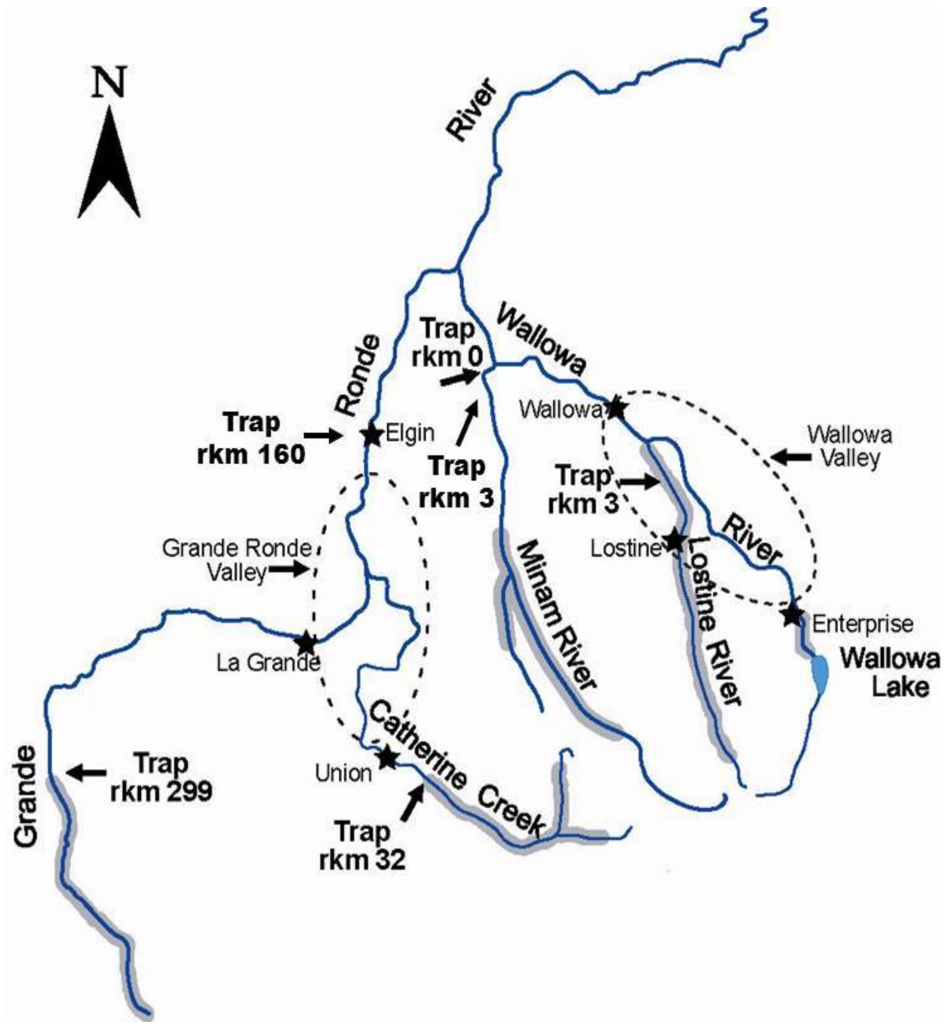


Figure 3. Locations of fish traps in Grande Ronde River Subbasin during the study period. Shaded areas delineate spring Chinook salmon spawning and upper rearing areas. Dashed lines indicate Grande Ronde and Wallowa river valleys.

Results
Spring Chinook Salmon

We estimated a minimum of 30,791 ± 2,501 juvenile spring Chinook salmon emigrated from Catherine Creek upper rearing areas during MY 2014 (Figure 4). Based on total minimum estimate, 58% (18,012 ± 1,308) migrated early and 42% (12,779 ± 2,132) migrated late.

We estimated a minimum of 68,046 ± 5,999 juvenile spring Chinook salmon emigrated from Lostine River during MY 2014 (Figure 5). Based on the minimum estimate, 74% (50,518 ± 5,426) of juvenile spring Chinook salmon migrated early, while 26% (17,528 ± 2,558) migrated late.

We estimated a minimum of 70,074 ± 7,036 juvenile spring Chinook salmon emigrated from Minam River during MY 2014 (Figure 6). Based on the minimum estimate, 74% (51,948 ± 6,590) of juvenile spring Chinook salmon migrated early and 26% (18,126 ± 2,465) migrated late.

We estimated a minimum of 32,842 ± 4,663 juvenile spring Chinook salmon emigrated from upper Grande Ronde River during MY 2014 (Figure 7). Based on the minimum estimate, 50% (16,362 ± 1,217) of juvenile spring Chinook salmon migrated early and 50% (16,480 ± 4,502) migrated late.

The middle Grande Ronde River trap at Elgin fished for fished for 100 d between 26 February 2014 and 17 June 2014. We estimated a minimum of 56,469 ± 23,066 juvenile spring Chinook salmon emigrated from upper rearing areas.

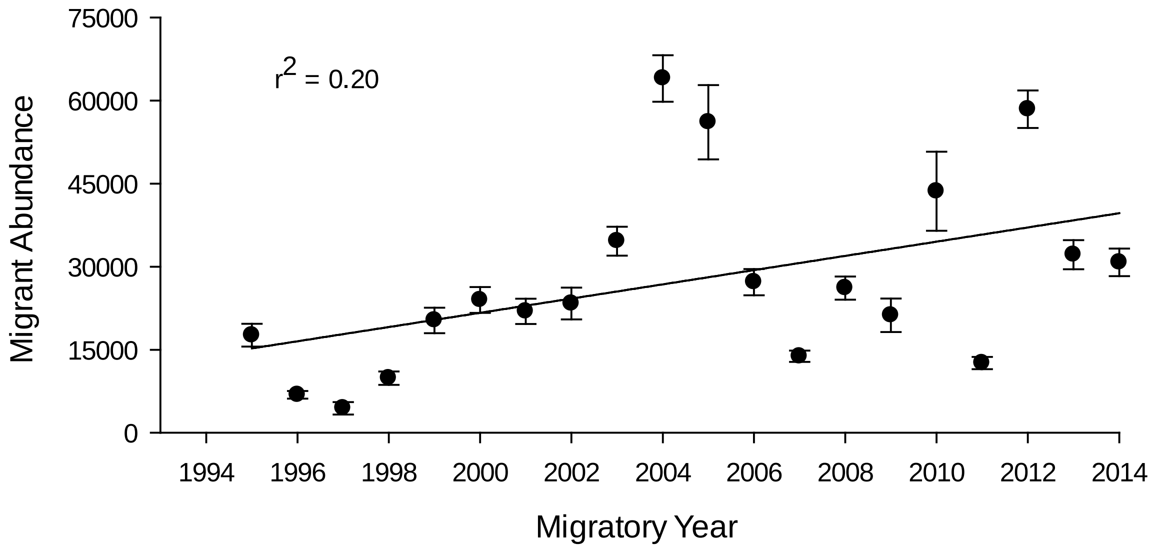


Figure 4. Spring Chinook salmon migrant abundance estimates at the Catherine Creek trap site by migratory year. Error bars are 95% confidence intervals.

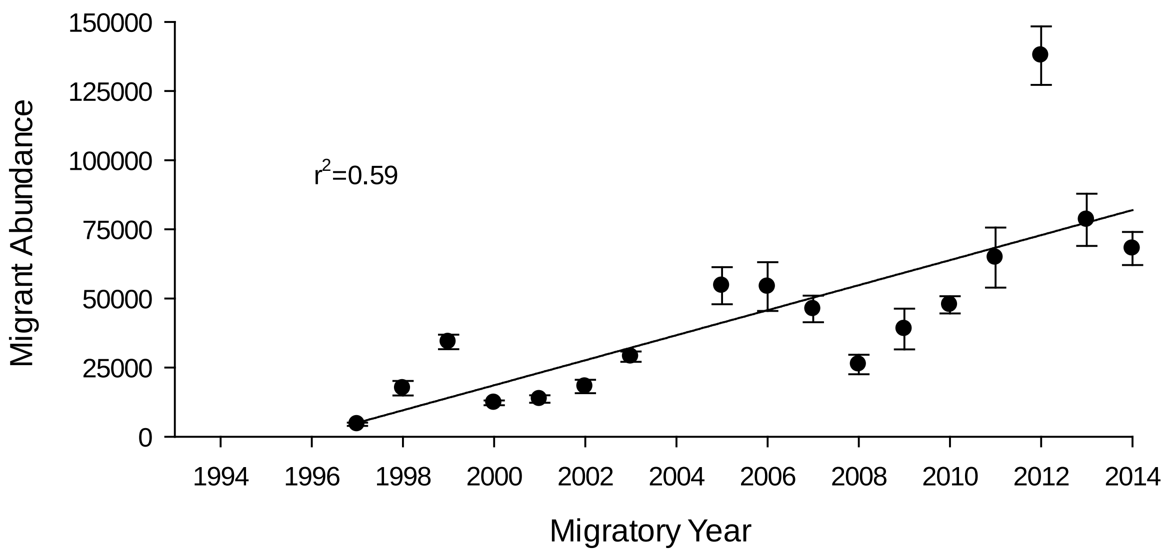


Figure 5. Spring Chinook salmon migrant abundance estimates at the Lostine River trap site by migratory year. Error bars are 95% confidence intervals.

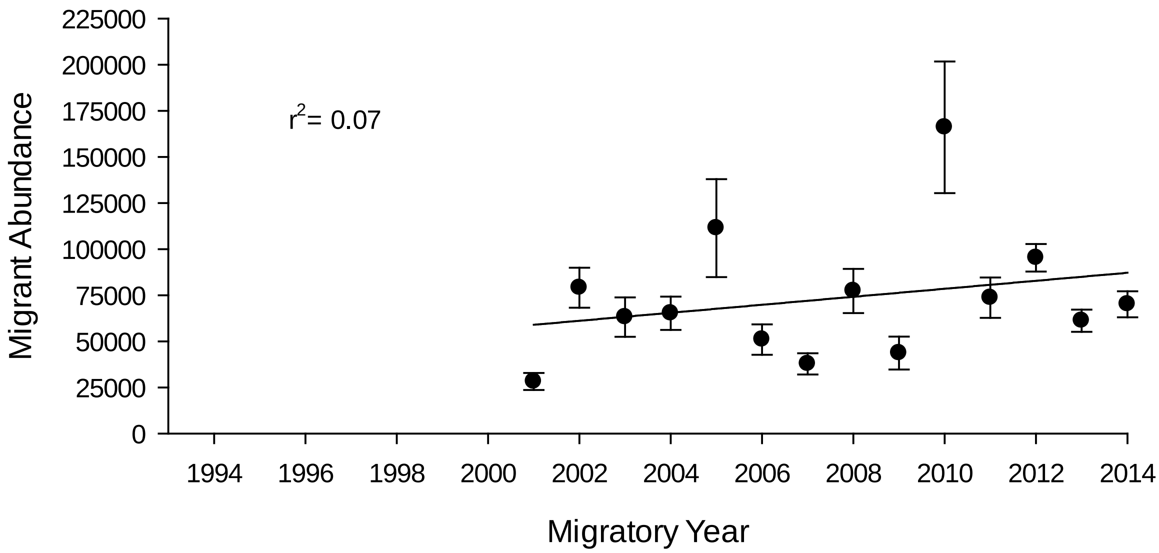


Figure 6. Spring Chinook salmon migrant abundance estimates at the Minam River trap site by migratory year. Error bars are 95% confidence intervals.

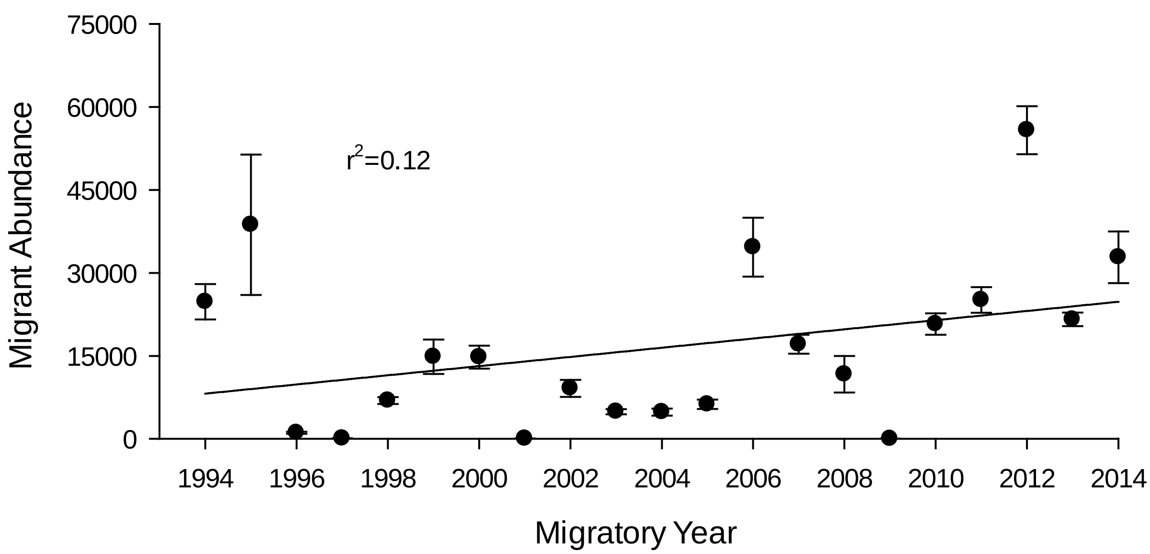


Figure 7. Spring Chinook salmon migrant abundance estimates at the upper Grande Ronde River trap site by migratory year. Error bars are 95% confidence intervals.

Fork lengths of juvenile spring Chinook salmon migrants at each of our rotary screw traps are shown in Figures 8 – 11. Mean fork lengths of migrants at the Catherine Creek, Minam, Lostine, and upper Grande Ronde River traps during the 2014 migratory year were within the range of fork lengths seen at these traps in previous years. We have observed that the length of fall migrants is negatively correlated with the abundance of parr in late summer (ODFW unpublished data).

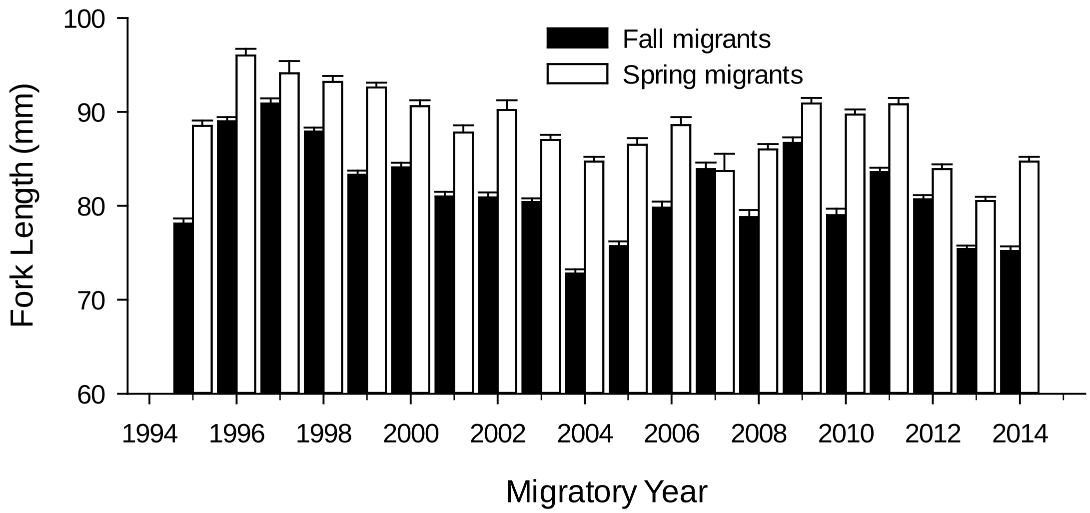


Figure 8. Fork length of spring Chinook salmon migrants captured at the Catherine Creek rotary screw trap by migratory year. Error bars are 95% confidence intervals.

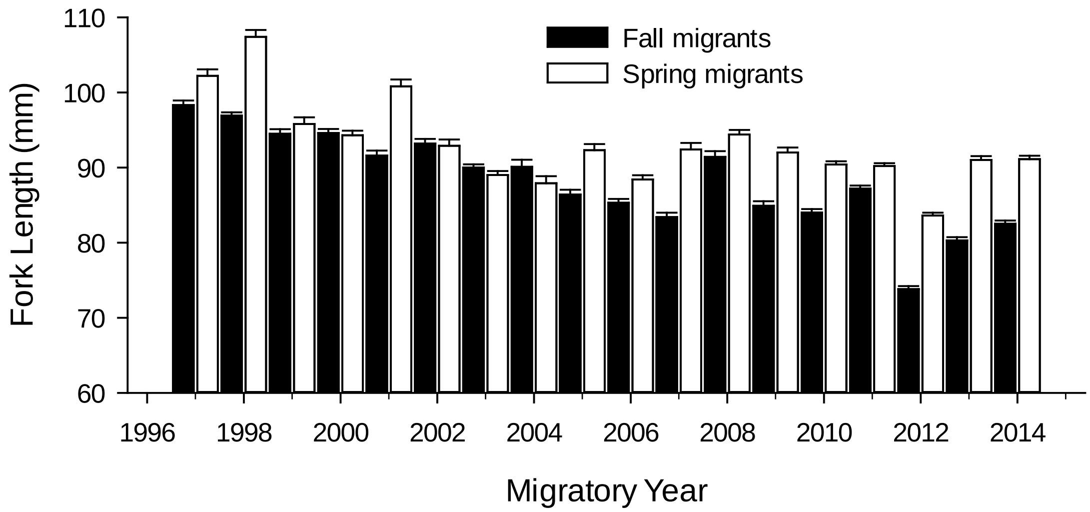


Figure 9. Fork length of spring Chinook salmon migrants captured at the Lostine River rotary screw trap by migratory year. Error bars are 95% confidence intervals.

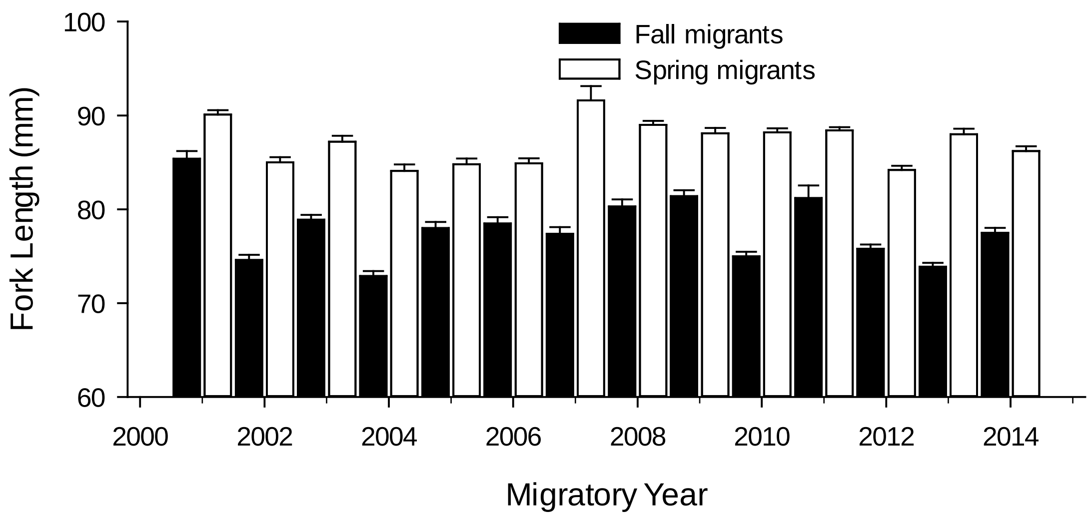


Figure 10. Fork length of spring Chinook salmon migrants captured at the Minam River rotary screw trap by migratory year. Error bars are 95% confidence intervals.

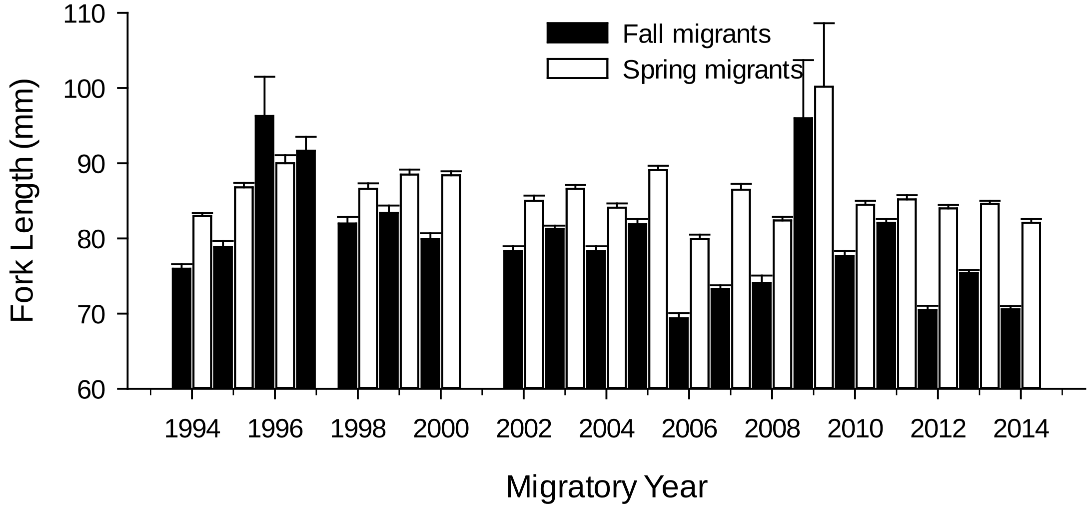


Figure 11. Fork length of spring Chinook salmon migrants captured at the upper Grande Ronde River rotary screw trap by migratory year. Error bars are 95% confidence intervals.

Survival probabilities to Lower Granite Dam for parr tagged during summer 2013 were 0.092 for Upper Catherine Creek, 0.019 for Lower Catherine Creek, 0.128 for Imnaha, 0.127 for Lostine, 0.134 for Minam, and 0.102 for upper Grande Ronde river populations (Figure 12). Generally, survival probabilities during MY 2014 fell within ranges previously reported; however, Lower Catherine Creek survival probability estimate (0.019) is the lower than any survival estimate previously reported.

Catherine Creek fall, winter, and spring tag group survival probabilities to Lower Granite Dam were 0.144, 0.116, and 0.340, respectively. Survival probabilities for Lostine River fall, winter, and spring tag groups were 0.209, 0.206, and 0.520, respectively. Probability of survival for the middle Grande Ronde River spring tag group was 0.677. Survival probabilities for Minam River fall and spring tag groups were 0.227 and 0.573, respectively. Upper Grande Ronde River fall, winter, and spring tag group survival probabilities to Lower Granite Dam were 0.201, 0.072, and 0.340, respectively. Survival probabilities, similar to past years, were generally higher for spring tag groups, likely because these fish were not subject to overwinter mortality that summer, fall, and winter tag groups experienced (Figure 12).

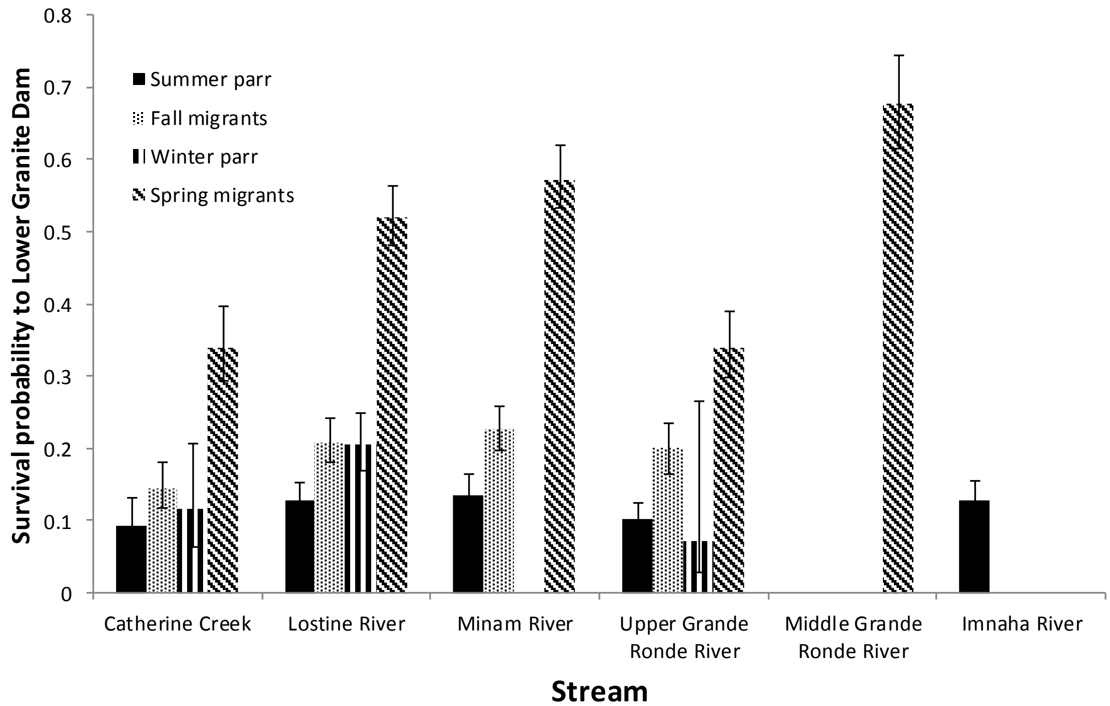


Figure 12. Survival probability to Lower Granite Dam of juvenile spring Chinook salmon PIT tagged at various life stages for the 2014 migratory year. Error bars are 95% confidence intervals.

Smolt equivalents are defined as the estimated number of smolts from a population that successfully emigrate from a specified area (Hesse et al. 2006). Combining the survival probability data with our migrant abundance estimates, we estimated the number of smolt equivalents produced in our study streams upstream of our rotary screw traps. In migratory year 2014 we estimated 20,494 smolt equivalents from Catherine Creek, 61,259 smolt equivalents from Lostine River, 38,706 smolt equivalents from Minam River, and 27,278 smolt equivalents from upper Grande Ronde River (Figure 13).

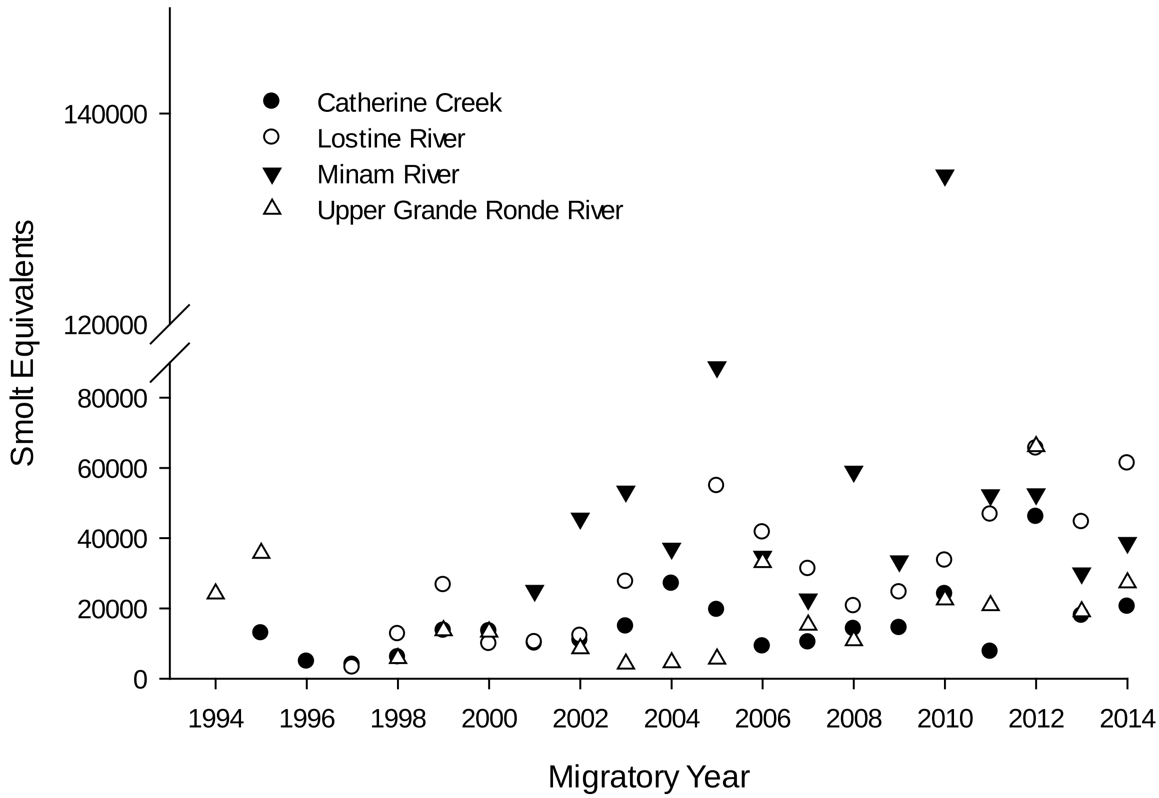


Figure 13. Spring Chinook salmon smolt equivalents produced from redds upstream of rotary screw traps in four study streams by migratory year.

Estimated productivity of spring Chinook salmon in Catherine Creek was 32 smolts per spawner for the 2012 brood year (2014 migratory year, Figure 14). Estimated productivity of spring Chinook salmon in Lostine River was 36 smolts per spawner for the 2012 brood year (2014 migratory year, Figure 15). Estimated productivity of spring Chinook salmon in Minam River was 62 smolts per spawner for the 2012 brood year (2014 migratory year, Figure 16). Estimated productivity of spring Chinook salmon in upper Grande Ronde River was 71 smolts per spawner for the 2012 brood year (2014 migratory year, Figure 17).

Plots of smolts per spawner versus spawners for each of the study streams show that productivity, as measured as smolts per spawner, decreases at higher spawner densities (Figures 18 – 21).

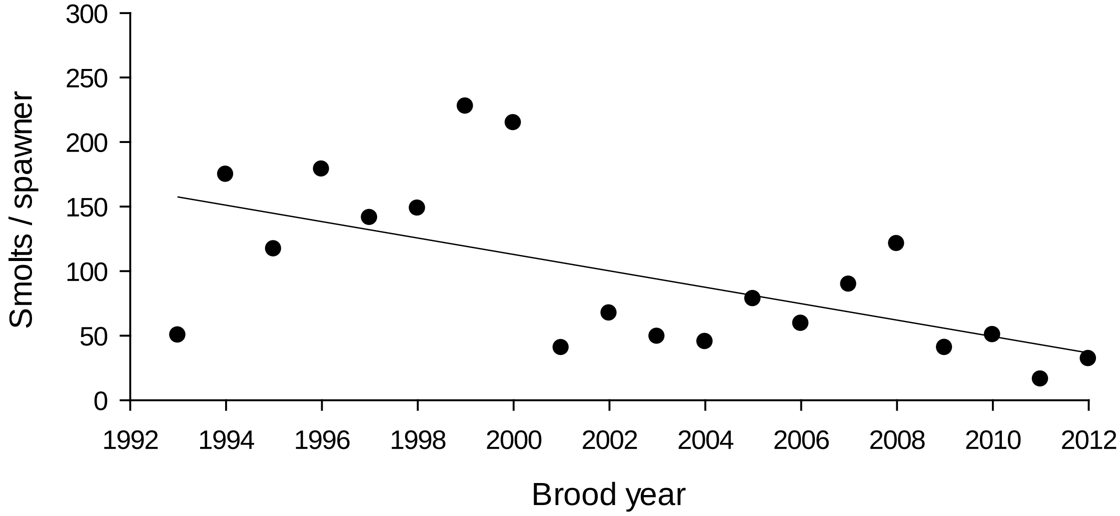


Figure 14. Spring Chinook salmon smolt equivalents produced per spawner in Catherine Creek by brood year.

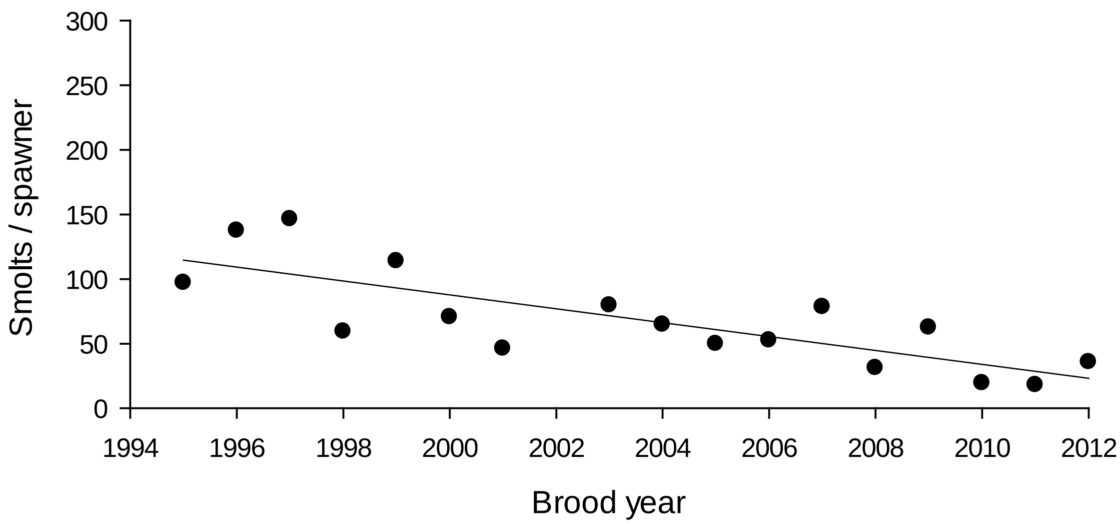


Figure 15. Spring Chinook salmon smolt equivalents produced per spawner in Lostine River by brood year.

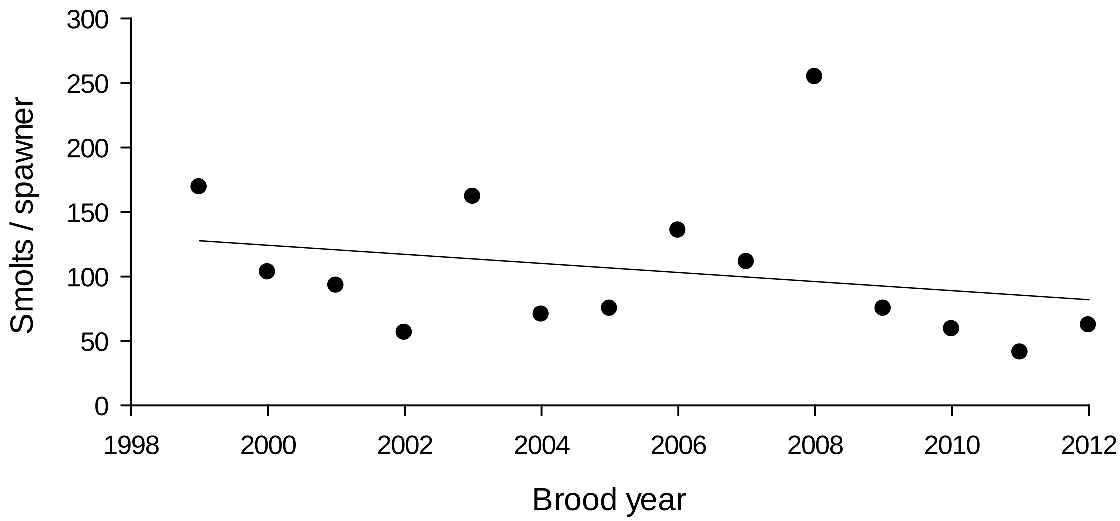


Figure 16. Spring Chinook salmon smolt equivalents produced per spawner in Minam River by brood year.

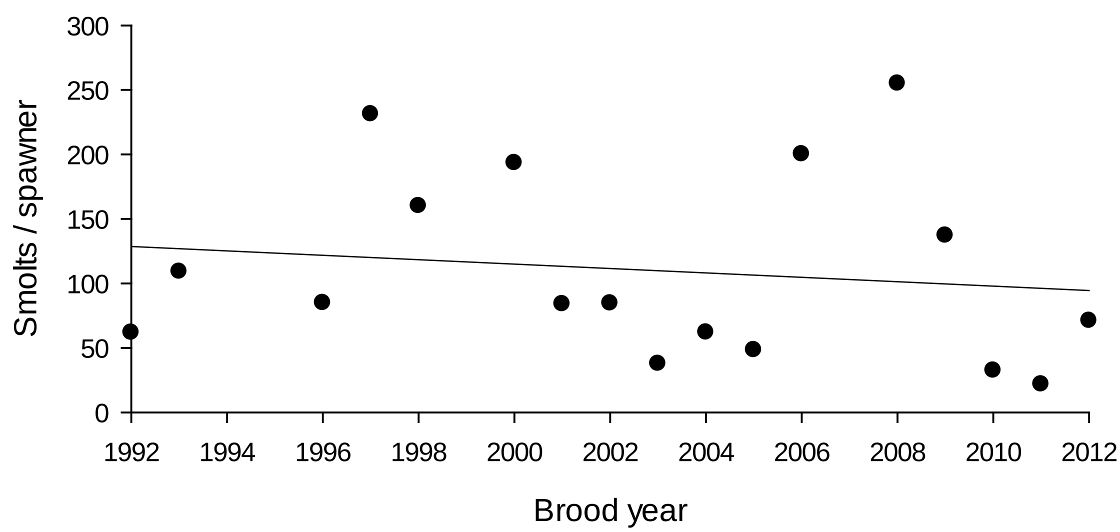


Figure 17. Spring Chinook salmon smolt equivalents produced per spawner in upper Grande Ronde River by brood year.

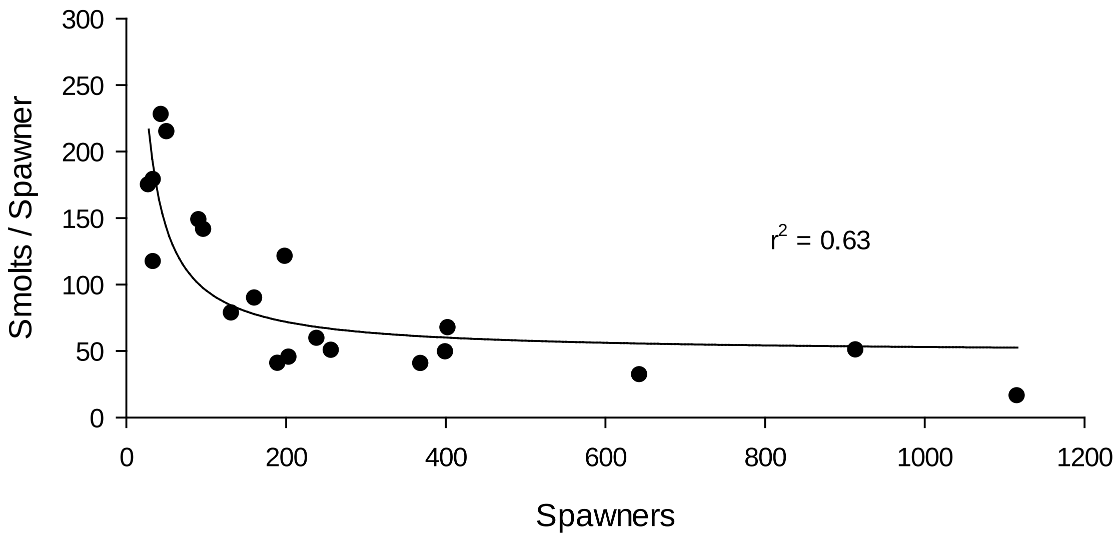


Figure 18. Spring Chinook salmon smolt equivalents produced per spawner in Catherine Creek by number of spawners.

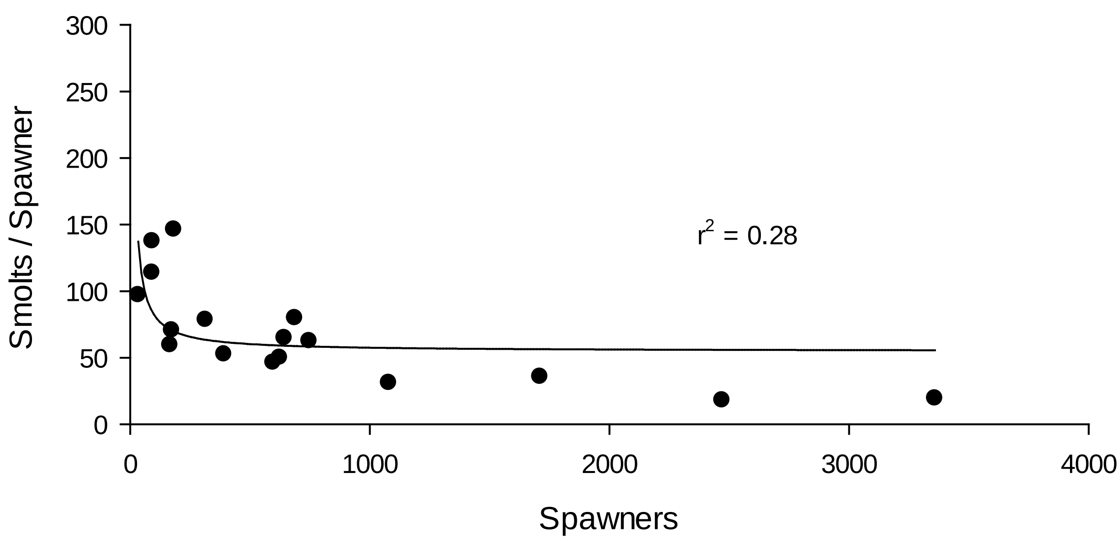


Figure 19. Spring Chinook salmon smolt equivalents produced per spawner in Lostine River by number of spawners.

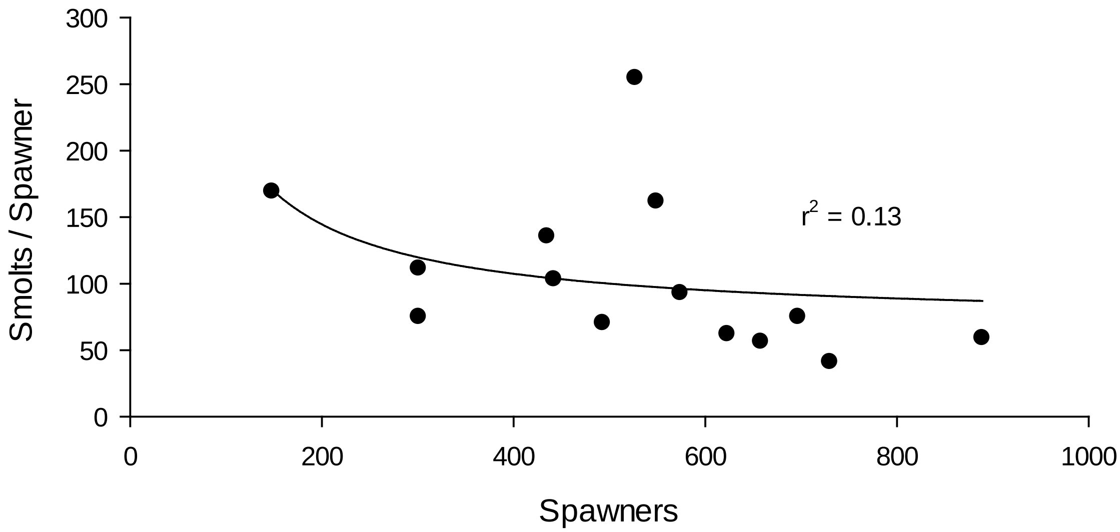


Figure 20. Spring Chinook salmon smolt equivalents produced per spawner in Minam River by number of spawners.

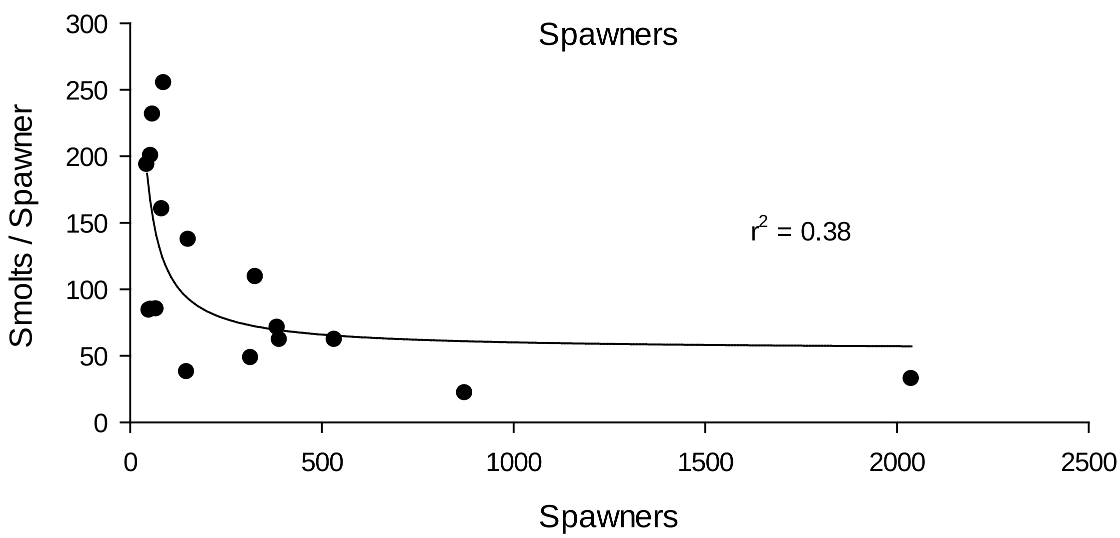


Figure 21. Spring Chinook salmon smolt equivalents produced per spawner in upper Grande Ronde River by number of spawners.

Radio-telemetry studies in 2014 consisted of determination of overwinter habitat use of early migrating juvenile spring Chinook salmon through the Grande Ronde River between our rotary screw trap and Elgin, OR. We found that the majority of juvenile spring Chinook salmon stayed within 10 km of the rotary screw trap through December 2014.

Steelhead

We estimated a minimum of 25,939 ± (95% CI, 4,463) juvenile steelhead migrated from Catherine Creek upper rearing areas during MY 2014 (Figure 22). Based on total minimum abundance estimate, 21% (5,366 ± 730) migrated early and 79% (20,573 ± 4,403) migrated late. MY 2014 proportion of juvenile steelhead emigrating from upper rearing areas as late migrants (79%) is within those proportions previously reported during 1997-2014.

We estimated a minimum of 22,094 ± 4,646 steelhead emigrated From Lostine River upper rearing areas during MY 2014 (Figure 23). Based on total minimum abundance estimate, 72% (15,889 ± 4,464) of juvenile steelhead migrated early and 28% (6,205 ± 1,286) migrated late. MY 2014 proportion of juvenile steelhead emigrating from upper rearing areas as late migrants (28%) is within those proportions previously reported during 1997-2014.

We estimated a minimum of 48,605 ± 7,824 juvenile steelhead migrated from Minam River rearing areas during MY 2014 (Figure 24). Based on total minimum abundance estimate, 46% (22,290 ± 6,288) migrated early and 54% (26,315 ± 4,655) migrated late. Proportion of juvenile steelhead emigrating as late migrants, during MY 2014, is consistent with proportions from previous migration years.

We estimated a minimum of 19,774 ± 2,951 juvenile steelhead emigrated from upper Grande Ronde River rearing areas during MY 2014, which is within estimates from previous migration years (Figure 25). Based on total minimum abundance estimate, 18% (3,516 ± 539) were early migrants and 82% (16,258 ± 2,902) were late migrants. Predominant late migration of juvenile steelhead in upper Grande Ronde River is consistent for all migration years studied to date.

The middle Grande Ronde River trap fished for 100 d between 26 February 2014 and 17 June 2014. We estimated a minimum of 132,413 ± 54,664 juvenile steelhead emigrated from upper rearing areas.

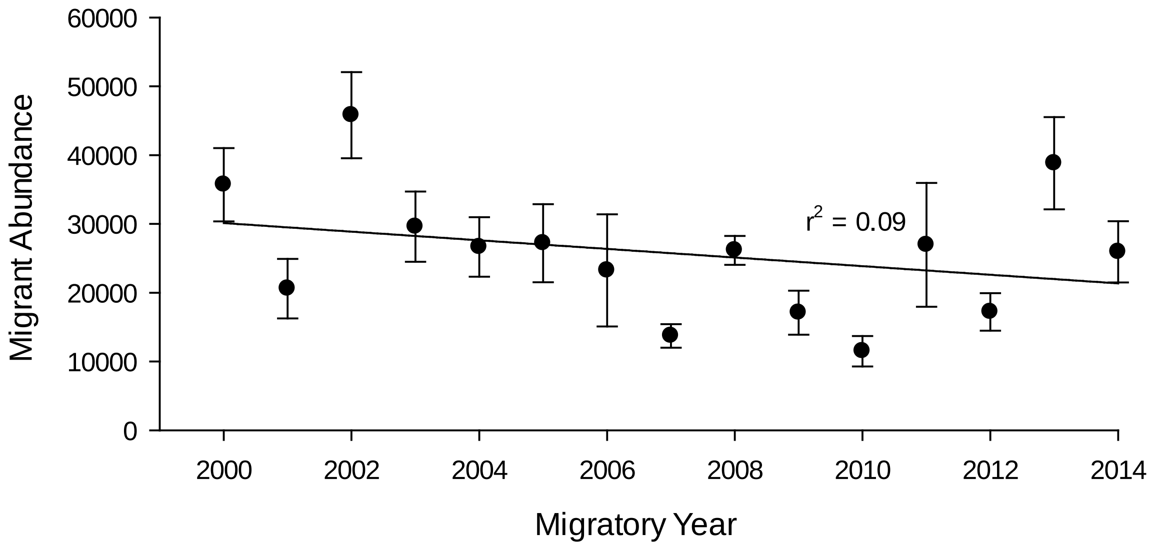


Figure 22. Steelhead migrant abundance estimates at the Catherine Creek trap site by migratory year. Error bars are 95% confidence intervals.

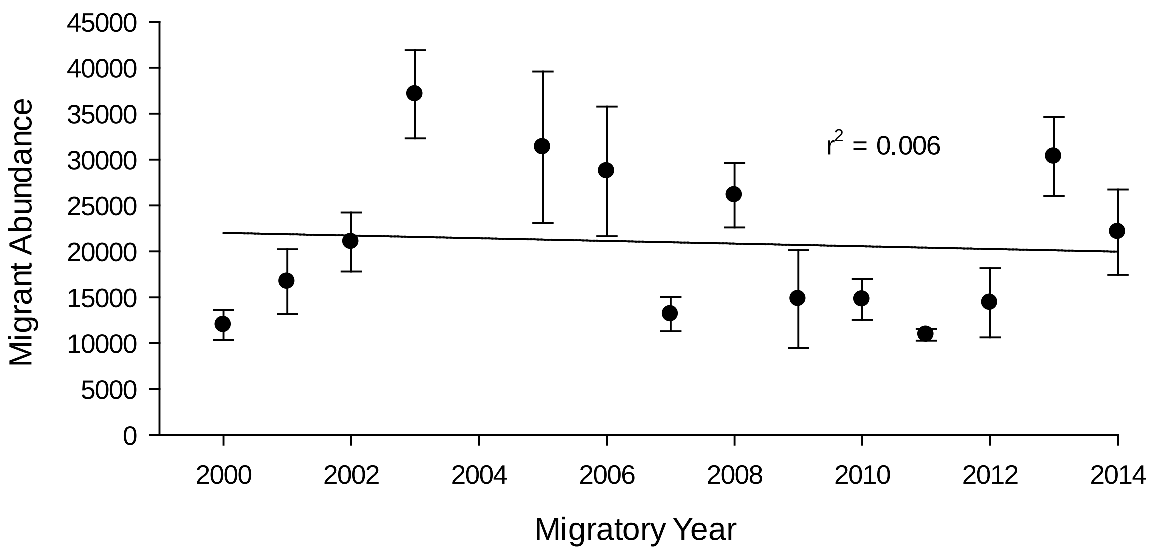


Figure 23. Steelhead migrant abundance estimates at the Lostine River trap site by migratory year. Error bars are 95% confidence intervals.

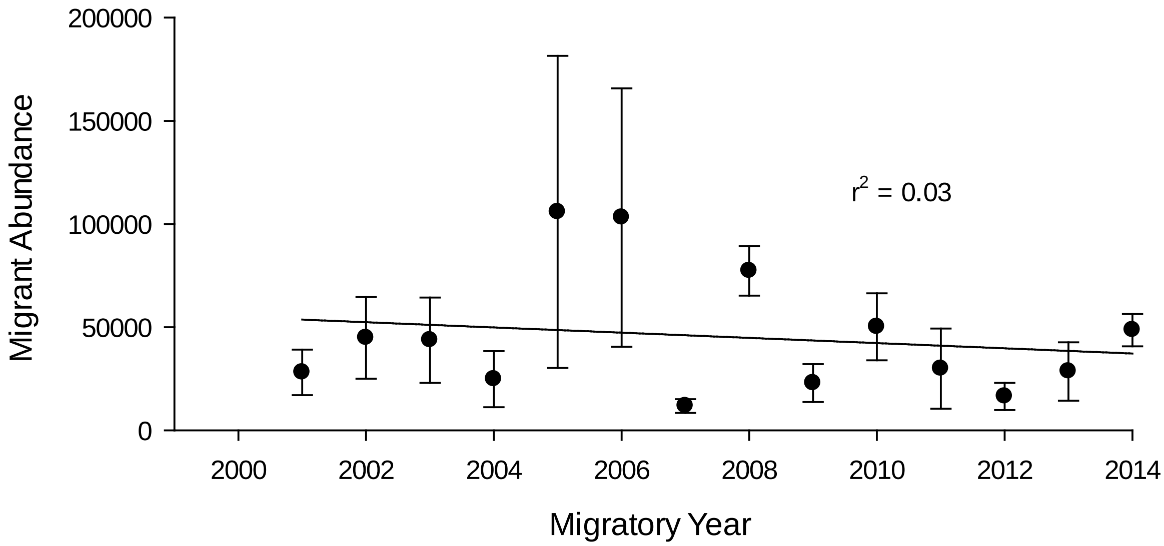


Figure 24. Steelhead migrant abundance estimates at the Minam River trap site by migratory year. Error bars are 95% confidence intervals.

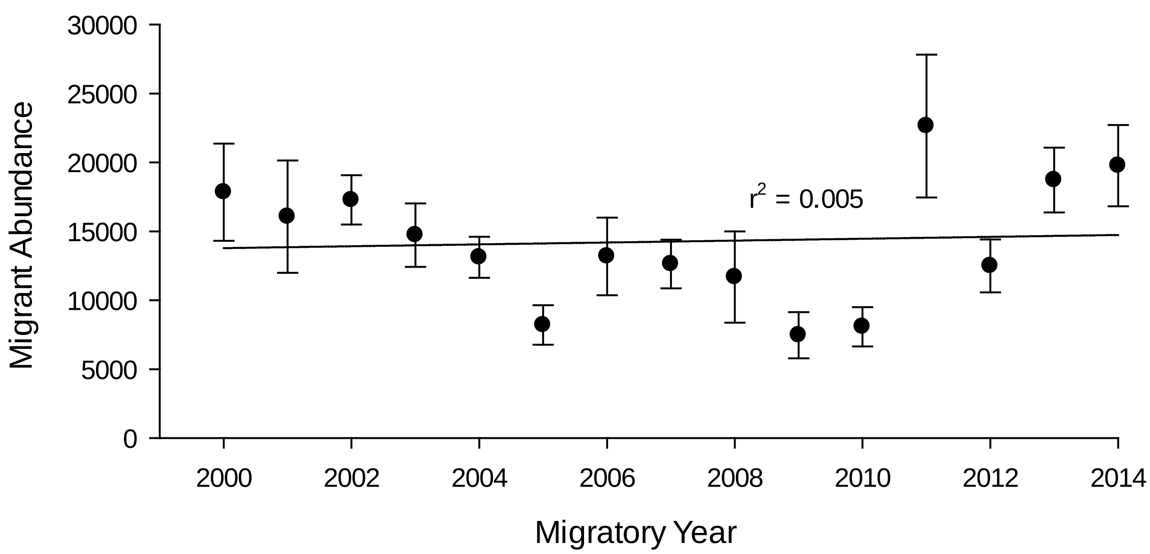


Figure 25. Steelhead migrant abundance estimates at the upper Grande Ronde River trap site by migratory year. Error bars are 95% confidence intervals.

Summer steelhead collected at trap sites during MY 2014 comprised five age-groups. Early migrants ranged from 0 to 4 years of age, while late migrants ranged from 1 to 4 years of age (Table 1). Majority of upper Grande Ronde river (51.5%) early migrants were age 1, while majority of Catherine Creek (54.4%), Lostine River (65.1%), and Minam River (82.9%) early migrants were age 0. Majority of Catherine Creek (74.6%), Lostine River (57.6%), and Minam River (57.8%) late migrants were age 1, while majority of middle Grande Ronde River (64.7%) and upper Grande Ronde River (53.1%) late migrants were age 2 (Table 1).

Table 1. Age structure of early and late steelhead migrants collected at trap sites during MY 2014. The same four cohorts were represented in each migration period, but ages increased by one year from early migrants to late migrants (e.g., age-0 early migrants were same cohort as age-1 late migrants). Age structure was based on frequency distribution of sampled lengths and allocated using an age–length key. Means were weighted by migrant abundance at trap sites.

	Percent				
Emigrant type and trap site	Age-0	Age-1	Age-2	Age-3	Age-4
Early					
Catherine Creek	54.4	40.3	5.0	0.3	0.0
Lostine River	65.1	22.6	12.0	0.3	0.0
Minam River	82.9	10.3	6.5	0.2	0.0
Upper Grande Ronde River	28.3	51.5	19.9	0.3	0.0
Late					
Catherine Creek	0.0	74.6	23.6	1.7	0.0
Lostine River	0.0	57.6	35.0	7.4	0.0
Minam River	0.0	57.8	29.9	11.8	0.6
Upper Grande Ronde River	0.0	34.1	53.1	12.7	0.0
Early and Late[a]					
Middle Grande Ronde River	0.0	25.0	64.7	10.3	0.0

[a] Middle Grande Ronde River trap was located downstream from Catherine Creek and upper Grande Ronde River overwinter rearing reaches resulting in early and late emigrants being sampled simultaneously during spring emigration.

Probability of surviving and migrating, during migration year of tagging, to Lower Granite Dam for steelhead tagged in fall 2013 ranged from 0.030 to 0.137 for all four spawning tributaries (Table 26). Probabilities of migration and survival, for larger steelhead (FL ≥ 115 mm) tagged during spring 2014, ranged from 0.463 to 0.794 for all five populations studied (Table 26). Generally, probabilities of migration and survival, during spring 2014, were similar for all five populations studied compared to previous years.

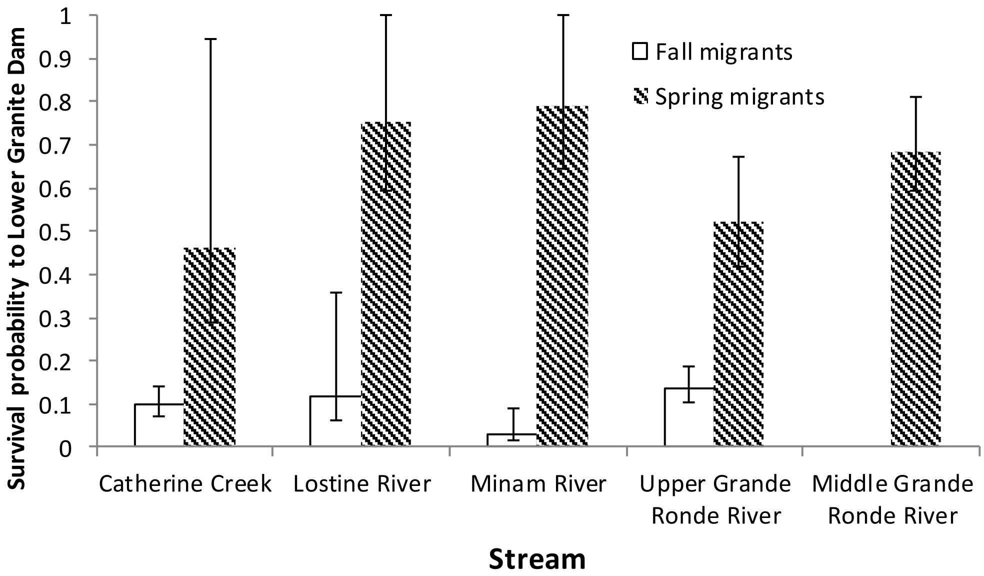


Figure 26. Probability of surviving and migrating, in the first year to Lower Granite Dam, for steelhead PIT-tagged at screw traps on Catherine Creek and Lostine, middle Grande Ronde, Minam, and upper Grande Ronde rivers during fall 2013 and spring 2014 (MY 2014). Catherine Creek and upper Grande Ronde River early migrants overwinter upstream of middle Grande Ronde River trap site, so no fall tag group was available for that site.

Conclusions

In 2014, we saw relatively high numbers of juvenile spring Chinook salmon from all of our study streams, resulting from the high number of spawners in 2012, continuing the increasing trend in juvenile migrants. We continue to see smaller juvenile spring Chinook salmon at higher spawner densities, which results in lower survival to Lower Granite Dam. The lower survival of the out-migrants results in low estimates of smolts/spawner, one indicator of the VSP parameter productivity. The higher number of spawners, whether of hatchery or natural origin, produced more total migrants but produced lower numbers of smolts per spawner, due to reduced survival rates of smolts. Habitat restoration projects funded by BPA and Bureau of Reclamation in the Upper Grande Ronde River watershed are addressing habitat capacity which should, in turn, result in an increase in productivity, such as smolts/spawner.

Steelhead emigrant abundance was above the trend line in all four streams we have been monitoring since 2000. In the future, this project will combine the out-migrant estimates, age structure, and survival rates to quantify the number of smolts by age and relate to the appropriate number of spawners to estimate smolts/spawner, a VSP indicator of productivity.

Steelhead Spawner Surveys

Introduction

Summer steelhead in the Grande Ronde River subbasin fall within the Snake River Distinct Population Segment (DPS) and are listed as threatened under the Endangered Species Act (62 FR 43937; August 18, 1997). The Upper Grande Ronde River (UGRR) and Joseph Creek watersheds (Figure 27) support two of the four Major Population Groups (MPG) in the Grande Ronde River subbasin. These populations are segregated based on topographic, genetic, and behavioral evidence of interactions. Historically, the Grande Ronde River was one of the more significant anadromous fish producing rivers in the Columbia River basin. Despite recovery efforts, these populations remain depressed relative to historic levels.

The goal of this project is to annually evaluate summer steelhead population abundance for the UGRR, and recently Joseph Creek, by conducting surveys of redds and spawning activity. These surveys provide those data needed to estimate adult steelhead escapement, improve our understanding of habitat utilization, and contribute to productivity and survival estimates for these populations.

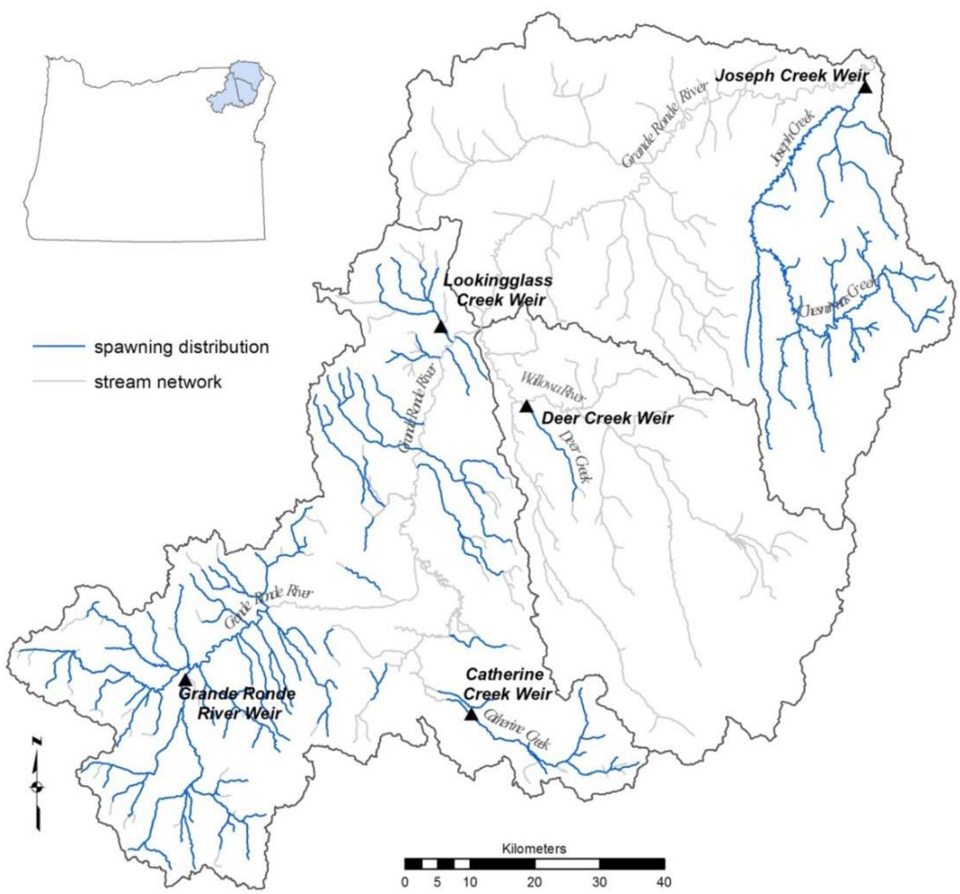


Figure 27. Grande Ronde River basin, divided by 4th order HUC. Steelhead distribution highlighted in blue for Joseph and UGRR subbasins.

Methods
Estimating Adult Summer Steelhead Escapement in North East Oregon
https://www.monitoringmethods.org/Protocol/Details/757

Results
We surveyed 29 sites in the UGRR (Figure 28) encompassing 61.3 km of an estimated 892 km (6.9 %) available steelhead spawning habitat (Appendix Table B-12). Two sites were not surveyed due to persistent high discharge and were not included in our calculations. Stream classification for the 29 surveyed sites was distributed evenly (10 sites in source classification, 9 in transport, and 10 in depositional). Four sites were located above the Grande Ronde River weir, two above the Catherine Creek weir, and one above the Lookingglass Creek weir.

Available spawning habitat was estimated at 897 km at the beginning of 2013 season, but we removed 5.2 km from Wright Slough, Orodell Ditch, and Conley Creek after determining this section of stream was ditched, had extremely low gradient, and little to no gravel available for spawning.

We conducted 119 surveys in the UGRR basin in 2014, with a mean interval of 16.6 days between surveys. A total of 65 steelhead redds were observed at 17 of the 29 sites (Appendix Table B-14). Redds were not evenly distributed among stream classifications: twelve (18%) were found in source areas, 31 (48%) in transport, and 22 (34%) in depositional reaches. A total of 19, live adult steelhead were observed in the UGRR (Appendix Table B-16). Of these fish three had an observable adipose fin clip, six were of wild origin, and 10 were of unknown origin. No carcasses were observed during our surveys in the UGGR basin.

Twenty-five sites were surveyed in Joseph Creek and tributaries (Figure 29), encompassing 51.8 km of an estimated 384 km (13.5 %) available spawning habitat (Appendix Table B-13), all of which were above the weir. Stream classification for the 25 sites was random with 10 sites surveyed in source classification, eight in transport, and seven in depositional.

A total of 73 surveys were completed in the Joseph Creek basin, with a mean interval of 10.5 days between surveys. We found 130 steelhead redds at 18 of the 25 sites (Appendix Table B-15). More redds were found in the depositional stream classification (n=53, 41%), than source or transport reaches (n=40 (31%) and 37 (28%) respectively). Eighteen live adult steelhead were observed at nine sites (Appendix Table B-17), while two dead, adult steelhead were found at two sites (Appendix Table B-18). No adipose-clipped hatchery fish were observed during our Joseph Creek surveys.

We conducted five surveys on Deer Creek encompassing 18.7 km of utilized spawning habitat from the weir to the USFS road 8270 bridge. In previous years, additional surveys were conducted upstream of these 18.7 km, and no redds or adult steelhead were observed.

We observed 18 redds on our visits to Deer Creek, 15 (83.3 %) of which were discovered in the lower 9.6 km. Seven live fish and three carcasses were observed on Deer Creek. Three adipose-clipped hatchery fish were also observed during our surveys.

Based on our redd observations, onset of spawn timing was similar between the UGRR and Joseph Creek basins, but a little later for Deer Creek. We observed the first redds on 25 March in the UGRR, March 19 Joseph Creek basins (Appendix Figure B-21) and 17 April in Deer Creek (Appendix Figure B-22). The last redds were observed on 06 June in the UGRR, 03 June in Joseph Creek and 15 May in Deer Creek. By 12 May, 52% of the total redds in the UGRR basin were observed. By 05 May, 61% of the total redds in the Joseph Creek basin were observed. By the third survey on 17 April, 28% of the total redds were observed on Deer Creek. Although onset of redd building was similar among basins, peak redd observations occurred slightly later in Joseph Creek than UGRR (Appendix Figure B-21), which is similar to the pattern observed in 2012 and 2013 (Dobos et al. 2012, Fitzgerald et al. 2013). Most redds in the UGRR basin were first observed during the descending hydrographs of early May to late June. Surveys on Deer Creek coincided with low discharge periods.

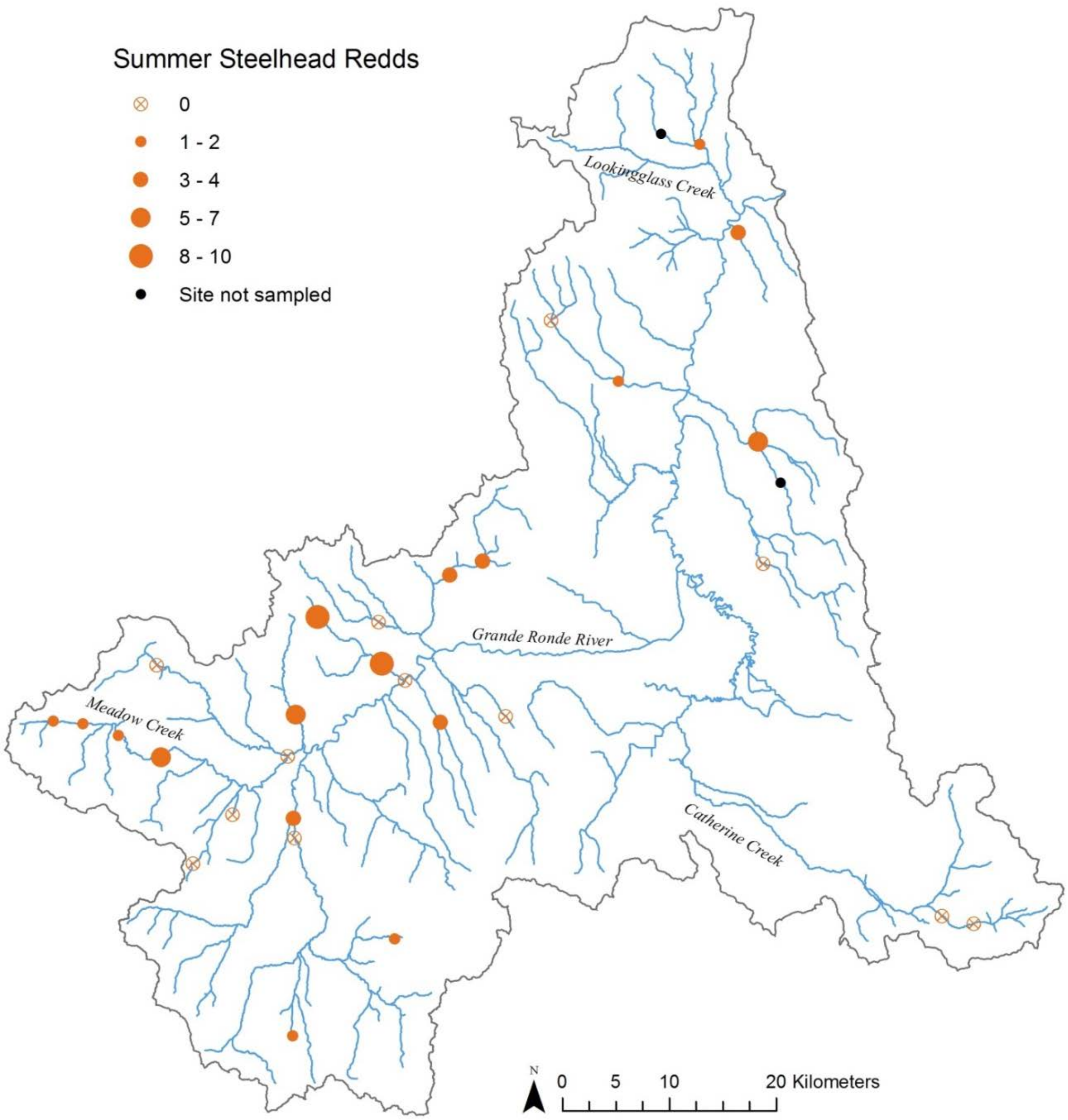


Figure 28. Map of the Upper Grande Ronde River basin displaying count of redds observed at each site in 2014. The two sites not surveyed were due to continual high flows and dangerous wading conditions.

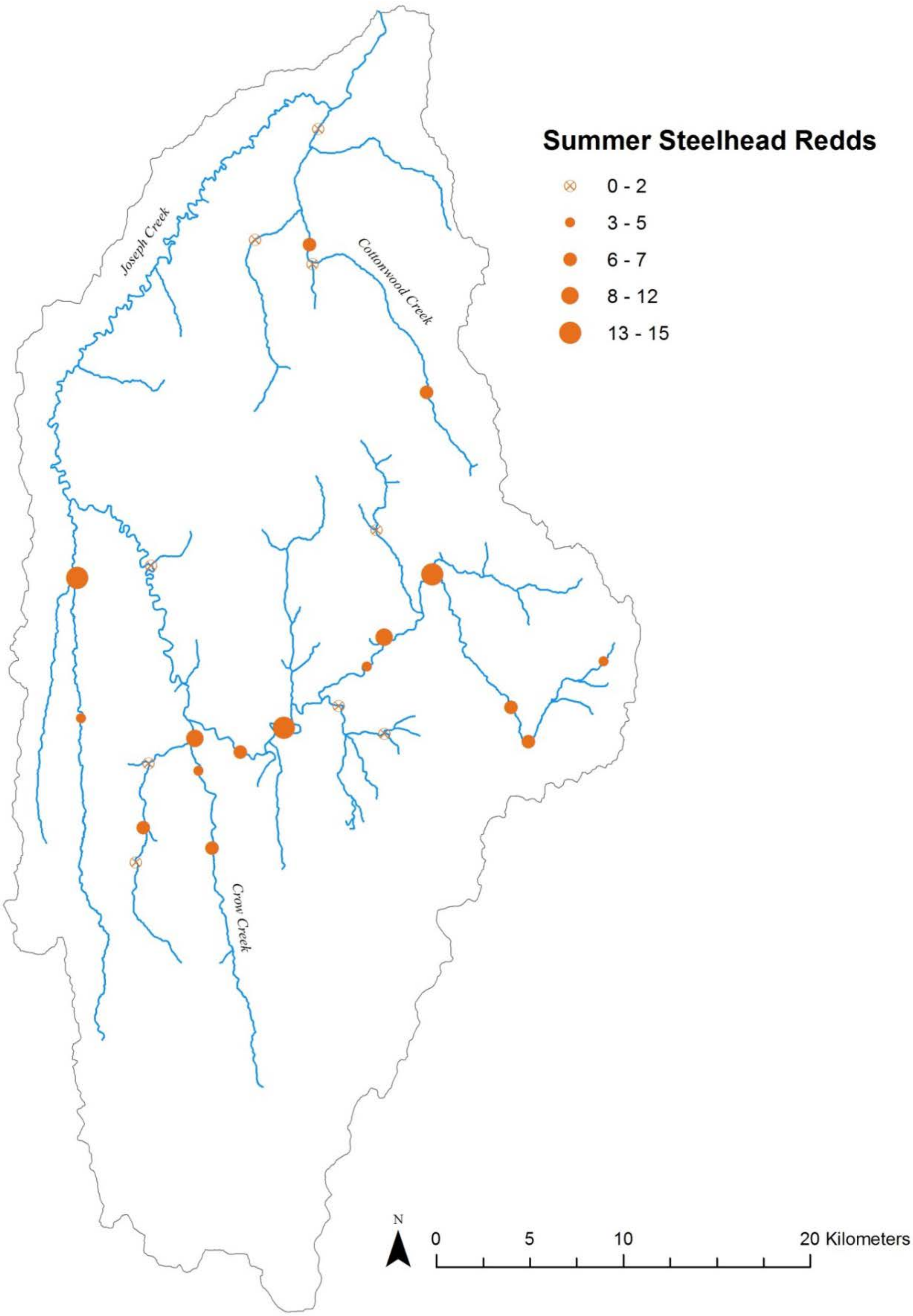


Figure 29. Map of the Joseph Creek basin showing count of redds observed at each site in 2014.

Conclusions

Most redds were first observed during descending limbs of the hydrograph. However, any relationship of spawning to stream flow may be obscured by artifacts of our sampling technique. Our ability to observe redds is strongly influenced by water clarity, which is generally better on the descending limb of hydrographs than on rising limbs. Even though our observations of redds were during these descending periods, they do not indicate exactly when the redd was made. Deer creek surveys illustrate this point. We were only able to survey during the low water periods between peaks in the hydrograph. However, redds were likely built during the high water periods between surveys. Our surveys cannot determine or estimate when redds were built (unless we observe fish actively spawning) limiting our ability to infer a relationship between flow and spawning activities.

Timing of initial redd observations was similar across both basins and in Deer Creek. However, the progression of redd building appeared to be slower in Joseph Creek. This seems counterintuitive, as Joseph Creek is lower in elevation, and generally warmer than UGRR or Deer Creek. We observed a two week lag (early April) between redd building in UGRR and Joseph Creek. This was also observed in 2012 and 2013 (Dobos et al. 2012, Fitzgerald et. al 2013), the first two years of Joseph Creek surveys. We were unable to determine if this is a real discrepancy in spawn timing, or an inability to effectively survey Joseph Creek tributaries during early April. Surveyors recorded water clarity (scale 1-3) at each survey event, and water clarity did improve substantially in Joseph Creek by mid- April. However, if water clarity/redd visibility was limiting our counts, one would expect a rapid increase in redd counts once water clarity improved. This was not the case, as redd observations climbed steadily after mid-April, but not faster than UGRR or Deer Creek.

Abundance of Steelhead Spawners at the Population Level

Introduction

Summer steelhead in the Grande Ronde River basin fall within the Snake River Distinct Population Segment (DPS) and are listed as threatened under the Endangered Species Act (62 FR 43937; August 18,1997). The Upper Grande Ronde River (UGRR) and Joseph Creek watersheds support two of the four Major Population Groups (MPG) in the Grande Ronde River basin. These populations are segregated based on topographic, genetic, and behavioral evidence of interactions. Historically, the Grande Ronde River was one of the more significant anadromous fish producing rivers in the Columbia River Basin. Despite recovery efforts, these populations remain depressed relative to historic levels.

The goal of this project is to annually evaluate summer steelhead population abundance for the UGRR, and recently Joseph Creek, by conducting surveys of redds and spawning activity. These surveys provide the data needed to estimate adult steelhead escapement, improve our understanding of habitat utilization, and contribute to productivity and survival estimates for these populations.

Methods

Estimating Adult Summer Steelhead Escapement in North East Oregon
https://www.monitoringmethods.org/Protocol/Details/757

Results

A fish:redd ratio of 2.67 (48/18) was generated using the number of fish passed above the weir at Deer Creek and the number of redds observed there in 2014. Using this ratio and a single weight value for all stream classifications (30.8), 2,512 adult steelhead (95% C.I.: 1,538–3,487) escaped into the UGRR basin and naturally spawned (Appendix Table B-19; Figure 30). No adipose-clipped hatchery fish were observed during surveys on the UGRR. Using this same method with a weight value of 15.4, 2,522 adult steelhead (95% C.I.: 1,744–3,300) escaped into the Joseph Creek basin. No adipose-clipped hatchery fish were observed during surveys on Joseph Creek.

Using the weight values for each strata, source (50.1), transport (27.0), and depositional (19.7), we estimated that 2,305 (95% CI, 1,362–3,348) adult steelhead for the UGRR population (Appendix Table B-21). For Joseph Creek estimates changed by only one fish: using the weight values for each strata, source (15.9), transport (14.3), and depositional (15.8), we estimated that 2,253 (95% CI, 1,726–3,320) adult steelhead returned to spawn (Appendix Table B-22).

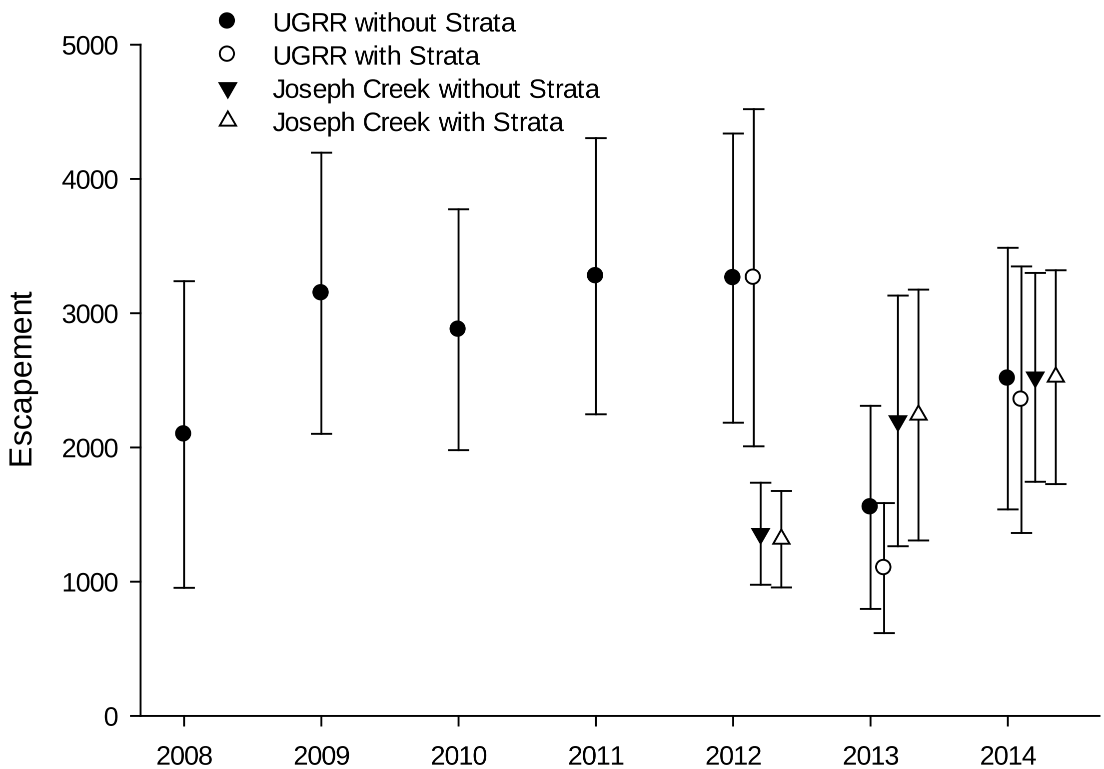


Figure 30. Escapement estimates with 95% confidence intervals for steelhead in the Upper Grande Ronde River basin using a single weight value, 2008−2014 and using strata weights for the three classifications of stream type for UGRR and Joseph Creek, 2012−2014.

Conclusions

Population-scale escapement estimates had relatively poor precision for both Joseph Creek and UGRR (95% CI ~38% of the estimate). This is better than last year's precision estimate of ~45% of estimate. Confidence intervals have consistently been 30–35% of the UGRR escapement estimate since 2009. This is despite our refinement of known steelhead spawning distribution, which has been reduced in length by 31% since 2008. It appears that the variable distribution of redds throughout the spawning distribution inflates the confidence intervals. In particular, observations of zero redds substantially increase the confidence interval, and certain streams are not likely to produce redds regardless of the number of adults returning. In 2014 we observed zero redds at 41% of our UGRR basin sites, and 28% of those in Joseph Creek. With continued observations of zero redds at some survey sites, it seems unlikely that precision will improve unless some other method of identifying appropriate spawning habitat can be found.

This is our third year of attempting to correlate redd locations with stream classifications. Redd observations were highest in transport reaches for UGRR and highest in depositional reaches for Joseph basins. This distribution is similar to Joseph Creek observations in 2012 and 2013, but far different for UGRR streams (Dobos et. al 2012, Fitzgerald et. al 2013). There seems to be only minor utility in attempting to relate stream classification generated from landscape level variables to redd locations. Steelhead are likely not choosing appropriate spawning sites at the landscape scale. With the overlap of CHaMP sites and steelhead spawning ground surveys, we are exploring other potential relationships between redd building and small-scale habitat characteristics.

We will continue to define the extent of these identified stream reaches deemed unsuitable for spawning and locate similar reaches when they are selected in our sample draw. As the spawning distribution is refined, precision in our escapement estimates should increase. We will also continue to monitor trends of both methods and relate redd locations to immediate habitat to gain better understanding of how spawning habitat is utilized.

Steelhead and Chinook Salmon Parr Surveys, Parr Density, and Distribution

Introduction

Human impacts on fish populations are apparent in the Grande Ronde River basin, a tributary to the Lower Snake River. Historically, the Grande Ronde River supported several anadromous salmonid runs, including spring, summer and fall Chinook salmon, sockeye salmon, coho salmon and summer steelhead (ODFW 1990). During the past century numerous factors, including those mentioned above, have led to a reduction in salmonid stocks. Today, the only viable populations remaining are spring Chinook salmon and summer steelhead. Snake River spring/summer Chinook salmon, including Grande Ronde River spring Chinook salmon, were listed as threatened under the Endangered Species Act (ESA) in 1992; summer steelhead in 1997.

Numerous habitat restoration and protection projects have occurred within the Grande Ronde River basin, and other Columbia River sub-basins, over the past decades in attempt to improve native salmonid populations. The effectiveness of these projects at increasing native salmonid production and/or use has not been systematically evaluated. The CHaMP program systematically characterizes stream habitats in a spatially balanced manner and allows both status and trend monitoring (Bouwes et al. 2011). Coupling these habitat characterizations with salmonid presence and abundance will improve our understanding of the most important habitats for salmonid production, and allow appropriate targeting for restoration and protection actions.

Methods

Sixty habitat and fish monitoring locations were chosen within the UGRR sub-basin for 2014. Habitat monitoring locations were generated with the generalized random tessellation stratification (GRTS) design for the fourth year of the CHaMP (Bouwes et al. 2011). Only streams within the known (or assumed) anadromous fish spawning distribution were eligible for selection. Two crews completed these surveys, one from Oregon Department of Fish and Wildlife (ODFW) and the other from CRITFC. Site length varied based on stream size and was approximately 20 times the bankfull width (minimum 120 m, maximum 600 m).

All 60 CHaMP sites (Appendix Table B-23) were surveyed for juvenile salmonids via either a single-pass snorkel protocol (Juvenile Salmonid Density & Distribution in Northeast Oregon Watersheds, http://www.monitoringmethods.org/Protocol/Details/370) or single pass electrofishing. Fifty-three of the sites were surveyed snorkeling and most of those were only snorkeled once.

The remaining seven sites, small headwater streams, were sampled via electrofishing. These sites were electrofished with a single backpack electrofishing unit (Smith-Root model LR-20) during low flow periods (late June and July 2014). Direct current was used at all sites, with frequency and voltage adjusted to permit efficient capture of fish. Block nets were placed at the bottom and top of sites if the stream was flowing continuously. Some sites had only intermittent flow, and block nets were not used if fish were trapped within the sample reach by stretches of dry stream channel. A single electrofishing pass was completed in an upstream direction. Only salmonids were netted, while a visual estimate of non-salmonid relative abundance (abundant, common, or rare) was made throughout the survey. Netted fish were kept in a bucket until the entire channel unit had been sampled. All salmonids captured were identified to species, measured (fork length, mm), and released in the unit they were collected.

No marks or tags were placed on/in any fish. Metrics calculated from electrofishing surveys included: catch per unit effort (CPUE, no. fish/hour), mean length and relative density (fish per $100m^2$). Abundance estimates were calculated with a correction factor relating electrofishing catch to mark/recapture population estimates (Horn and Sedell 2012).

Electrofishing Abundance Est. (all unit types): $NHat = 1.7507 * Efish\ Count$

Results

A significant change occurred in our snorkel methodologies in 2014. We began enumerating juveniles steelhead and Chinook salmon in the <50mm size class. In previous years (2011-2013) salmonids of this size were only noted for presence/absence. Thus, total estimates in 2014 will be inflated compared to any previous version of this report.

Salmonids were observed at all 60 surveyed CHaMP sites. Steelhead were found at 60 of the 60 sites, Chinook salmon at 29, and bull trout *Salvelinus confluentus* at only eight sites.

In the UGRR sub-basin, Chinook were usually the dominant salmonid in mainstem snorkel surveys (Figure 31), with counts in the hundreds, while counts were in the dozens for tributaries (Appendix Table B-24). A total of 4,586 juvenile Chinook were observed during snorkel surveys, and 90.1% were in the 50 – 90 mm size categories (age 0), while only 3% were in the <50mm size class. The remaining handful of Chinook salmon in the >90 mm size categories correspond to age 1 fish. Chinook were most abundant in mainstem UGRR and Catherine Creeks (Figure 32), with fewer observed in the larger tributaries like Sheep Creek, Meadow Creek, and the Catherine Creek Forks. There were fewer tributary observations of Chinook in 2014 than in previous years.

Steelhead were more widely distributed than Chinook (Figure 33), with individuals observed at all sites in 2014. Counts were higher than Chinook, with 5,563 individuals observed. Steelhead counts were much higher than in previous years, with many sites having counts over 100 individuals. However, 50.1% of the steelhead observed were in the size classes <50mm and 50-79mm. In past years the smallest steelhead size class available for enumeration was 70-130mm. Smaller individuals were noted as young-of-year and marked as present only. Thus, higher counts (and corresponding abundance estimates) do not reflect increased population levels. We made no differentiation between resident and anadromous individuals, and it is possible that many individuals observed in the smaller streams were resident rainbow trout, not steelhead. No adult steelhead were observed due to the timing of surveys.

Juvenile Chinook salmon and steelhead density estimates, were significantly higher (Kruskal-Wallis with Dunn's Test, $p<0.05$) in pools than fastwater units or runs (Appendix Table B-25). There was no statistically significant difference between densities in fastwater units compared to runs. Catherine Creek and UGRR had the highest densities of Chinook, similar to previous years. Steelhead densities were highest in lower Fly Creek and Catherine Creek.

Other fish taxa observed during snorkeling were bull trout, mountain whitefish (*Prosopium williamsoni*), northern pikeminnow (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), speckled dace (*Rhinichthys osculus*), longnose dace (*Rhinichthys cataractae*), sculpin (*Cottus spp.),* bridgelip and unidentified suckers (*Catostomus spp.*), unidentified catfish (*Ictalurus spp.*) and sunfish (*Lepomis spp.)* (Appendix Table B-26). Bull trout were only observed in Catherine Creek (mainstem, north and south forks) and the upper reaches of UGRR. Mountain whitefish, northern pikeminnow and suckers were generally seen in the mainstem Catherine Creek and UGRR sites, while dace, redside shiners and sculpins were observed in mainstem and lower gradient tributary sites, like Meadow Creek. In many cases, dace and shiners outnumbered salmonids in the same reaches. The smallest, high gradient sites generally produced only steelhead and sculpin. Catfish and sunfish were rarely observed in Meadow Creek and the UGRR mainstem.

Steelhead were the only salmonid captured via electrofishing at small stream sites. Juvenile steelhead were captured at all seven sampled sites. Steelhead CPUE ranged from 10.3 – 84.5 fish/hour (Appendix Table B-27), and densities ranged from 1.38 – 19.85 fish/100m^2.

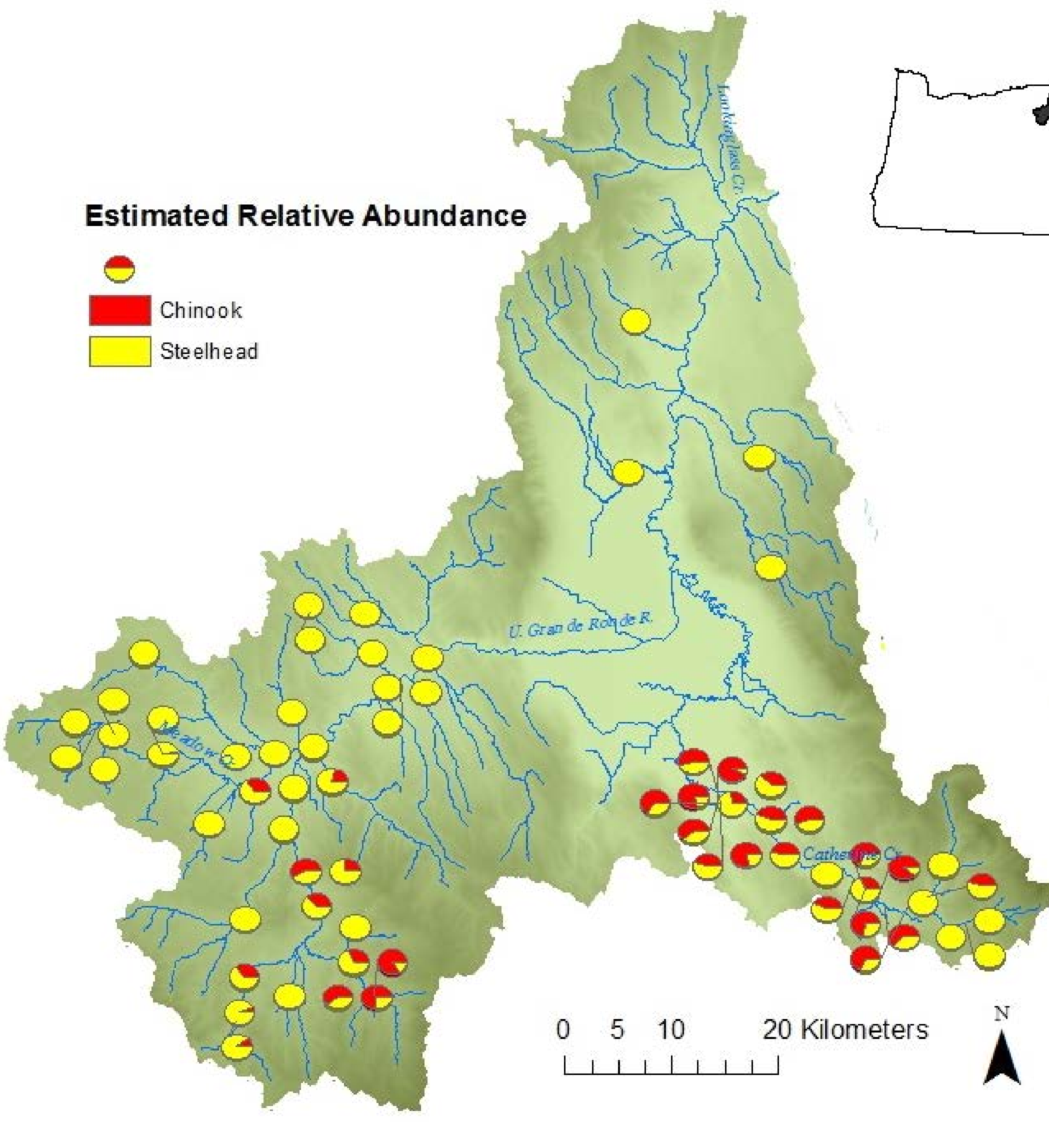


Figure 31. Proportional distribution of juvenile steelhead and Chinook salmon observed via snorkel and electrofishing surveys, 2014.

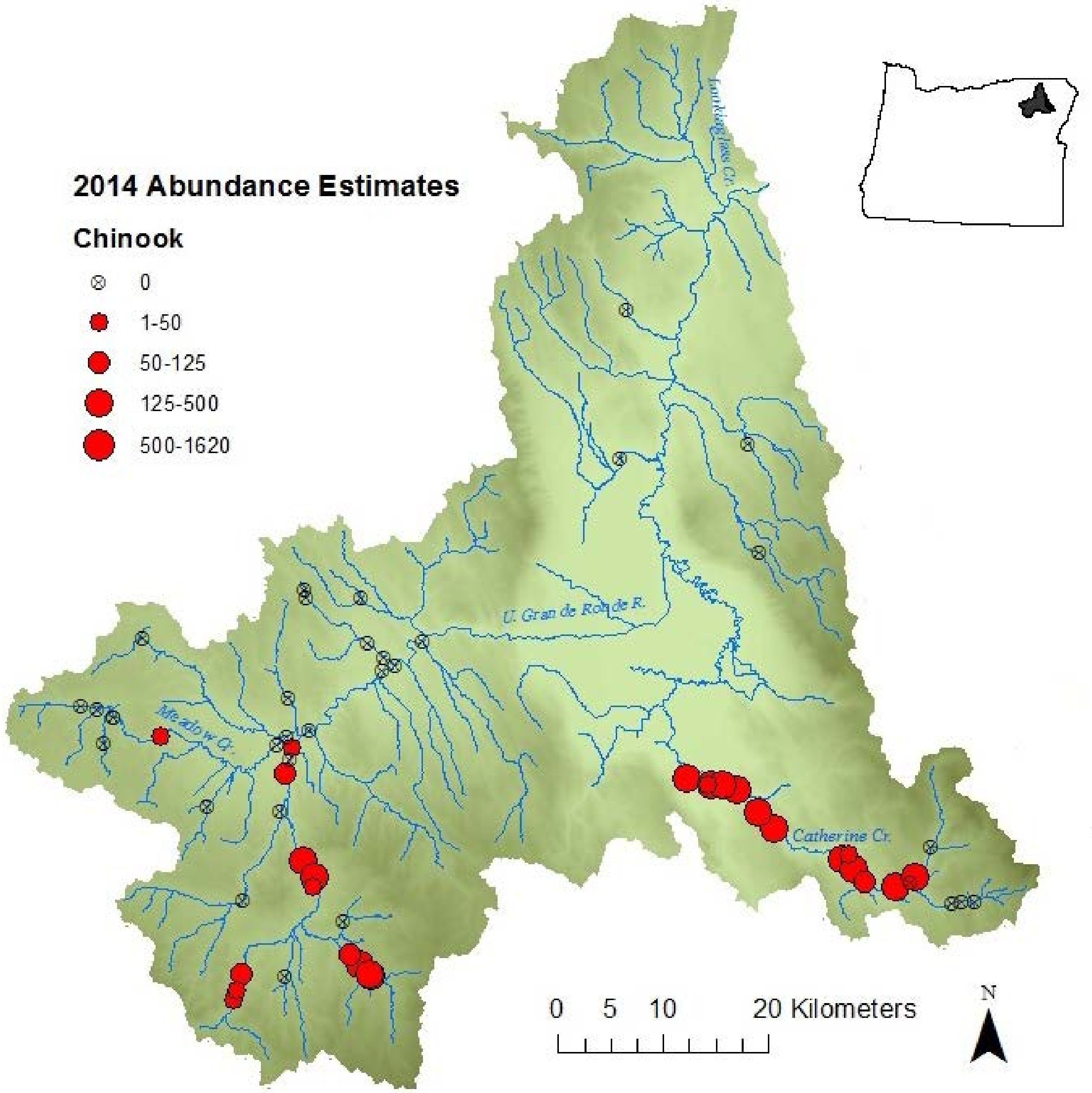


Figure 32. Spatial distribution and site level abundance estimates of Chinook salmon observed during snorkel and electrofishing surveys of the UGRR basin, 2014. Concentric circles indicate repeat snorkel surveys.

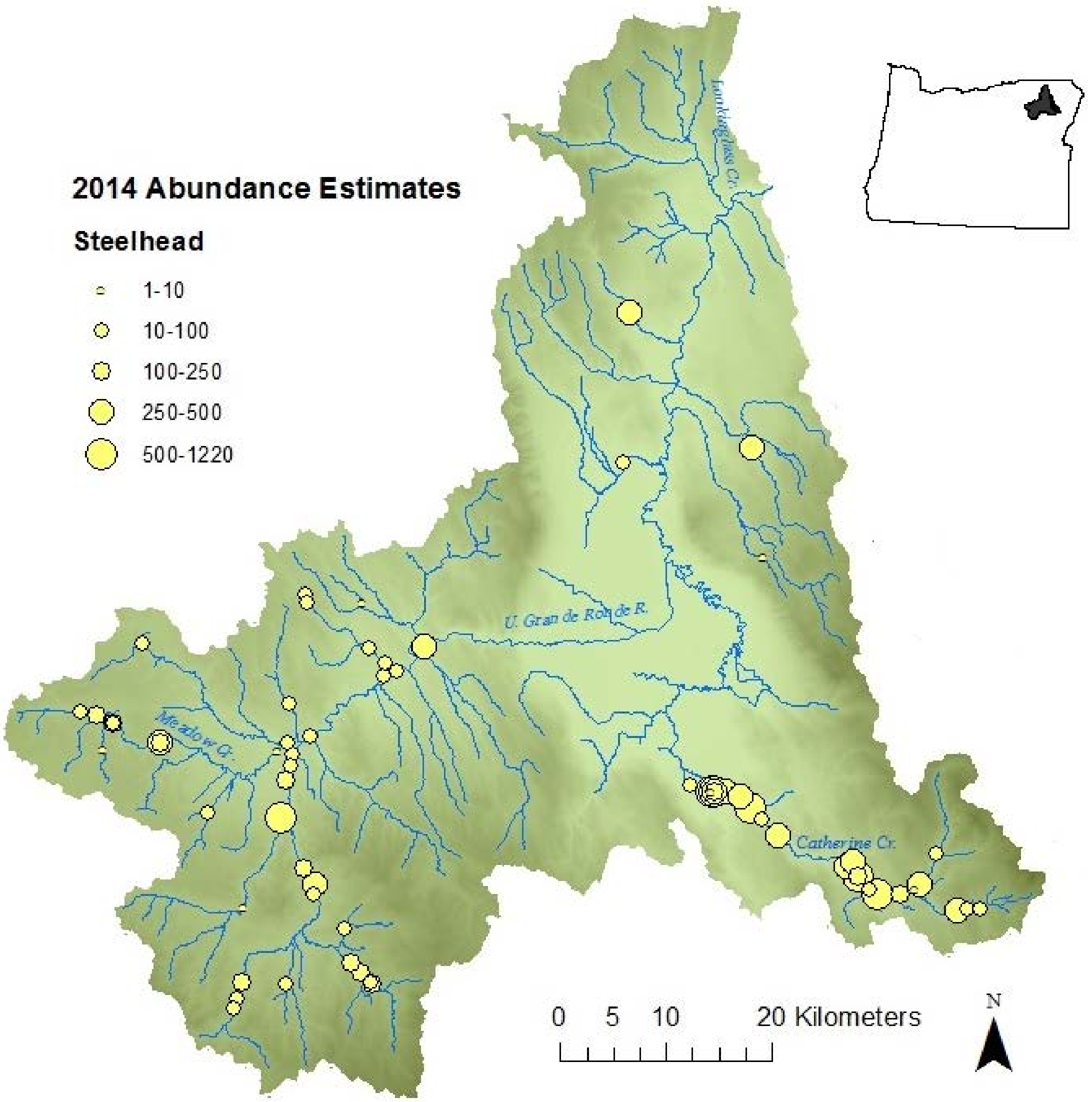


Figure 33. Spatial distribution and site level abundance estimates of steelhead observed during snorkel surveys of the UGRR basin, 2014. Concentric circles indicate repeat snorkel surveys.

Conclusions

The observed distribution of juvenile Chinook salmon was generally consistent with previous surveys and local, professional estimation of the Chinook rearing habitat. The majority of fish were using the mainstem Catherine Creek and Upper Grande Ronde River during their first summer. These areas are also the primary spawning grounds for UGRR Chinook salmon (Feldhaus et al. 2012). Additionally, a substantial number of Chinook were observed in Sheep Creek, which also has some spawning. The only other Chinook observed were in Meadow Creek. No Chinook salmon spawning is known to occur in this tributary, yet a few individuals were observed in the Starkey Experimental Range and Forest. These are likely stray juveniles seeking thermal refuge during hot summer months.

One of our goals is to constantly refine the known spawning and rearing distribution for steelhead in UGRR subbasin. This information is used by other ODFW research projects to define their sample space. As all sites contained *O. mykiss* in 2014, not sites are candidates for removal from the steelhead distribution.

This was the first year enumerating salmonids in the <50 mm size category. Steelhead were generally identifiable around the 45mm size when snorkeling, and a large portion of the steelhead counts were in this size class. A much smaller proportion of the Chinook salmon count were individuals <50mm, presumably due to earlier hatch dates and later snorkel dates for the larger, Chinook-dominated streams. Generally, crews found little difficulty with the addition of these smaller size classes, and we will continue to include them in our estimates. However, caution should be exercised when comparing these 2014 estimates to previous years', as the addition of smaller size classes has inflated the estimates.

References

Bouwes, N., J. Moberg, N. Weber, B. Bouwes, C. Beasley, S. Bennett, A.C. Hill, C.E. Jordan, R. Miller, P. Nelle, M. Polino, S. Rentmeester, B. Semmens, C. Volk, M.B. Ward, G. Wathen, and J. White. 2011. Scientific protocol for salmonid habitat surveys within the Columbia Habitat Monitoring Program. Prepared by the Integrated Status and Effectiveness Monitoring Program and published by Terraqua, Inc., Wauconda, WA.

Dobos, M.E., J.R. Ruzycki, C.D. Horn, E.R. Sedell, K. L. Bleisner and R.W. Carmichael. 2012. Steelhead escapement monitoring in the upper Grande Ronde River and Joseph Creek basins. Annual Technical Report. Oregon Dept. of Fish and Wildlife, La Grande, Oregon.

Feldhaus, J., T.L. Hoffnagle and R.W. Carmichael. 2012. Lower Snake River compensation plan: Oregon spring Chinook salmon evaluation studies. 2010 Annual Progress Report, contract 14-11-10-J011, Oregon Department of Fish and Wildlife, Salem, OR.

Hesse, J. A., J. R. Harbeck, and R. W. Carmichael. 2006. Monitoring and evaluation plan for Northeast Oregon Hatchery Imnaha and Grande Ronde Subbasin spring Chinook Salmon. Technical Report, Project 198805301, BPA Report DOE/BP-00004034-1 http://pisces.bpa.gov/release/documents/documentviewer.aspx?doc=00004034-1

Horn, C.D., and E.R. Sedell. 2012. Juvenile salmonid monitoring at Columbia Habitat Monitoring Program (CHaMP) sites in the upper Grande Ronde River basin. Annual Technical Report. Oregon Dept. of Fish and Wildlife, La Grande, Oregon.

ODFW (Oregon Department of Fish and Wildlife). 1990. Grande Ronde River Subbasin Salmon and Steelhead Production Plan. Oregon Department of Fish and Wildlife, Portland, OR.

Van Dyke, E.S., D.L. Scarnecchia, B.C. Jonasson, and R.W. Carmichael. 2010. Ecology of Winter Concealment Behavior of Juvenile Spring Chinook Salmon in the Grande Ronde River Basin, Oregon. Northwest Science 84(1): 9 – 19.

Appendix A: Use of Data and Products

Viable Salmonid Population (VSP) indicator and metric data that support and feed ODFW's Recovery Planning and BiOP reporting needs are summarized and compiled into a standard format (Coordinated Assessments Data Exchange Standard; DES) at the population level and stored in a central server location. VSP data in DES format is quality checked, reviewed and approved for sharing by a data steward and the primary VSP data contact for each population(s). Upon reviewer approval, data in DES format is made available to the public and interested parties through upload on ODFW's Salmon and Steelhead Recovery Tracker (http://odfwrecoverytracker.org/), NOAA's Salmon Population Summary (SPS; https://www.webapps.nwfsc.noaa.gov/apex/f?p=261:home:0) database and StreamNet (http://www.streamnet.org/).

Appendix B: Detailed Results

WE H: Abundance and Migration of Juvenile Salmonids in Study Streams During Migration Year 2013, and
WE I: Survival and Relative Success of Juvenile Salmonids from the Grande Ronde and Imnaha Subbasins

Appendix Table B-1. Dates of tagging and number of spring Chinook salmon parr PIT-tagged in various northeast Oregon streams during summer 2012 and 2013.

Migration year and stream	Tagging Dates	Number PIT-tagged	Distance to Lower Granite Dam (km)
2014 (Summer 2013)			
Upper Catherine Creek	22 Jul–31 Jul	998	371–383
Lower Catherine Creek	29 Jul–31 Jul	1,000	356–359
Imnaha River	12 Aug–15 Aug	1,000	221–233
Lostine River	1 Aug, 4–6 Aug	1,000	271–308
Minam River	19 Aug–22 Aug	999	276–290
Upper Grande Ronde	26 Aug–28 Aug	1,000	418–428
2015 (Summer 2014)			
Upper Catherine Creek	24 Jul, 28–30 Jul	999	371–383
Lower Catherine Creek	21 Jul–23 Jul	999	356–359
Imnaha River	11 Aug–13 Aug	998	221–233
Lostine River	4 Aug–6 Aug	999	271–308
Minam River	18 Aug–21 Aug	995	276–290
Upper Grande Ronde	25 Aug–27 Aug	1,000	418–428

Appendix Table B-2. Juvenile spring Chinook salmon catch at five general trap locations in Grande Ronde River Subbasin during MY 2014. Early migration period starts 1 July 2013 and ends 28 January 2013. Late migration period starts 29 January and ends 30 June 2014. The period a trap operated was used to identify total number of days fished, with percentage in parentheses, during each migration period.

Trap site	Migration period	Sampling period	Days fished	Trap catch
Catherine Creek	Early	11 Sep 13–21 Dec 13	66 (92)	9,767
	Late	19 Feb 14–30 Jun 14	114 (86)[a]	2,719[a]
			5 (4)[b]	19[b]
Lostine River	Early	12 Sep 13–28 Jan 14	92 (66)	9,029
	Late	29 Jan 14–12 Jun 14	117 (87)[a]	1,470[a]
			4 (3)[b]	160[b]
Middle Grande Ronde River	Late	26 Feb 14–17 Jun 14	100 (89)	557
Minam River	Early	13 Sep 13–21 Nov 13	64 (91)	13,699
	Late	28 Feb 14–6 Jun 14	91 (85)	4,090
Upper Grande Ronde River	Early	12 Sep 13–21 Nov 13	58 (82)	11,619
	Late	5 Mar 14–30 Jun 14	99 (84)	2,193

[a] Continuous 24 h trapping
[b] Sub-sampling with 1 to 4 h trapping.

Appendix Table B- 3. Fork lengths of juvenile spring Chinook salmon collected from study streams during MY 2014. Early and late migrants were captured with a rotary screw trap on each study stream. Summer and winter tag group fish were captured using netting techniques upstream from rotary screw traps. Min = minimum, Max = maximum.

	Lengths (mm) of fish collected					Lengths (mm) of fish tagged and released				
Stream and tag group	*n*	Mean	SE	Min	Max	*n*	Mean	SE	Min	Max
Catherine Creek										
Summer (upper)	1,173	61.0	0.21	42	85	998	63.2	0.19	55	85
Summer (lower)	1,046	71.2	0.20	51	92	1,000	71.7	0.19	56	92
Early migrants	1,469	75.2	0.25	49	134	920	73.5	0.29	55	99
Winter	140	83.1	0.71	59	99	129	83.1	0.74	59	99
Late migrants	915	84.7	0.26	41	120	764	84.9	0.28	63	120
Lostine River										
Summer	1,156	64.7	0.30	44	110	1,000	66.4	0.29	55	99
Early migrants	1,771	82.5	0.23	51	125	1,199	82.4	0.26	57	113
Winter	608	76.5	0.31	50	108	598	76.8	0.30	56	108
Late migrants	1,465	91.1	0.24	68	131	1,153	90.7	0.27	68	131
Middle Grande Ronde River										
Spring emigrants	539	95.1	0.51	60	126	530	95.0	0.51	60	126
Minam River										
Summer	1,044	67.9	0.24	44	96	999	68.7	0.22	55	96
Early migrants	1,397	77.5	0.27	49	124	1,084	78.1	0.29	55	110
Late migrants	1,492	86.2	0.26	60	156	1,103	85.4	0.25	61	138
Upper Grande Ronde River										
Summer	1,419	59.1	0.19	44	82	1,000	62.3	0.20	55	82
Early migrants	1,501	70.6	0.22	51	111	636	70.5	0.30	55	94
Winter	139	65.8	0.72	50	90	125	66.2	0.73	55	90
Late migrants	1,326	82.1	0.24	57	106	808	81.3	0.31	57	106

Appendix Table B- 4. Weights of juvenile spring Chinook salmon collected from study streams during MY 2014. Early and late migrants were captured with a rotary screw trap on each study stream. Summer and winter tag group fish were captured using netting techniques upstream from rotary screw traps. Min = minimum, Max = maximum.

	Weights (g) of fish collected					Weights (g) of fish tagged and released				
Stream and group	*n*	Mean	SE	Min	Max	*n*	Mean	SE	Min	Max
Catherine Creek										
Summer (upper)	965	3.0	0.03	1.3	7.5	996	3.0	0.03	1.6	7.5
Summer (lower)	1,035	4.6	0.04	1.9	9.6	1,000	4.6	0.04	2.0	9.6
Early migrants	1,469	4.9	0.05	1.3	29.0	920	4.6	0.05	1.8	10.5
Winter	140	6.2	0.15	2.1	10.9	129	6.2	0.15	2.1	10.9
Late migrants	915	6.5	0.06	1.0	19.6	764	6.5	0.07	2.5	19.6
Lostine River										
Summer	1,001	3.7	0.06	1.6	18.7	998	3.6	0.06	1.6	12.8
Early migrants	1,768	6.4	0.06	1.4	25.5	1,197	6.4	0.06	2.1	15.7
Winter	604	4.8	0.06	1.8	13.8	598	4.8	0.06	1.8	13.8
Late migrants	1,465	8.4	0.07	3.2	25.1	1,153	8.2	0.08	3.2	25.1
Middle Grande Ronde River										
Spring emigrants	539	9.5	0.16	2.3	24.2	530	9.5	0.17	2.3	24.2
Minam River										
Summer	999	3.9	0.04	1.7	11.4	999	3.9	0.04	1.7	11.4
Early migrants	1,376	5.2	0.06	1.3	20.3	1,069	5.3	0.06	1.5	14.2
Late migrants	1,492	7.0	0.08	1.8	34.5	1,102	6.7	0.07	2.2	26.2
Upper Grande Ronde River										
Summer	999	2.7	0.03	1.5	6.3	999	2.7	0.03	1.5	6.3
Early migrants	1,501	3.8	0.04	1.3	13.4	636	3.8	0.05	1.7	8.4
Winter	139	3.1	0.11	1.2	7.2	125	3.2	0.11	1.4	7.2
Late migrants	1,326	5.8	0.06	1.6	13.2	808	5.6	0.07	1.7	13.2

Appendix Table B- 5. Survival probability to Lower Granite Dam of juvenile spring Chinook salmon tagged during summer 2012 and detected at Columbia and Snake river dams during 2014.

Stream	Number PIT-tagged and released	Survival probability (95% CI)
Upper Catherine Creek	998	0.092 (0.071–0.121)
Lower Catherine Creek	1,000	0.019 (0.010–0.036)
Imnaha River	1,000	0.128 (0.104–0.156)
Lostine River	1,000	0.127 (0.106–0.152)
Minam River	999	0.134 (0.110–0.164)
Upper Grande Ronde River	1,000	0.102 (0.083–0.125)

Appendix Table B- 6. Juvenile spring Chinook salmon survival probability by location and tag group from time of tagging to Lower Granite Dam. Spring Chinook salmon were tagged from fall 2013 to spring 2014 and detected at dams during 2014.

Stream and tag group	Number PIT-tagged and released	Survival probability (95% CI)
Catherine Creek		
Fall (trap)	920	0.144 (0.117–0.182)
Winter (above trap)	129	0.116 (0.064–0.206)
Spring (trap)	764	0.340 (0.293–0.398)
Lostine River		
Fall (trap)	1,199	0.209 (0.181–0.241)
Winter (above trap)	598	0.206 (0.169–0.250)
Spring (trap)	1,153	0.520 (0.482–0.563)
Middle Grande Ronde River		
Spring (trap)	530	0.677 (0.616–0.744)
Minam River		
Fall (trap)	1,084	0.227 (0.198–0.259)
Spring (trap)	1,103	0.573 (0.532–0.620)
Upper Grande Ronde River		
Fall (trap)	636	0.201 (0.165–0.245)
Winter (above trap)	125	0.072 (0.029–0.265)
Spring (trap)	808	0.340 (0.296–0.391)

Appendix Table B- 7. Juvenile steelhead catch at five general trap locations in Grande Ronde River Subbasin during MY 2014. Early migration period starts 1 July 2013 and ends 28 January 2014. Late migration period starts 29 January and ends 30 June 2014. The period a trap operated was used to identify total number of days fished, with percentage in parentheses, during each migration period.

Trap site	Migration period	Sampling period	Days fished / days operated	Trap catch
Catherine Creek	Early	11 Sep 13–21 Nov 13	66 (92)	1,883
	Late	19 Feb 14–30 Jun 14	114 (86)[a]	1,330[a]
			5 (4)[b]	13[b]
Lostine River	Early	12 Sep 13–28 Jan 14	92 (66)	1,293
	Late	29 Jan 14–12 Jun 14	117 (87)[a]	352[a]
			4 (3)[b]	9[b]
Middle Grande Ronde River	Late	26 Feb 14–17 Jun 14	100 (89)	748
Minam River	Early	13 Sep 13–21 Nov 13	64 (91)	4,090
	Late	28 Feb 14–6 Jun 14	91 (85)	1,534
Upper Grande Ronde River	Early	12 Sep 13–21 Nov 13	58 (82)	1,655
	Late	5 Mar 14–30 Jun 14	99 (84)	1,263

[a] Continuous 24 h trapping
[b] Sub-sampling with 1 to 4 h trapping.

Appendix Table B- 8. Age structure of early and late steelhead migrants collected at trap sites during MY 2014. The same four cohorts were represented in each migration period, but ages increased by one year from early migrants to late migrants (e.g., age-0 early migrants were same cohort as age-1 late migrants). Age structure was based on frequency distribution of sampled lengths and allocated using an age–length key. Means were weighted by migrant abundance at trap sites.

	Percent				
Emigrant type and trap site	Age-0	Age-1	Age-2	Age-3	Age-4
Early					
Catherine Creek	54.4	40.3	5.0	0.3	0.0
Lostine River	65.1	22.6	12.0	0.3	0.0
Minam River	82.9	10.3	6.5	0.2	0.0
Upper Grande Ronde River	28.3	51.5	19.9	0.3	0.0
Mean	56.5	32.2	11.0	0.3	0.0
CV (%)	40.4	56.9	61.2	20.3	0.0
Late					
Catherine Creek	0.0	74.6	23.6	1.7	0.0
Lostine River	0.0	57.6	35.0	7.4	0.0
Minam River	0.0	57.8	29.9	11.8	0.6
Upper Grande Ronde River	0.0	34.1	53.1	12.7	0.0
Mean	0.0	59.0	33.5	7.3	0.1
CV (%)	0.0	28.2	37.9	69.0	0.0
Early and Late[a]					
Middle Grande Ronde River	0.0	25.0	64.7	10.3	0.0

[a] Middle Grande Ronde River trap was located downstream from Catherine Creek and upper Grande Ronde River overwinter rearing reaches resulting in early and late emigrants being sampled simultaneously during spring emigration.

Appendix Table B- 9. Travel time to Lower Granite Dam of wild steelhead PIT-tagged at screw traps during spring 2014 and subsequently arriving at Lower Granite Dam (LGD) during spring 2014.

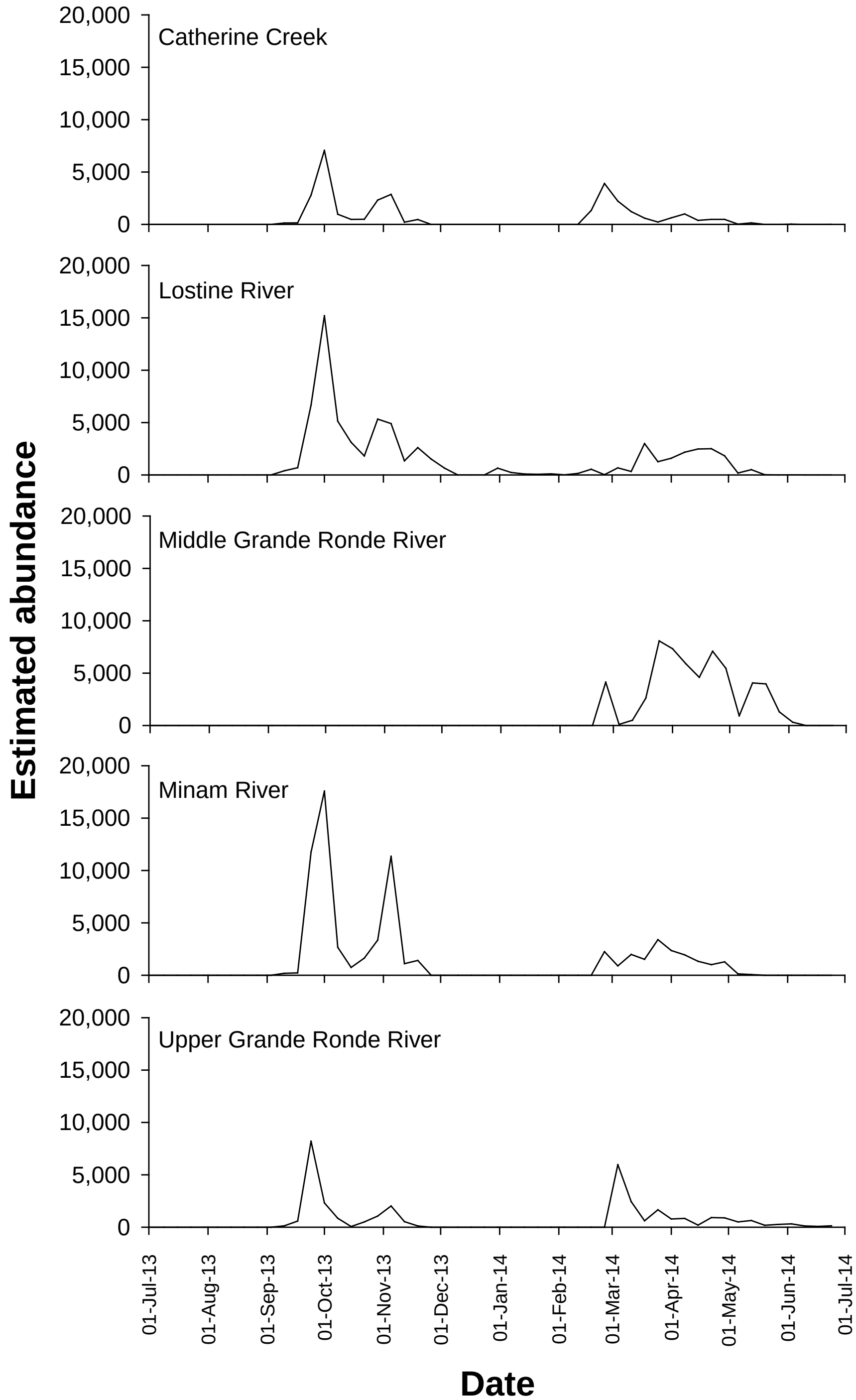
Stream	Distance to LGD (km)	Number detected	Travel time (d) Median	Min	Max
Catherine Creek	362	29	52	10	88
Lostine River	274	46	11	4	52
Middle Grande Ronde River	258	114	14	4	87
Minam River	245	73	26	5	77
Upper Grande Ronde River	397	68	52	6	87

Appendix Table B- 10. Probability of surviving and migrating, in the first year to Lower Granite Dam, for steelhead PIT-tagged at screw traps on Catherine Creek and Lostine, middle Grande Ronde, Minam, and upper Grande Ronde rivers during fall 2013 and spring 2014 (MY 2014). Catherine Creek and upper Grande Ronde River early migrants overwinter upstream of middle Grande Ronde River trap site, so no fall tag group was available for that site.

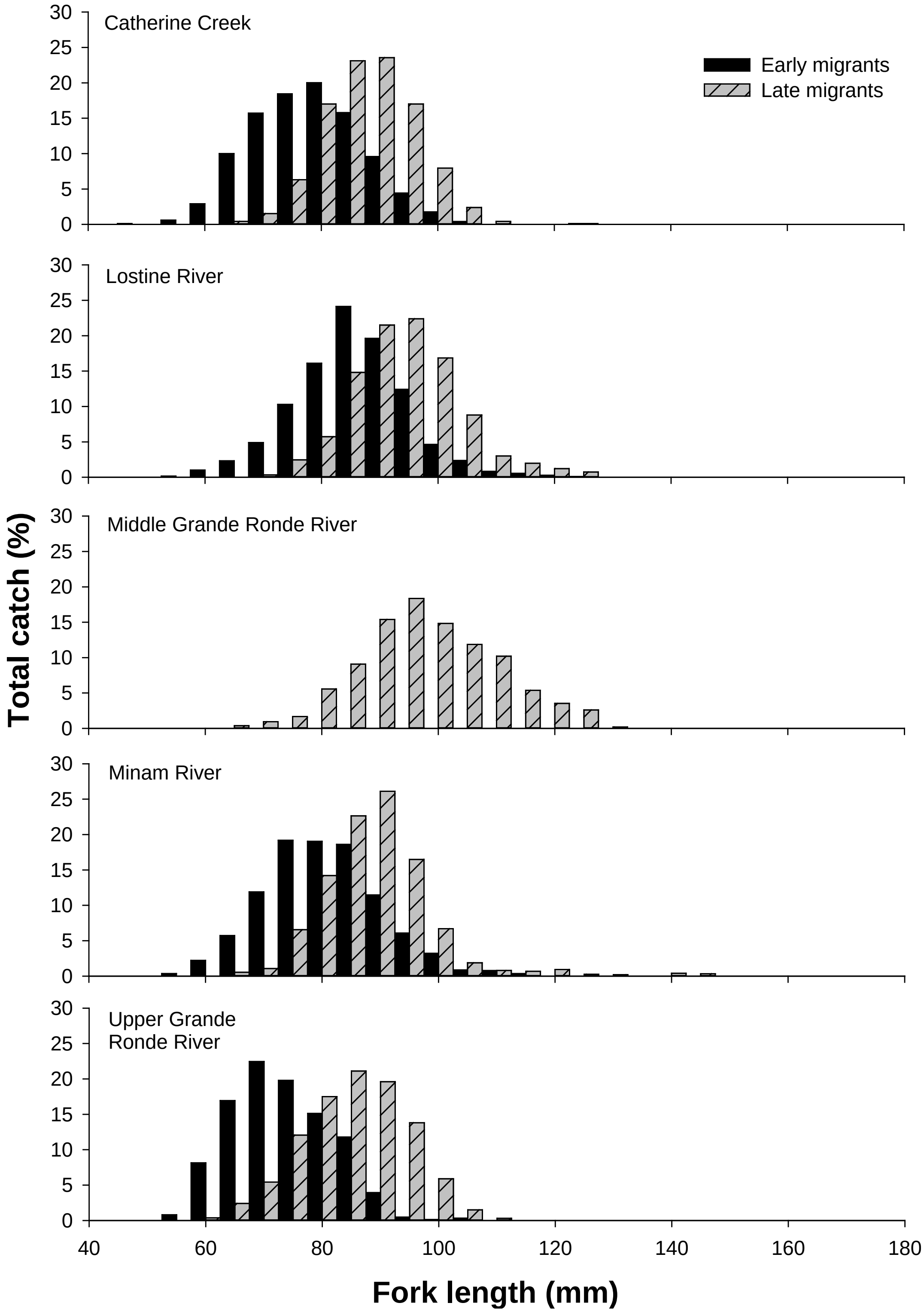
Season and location tagged	Number tagged	Number detected	Probability of surviving and migrating in the first year (95% CI)
Fall			
Catherine Creek	601	49	0.099 (0.071–0.143)
Lostine River	606	35	0.117 (0.063–0.359)
Minam River	478	14	0.030 (0.015–0.091)
Upper Grande Ronde River	585	65	0.137 (0.102–0.188)
Spring (FL ≥ 115 mm)			
Catherine Creek	255	59	0.463 (0.291–0.947)
Lostine River	146	81	0.755 (0.593–1.059)
Middle Grande Ronde River	557	272	0.687 (0.593–0.811)
Minam River	286	149	0.794 (0.644–1.036)
Upper Grande Ronde River	481	160	0.522 (0.420–0.675)

Appendix Table B- 11. PIT tagged early migrating steelhead sampled by screw trap in the Grande Ronde Basin, and subset subsequently detected at Snake and Columbia River dams during spring 2014. Italicized headings represent smolt age at time detections were recorded at a dam. Means are weighted by sample size (*n*).

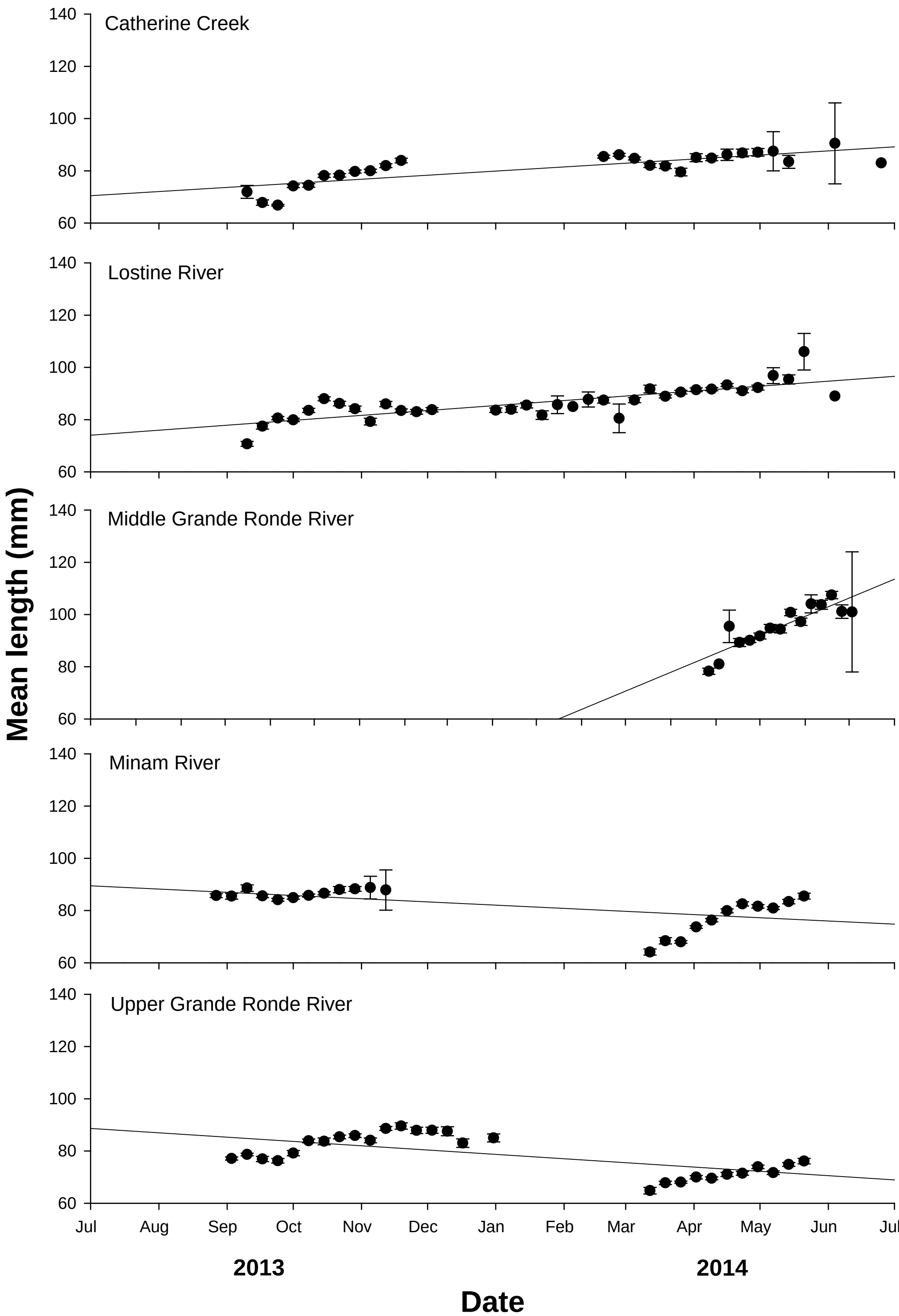
Trap site	*n*	Age-0 *Age-1 smolt*	Age-1 *Age-2 smolt*	Age-2 *Age-3 smolt*	Age-3 *Age-4 smolt*
		PIT tagged fish with known age (%)			
Catherine Creek	182	30	58	11	1
Lostine River	194	35	41	23	1
Minam River	115	50	25	24	0
Upper Grande Ronde River	156	13	53	33	1
Mean		32.2	44.2	22.8	0.9
CV (%)		47.4	33.0	39.2	67.8
		PIT tagged fish detected at dams (%)			
Catherine Creek	14	0	57	43	0
Lostine River	23	0	93	43	0
Minam River	7	0	21	57	0
Upper Grande Ronde River	12	0	42	50	8
Mean		0	53.3	48.4	2.1
CV (%)		0	56.6	13.8	200.0



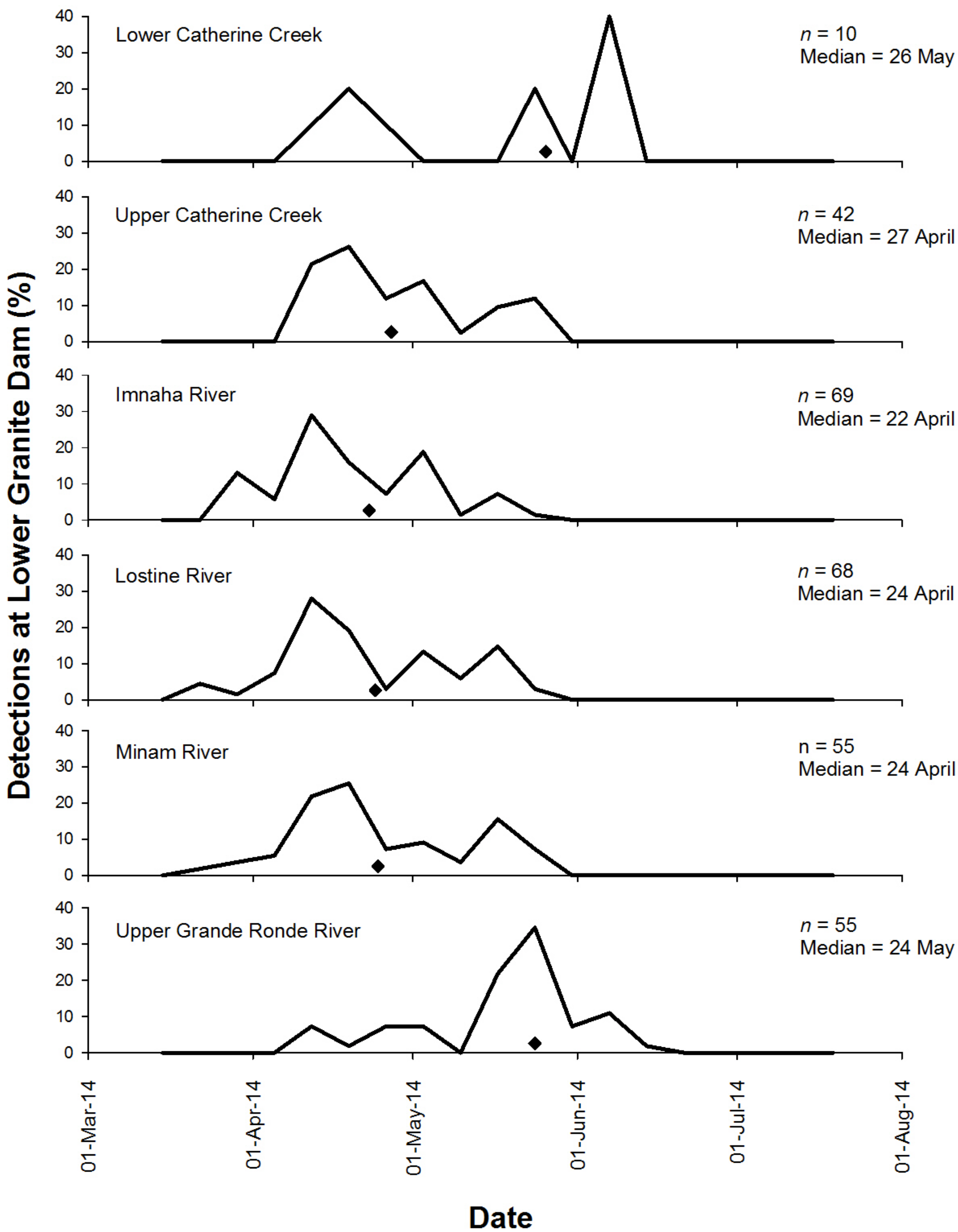
Appendix Figure B-1. Estimated migration timing and abundance for juvenile spring Chinook salmon migrants sampled by rotary screw traps during MY 2014. Traps were located at rkm 32 on Catherine Creek, rkm 3 on Lostine River, rkm 0 on Minam River, and rkm 299 on upper Grande Ronde River.



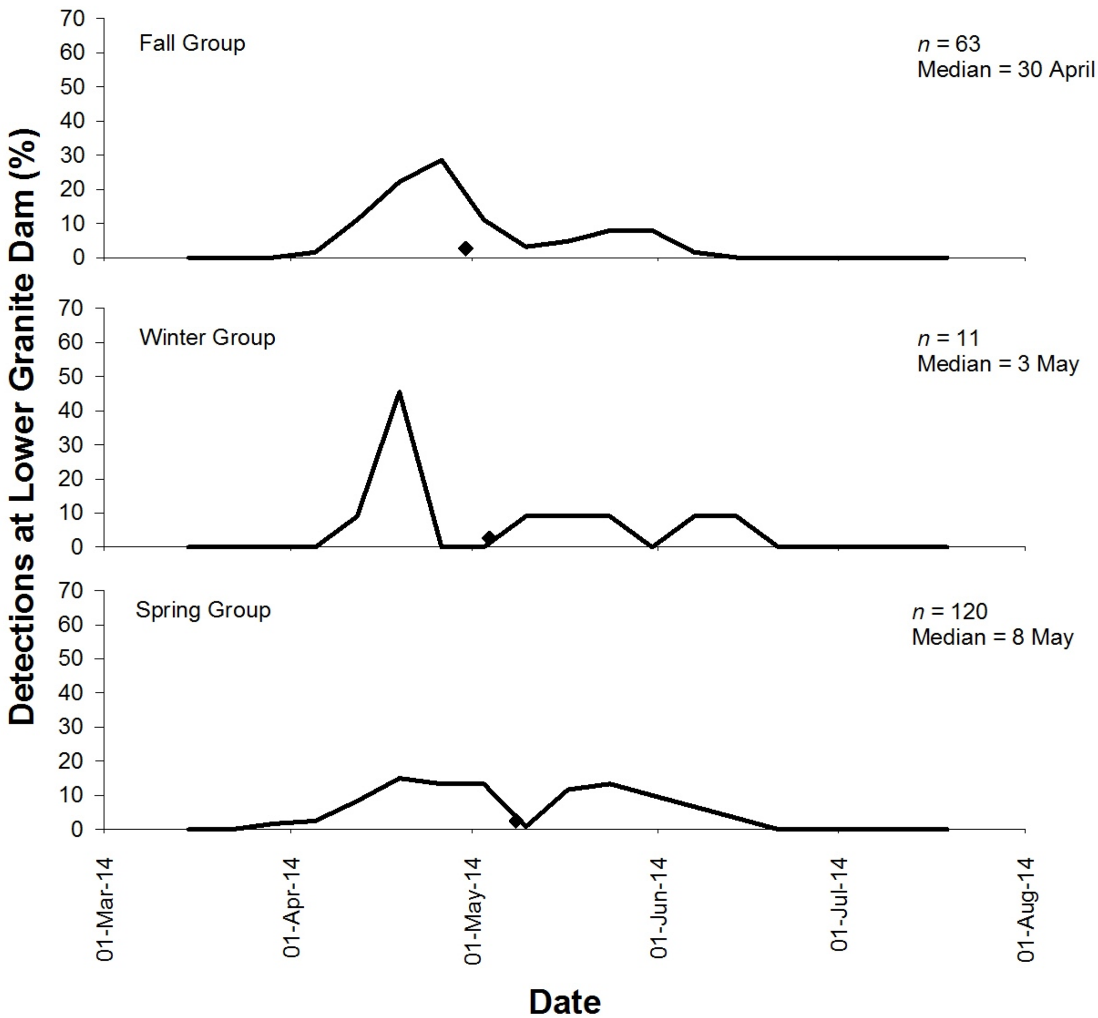
Appendix Figure B-2. Length frequency distribution (fork length) of early and late migrating juvenile spring Chinook salmon captured at Catherine Creek (rkm 32), Lostine (rkm 3), middle Grande Ronde (rkm 160), Minam (rkm 0), and upper Grande Ronde (rkm 299) river traps during MY 2014.



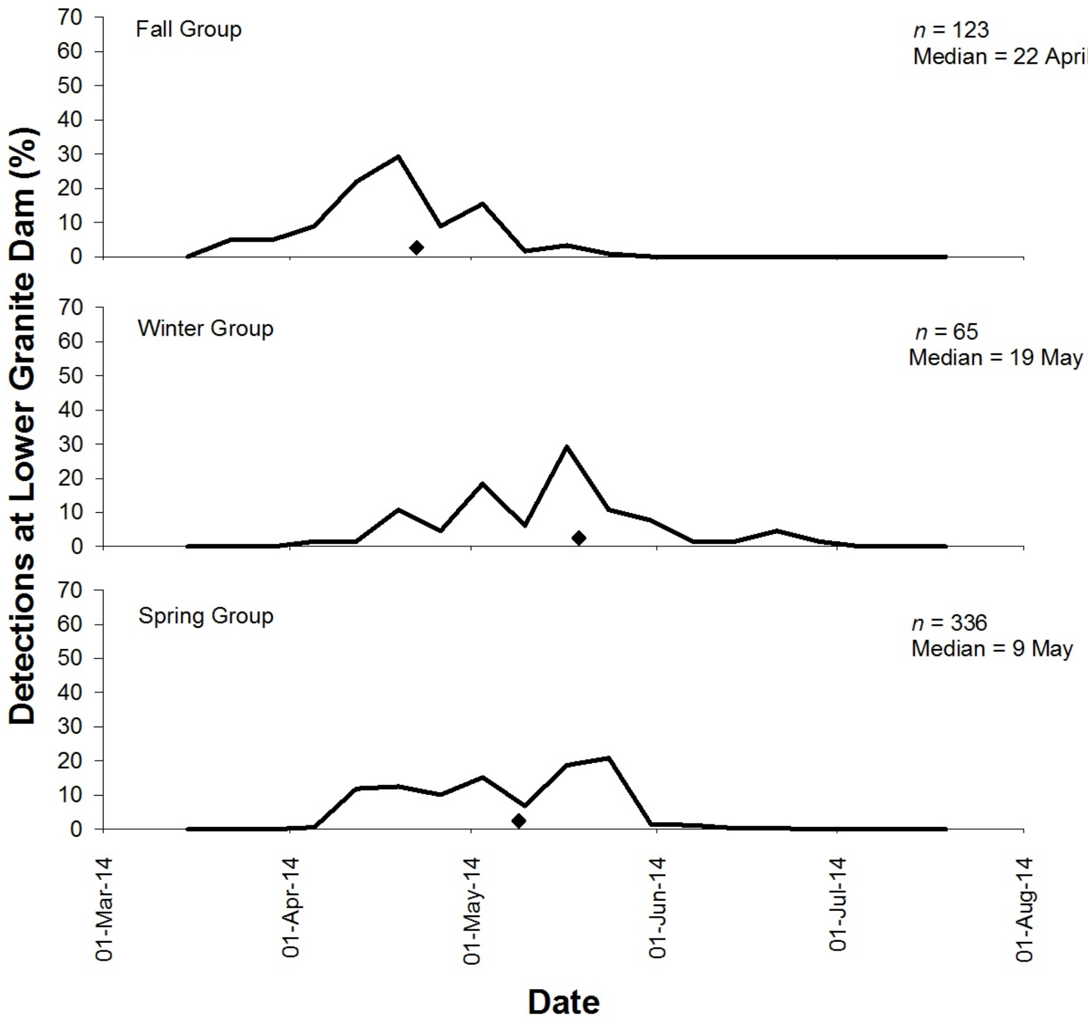
Appendix Figure B-3. Weekly mean fork lengths and associated standard error for spring Chinook salmon captured by rotary screw traps in Grande Ronde River Subbasin during MY 2014.



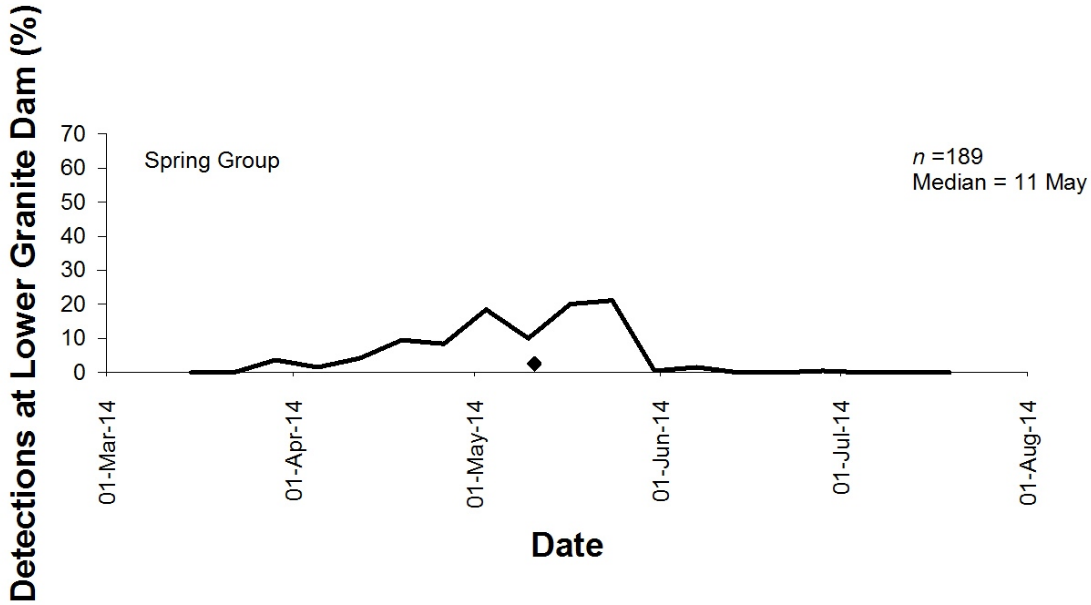
Appendix Figure B-4. Dates of arrival, during 2014 at Lower Granite Dam, of spring Chinook salmon PIT-tagged as parr in Catherine Creek and Imnaha, Lostine, Minam, and upper Grande Ronde rivers during summer 2013. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ♦ = median arrival date.



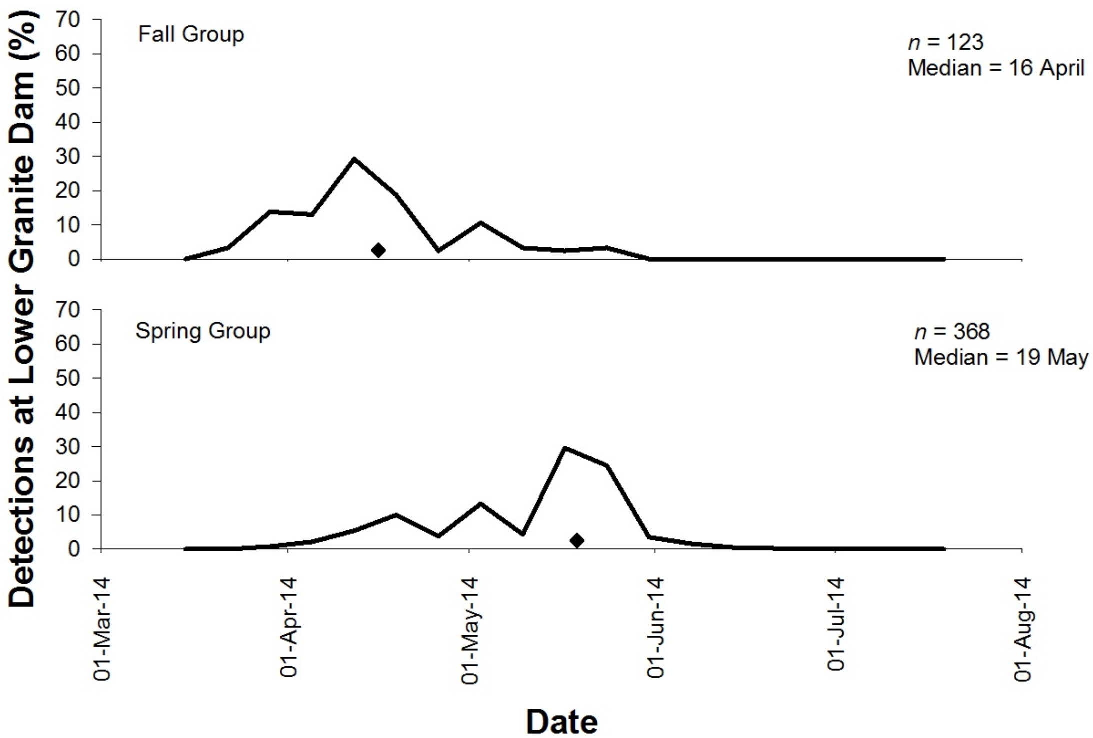
Appendix Figure B-5. Dates of arrival, during 2014 at Lower Granite dam, for fall, winter, and spring tag groups of juvenile spring Chinook salmon PIT-tagged from Catherine Creek. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ◆ = median arrival date.



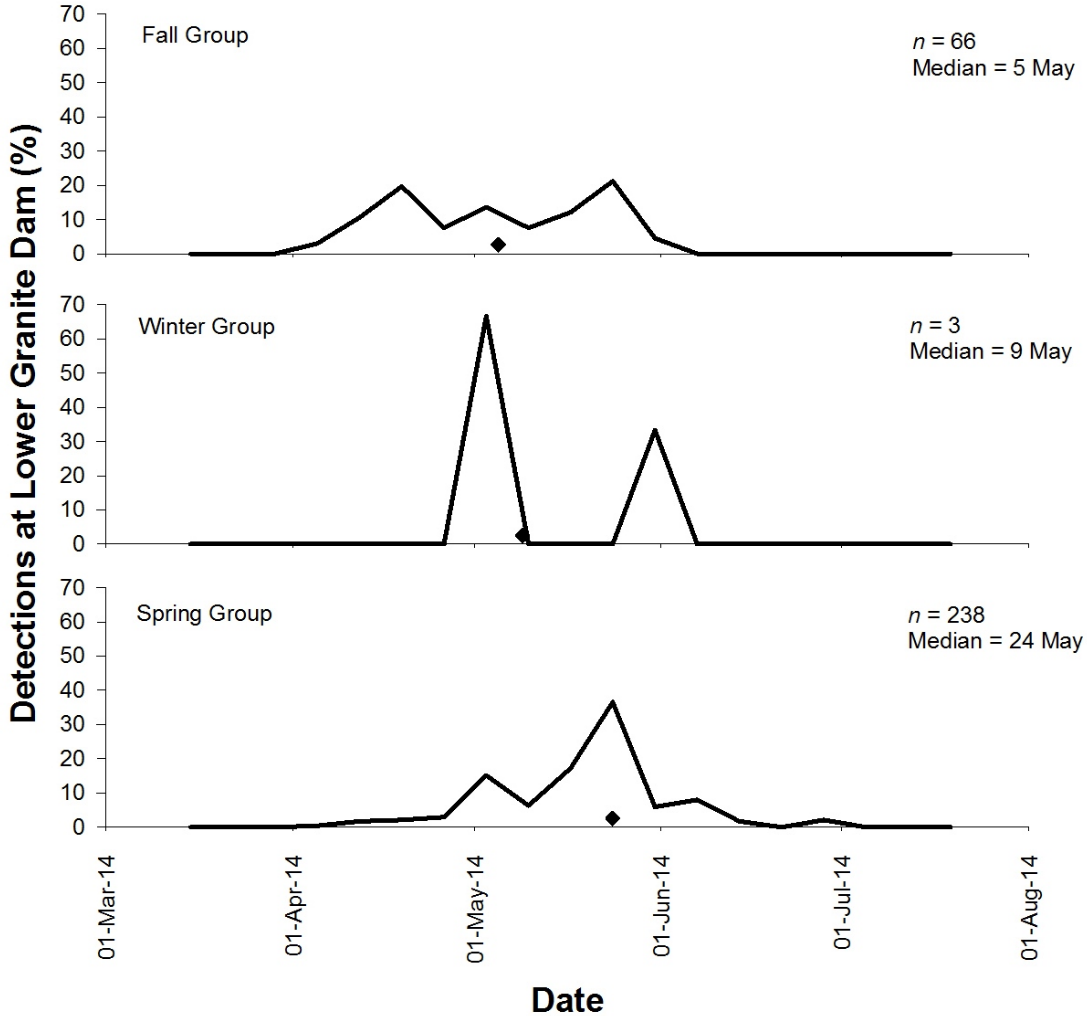
Appendix Figure B-6. Dates of arrival, during 2014 at Lower Granite dam, for fall, winter, and spring tag groups of juvenile spring Chinook salmon PIT-tagged from Lostine River. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ◆ = median arrival date.



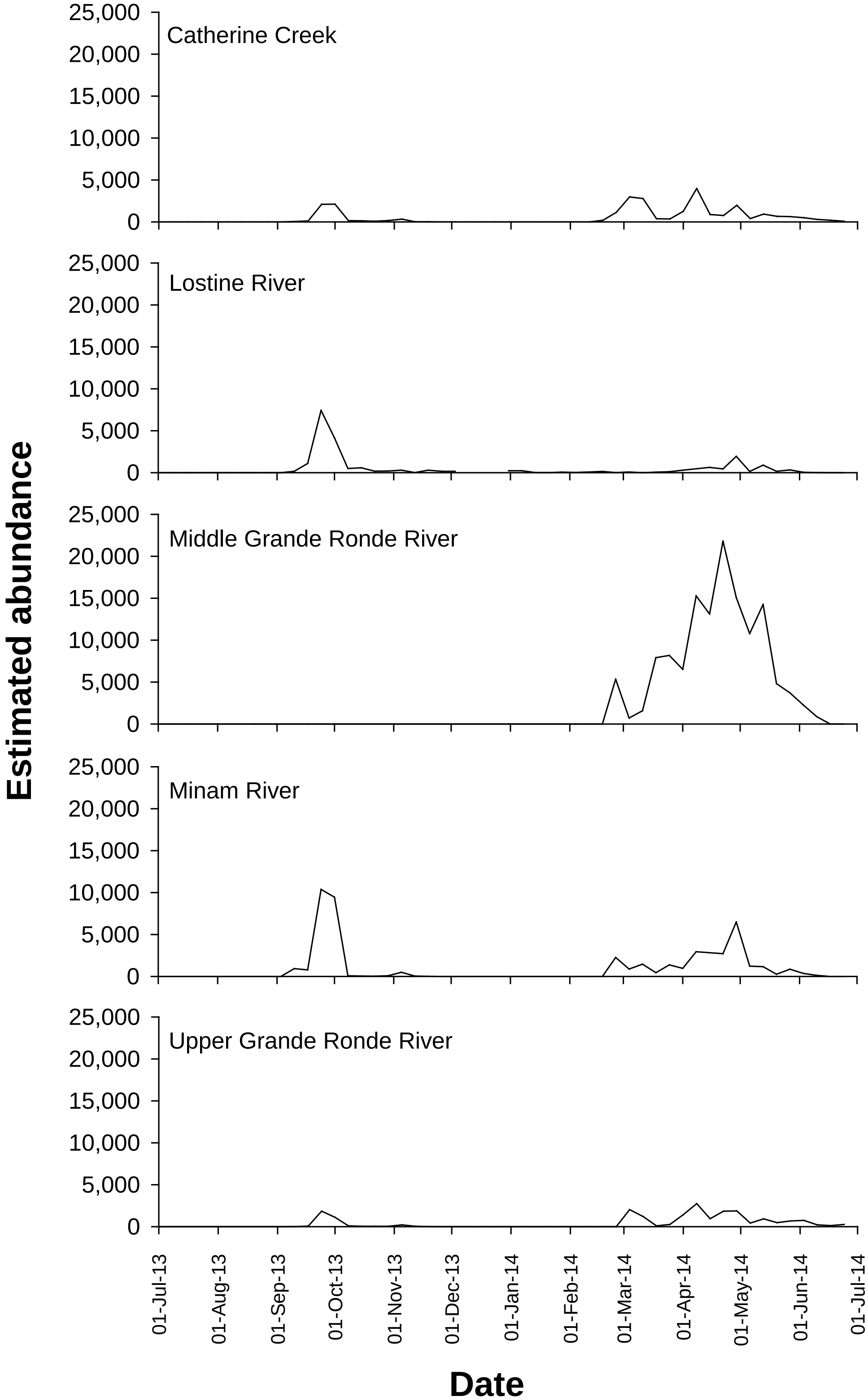
Appendix Figure B-7. Dates of arrival, during 2014 at Lower Granite dam, for the spring tag group of juvenile spring Chinook salmon PIT-tagged from middle Grande Ronde River. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ◆ = median arrival date.



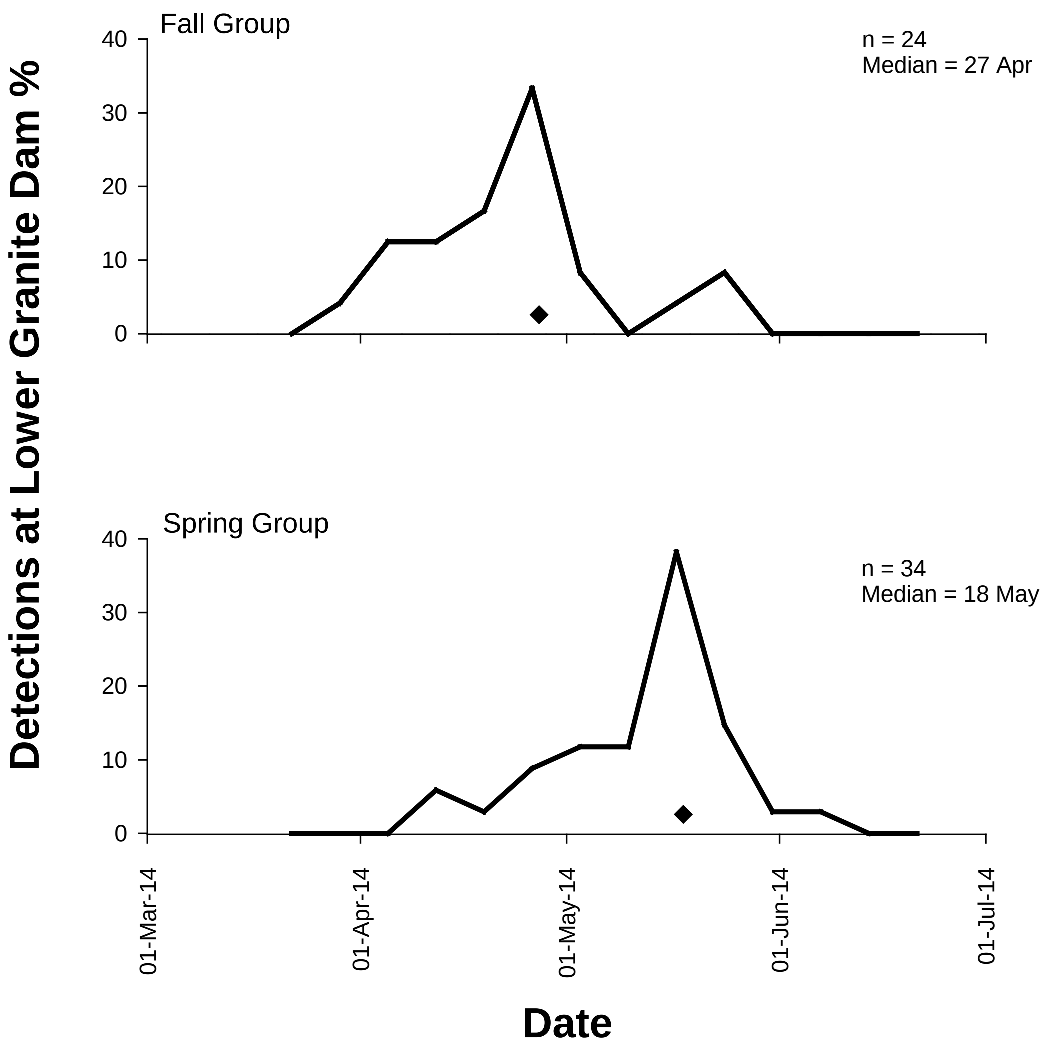
Appendix Figure B-8. Dates of arrival, during 2014 at Lower Granite dam, for fall and spring tag groups of juvenile spring Chinook salmon PIT-tagged from Minam River. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ◆ = median arrival date.



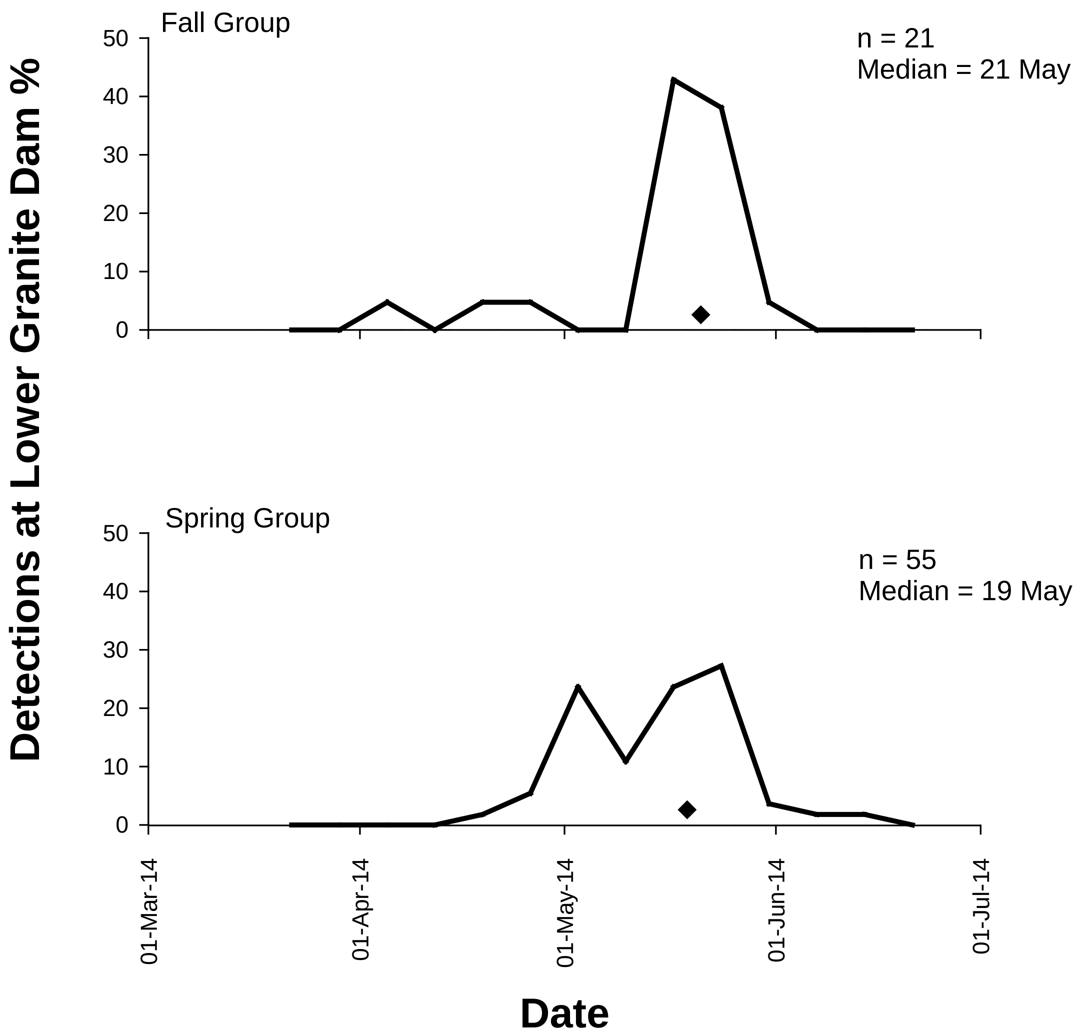
Appendix Figure B-9. Dates of arrival, during 2014 at Lower Granite dam, for fall, winter, and spring tag groups of juvenile spring Chinook salmon PIT-tagged from upper Grande Ronde River. Data was summarized by week and expressed as percentage of total detected. Detections were expanded for spillway flow. ◆ = median arrival date.



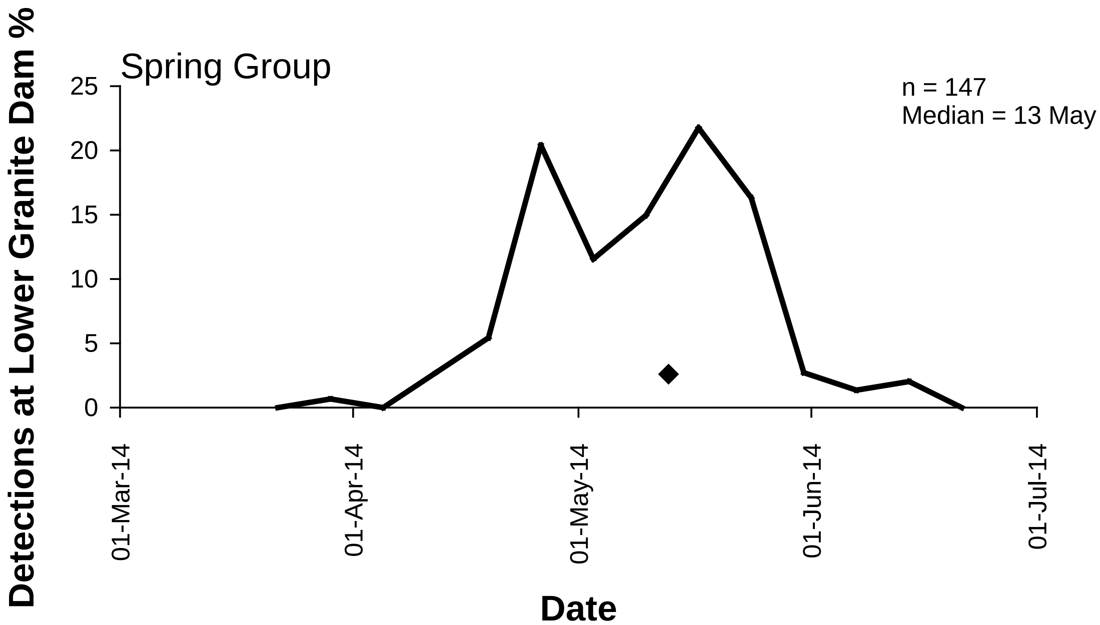
Appendix Figure B-10. Estimated migration timing and abundance of juvenile summer steelhead migrants captured by rotary screw trap during MY 2014.



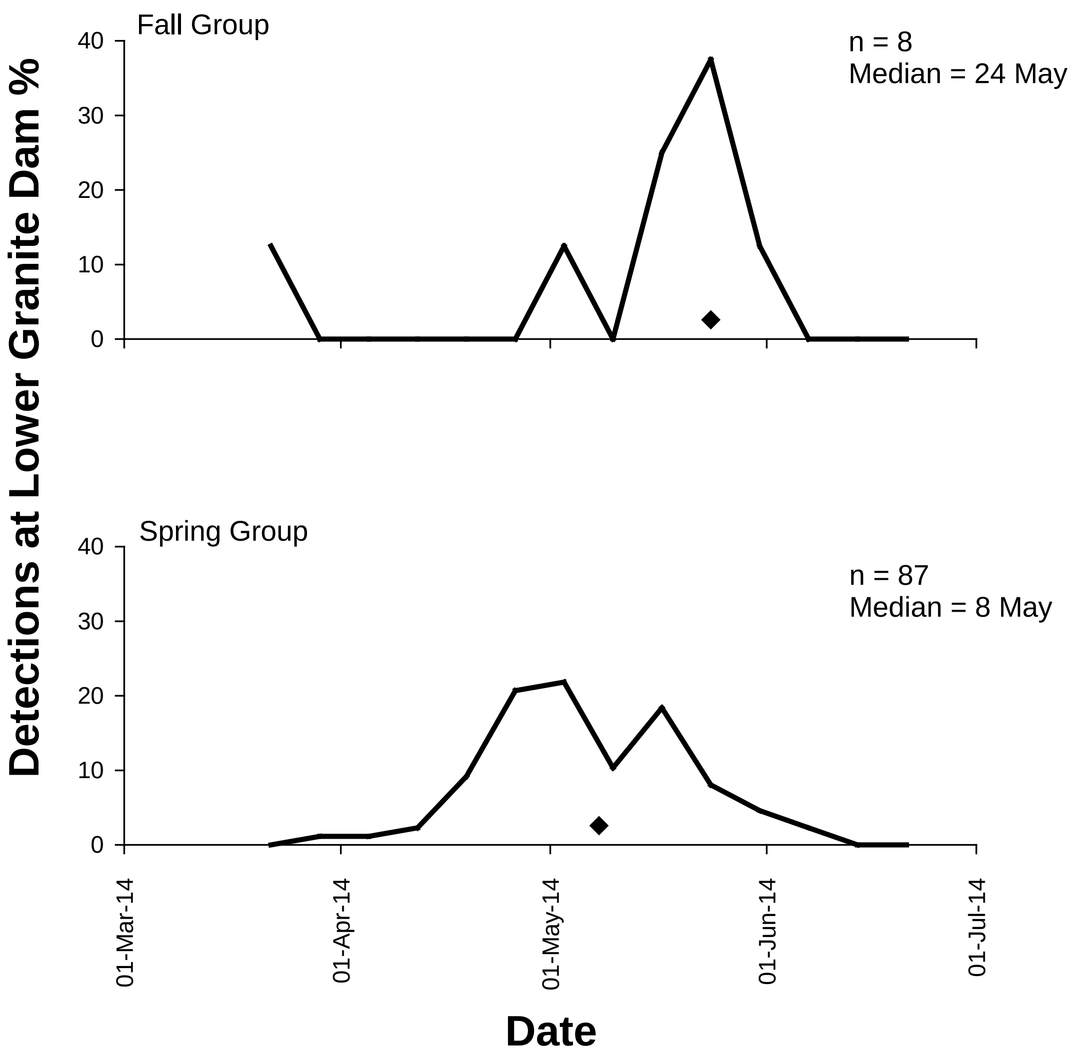
Appendix Figure B-11. Dates of arrival, in 2014, at Lower Granite Dam for fall and spring tag groups of steelhead PIT-tagged from Catherine Creek, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



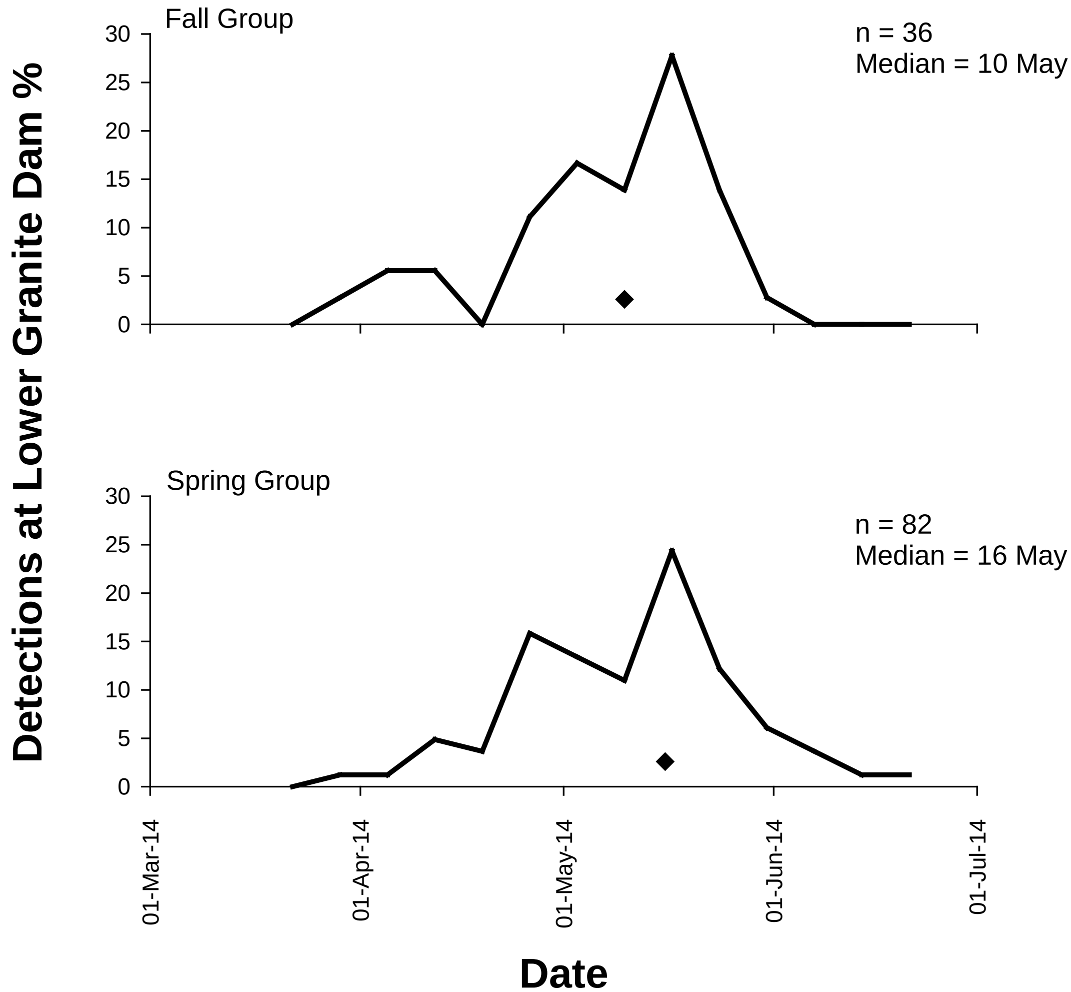
Appendix Figure B-12. Dates of arrival, in 2014, at Lower Granite Dam for fall and spring tag groups of steelhead PIT-tagged from Lostine River, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



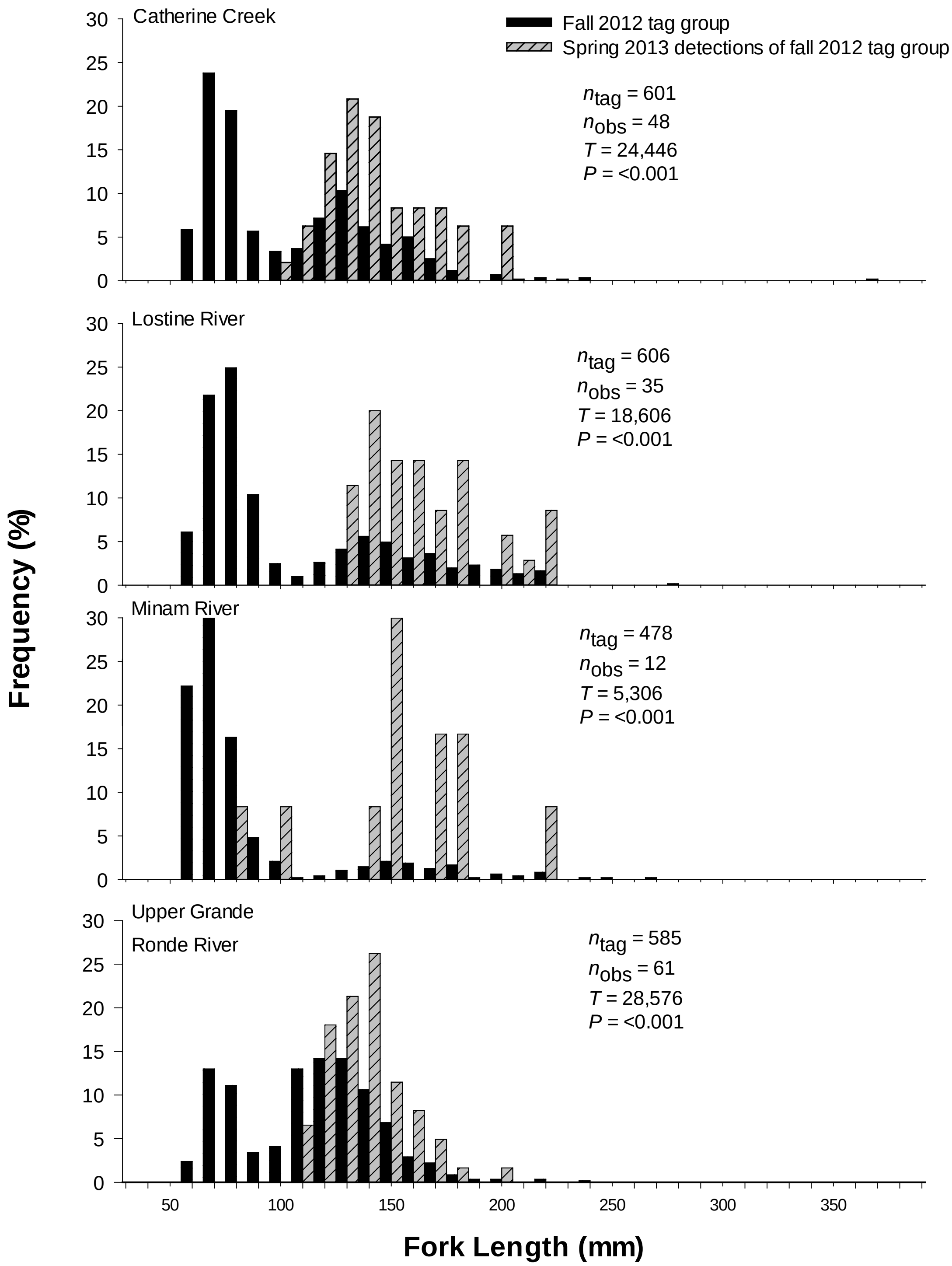
Appendix Figure B-13. Dates of arrival, in 2014, at Lower Granite Dam for fall and spring tag groups of steelhead PIT-tagged from middle Grande Ronde River, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



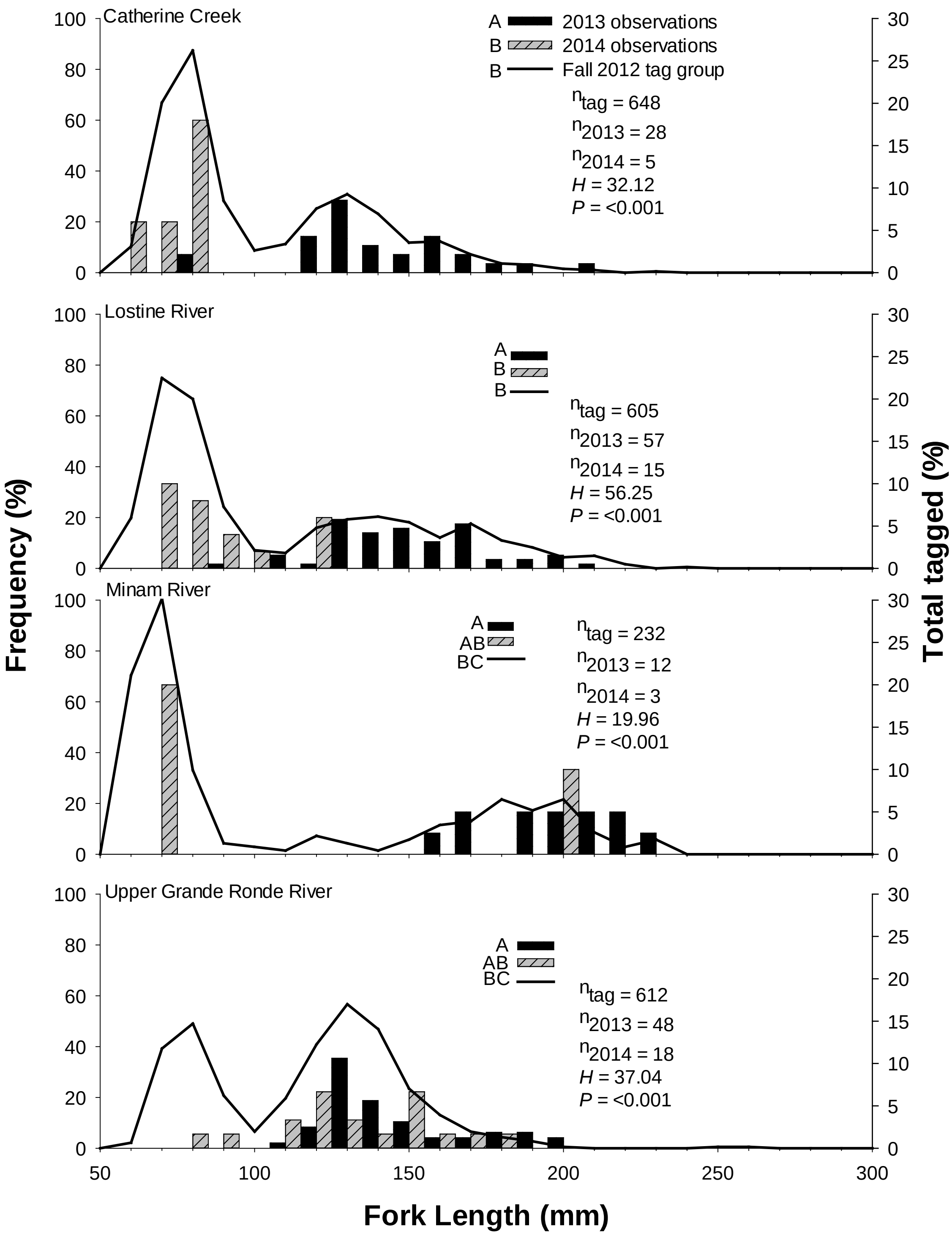
Appendix Figure B-14. Dates of arrival, in 2014, at Lower Granite Dam for fall and spring tag groups of steelhead PIT-tagged from Minam River, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



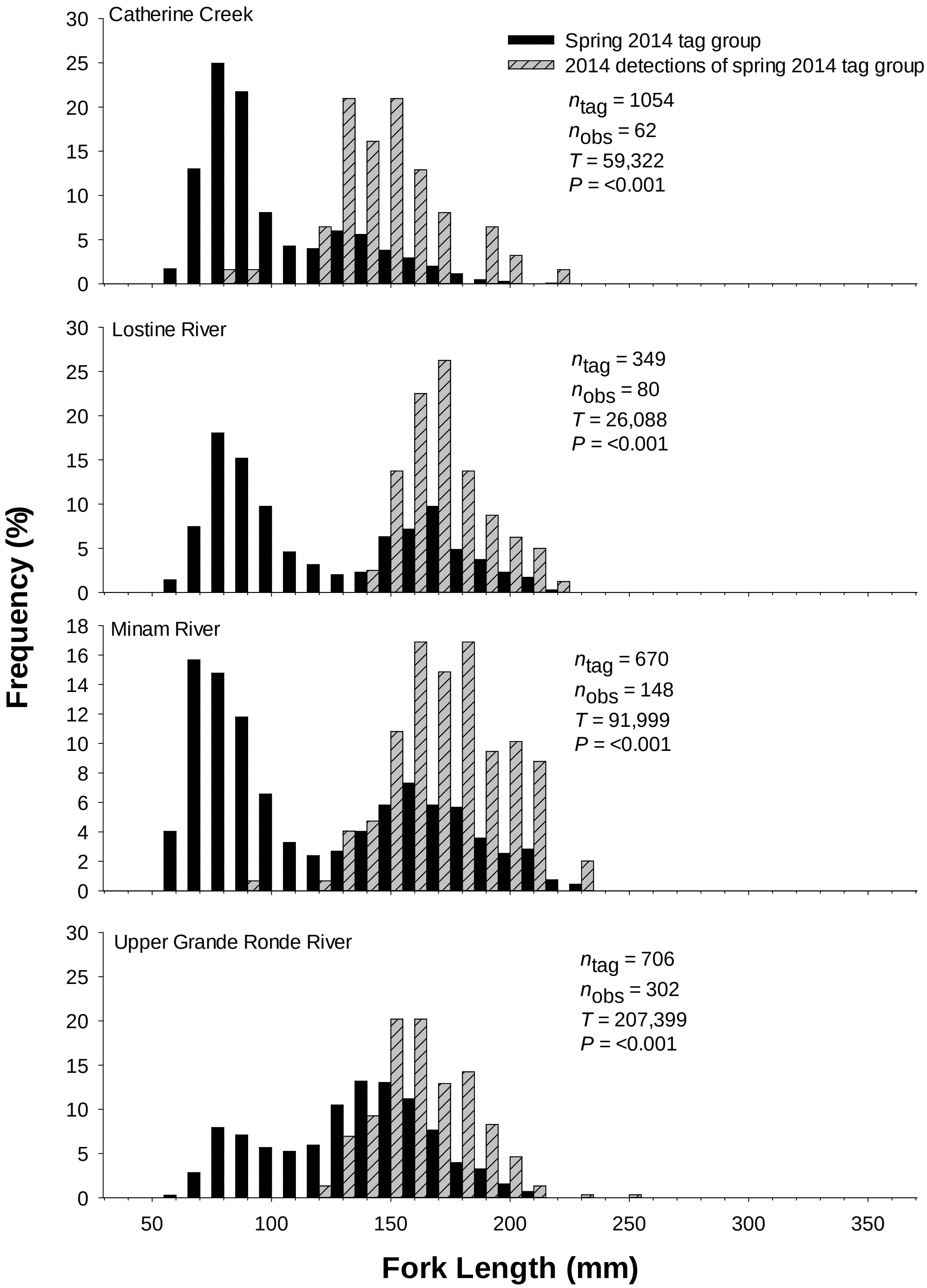
Appendix Figure B-15. Dates of arrival, in 2014, at Lower Granite Dam for fall and spring tag groups of steelhead PIT-tagged from upper Grande Ronde River, and expressed as a percentage of total detected for each group. Detections were expanded for spillway flow. ♦ = median arrival date.



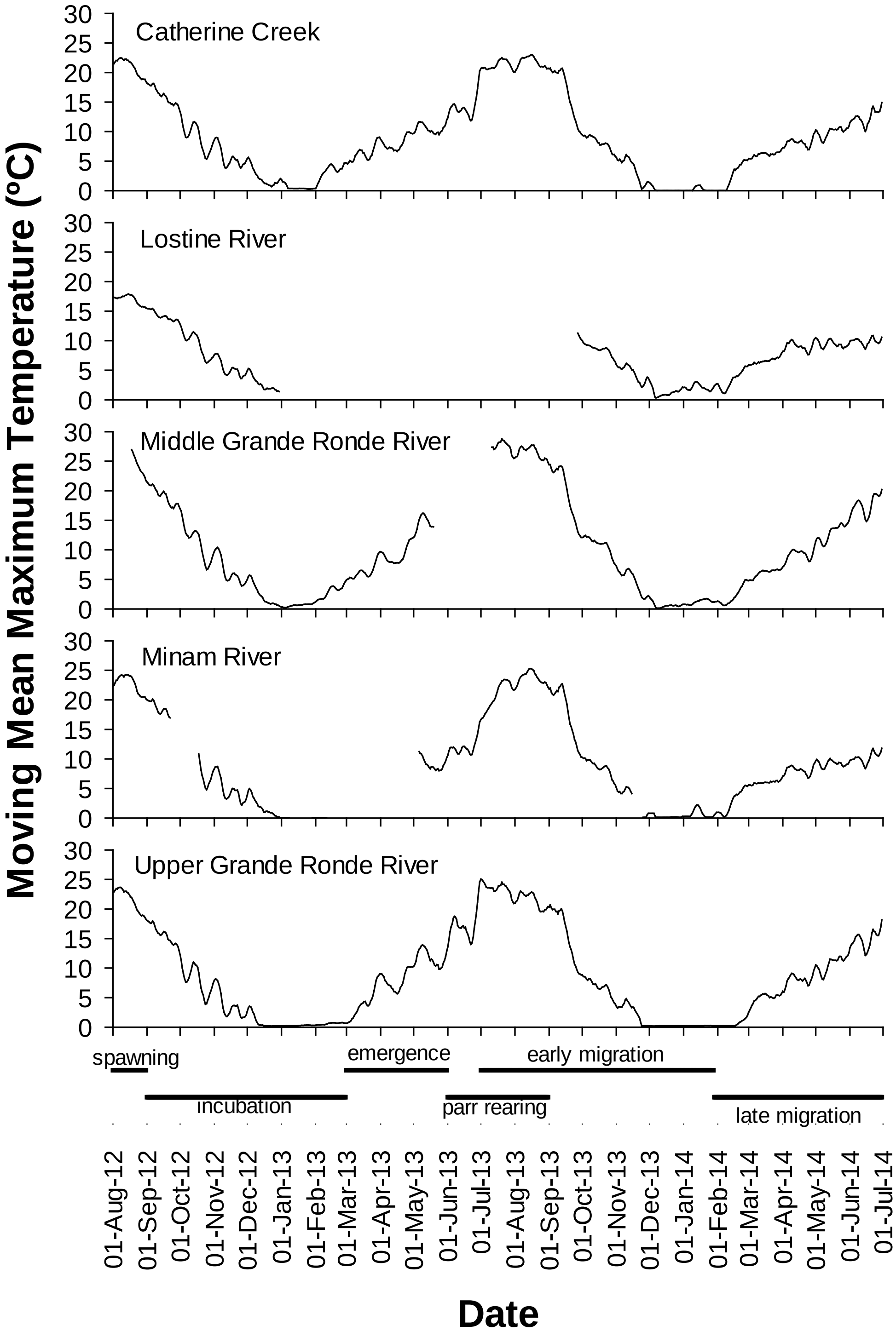
Appendix Figure B-16. Length frequency distributions for all steelhead PIT-tagged at screw traps during fall 2013 and those subsequently observed at Snake or Columbia river dams during spring 2014. Fork lengths are based on measurements taken at time of tagging. Frequency is expressed as percent of total number tagged (n_{tag}). 'n_{obs}' is number detected.



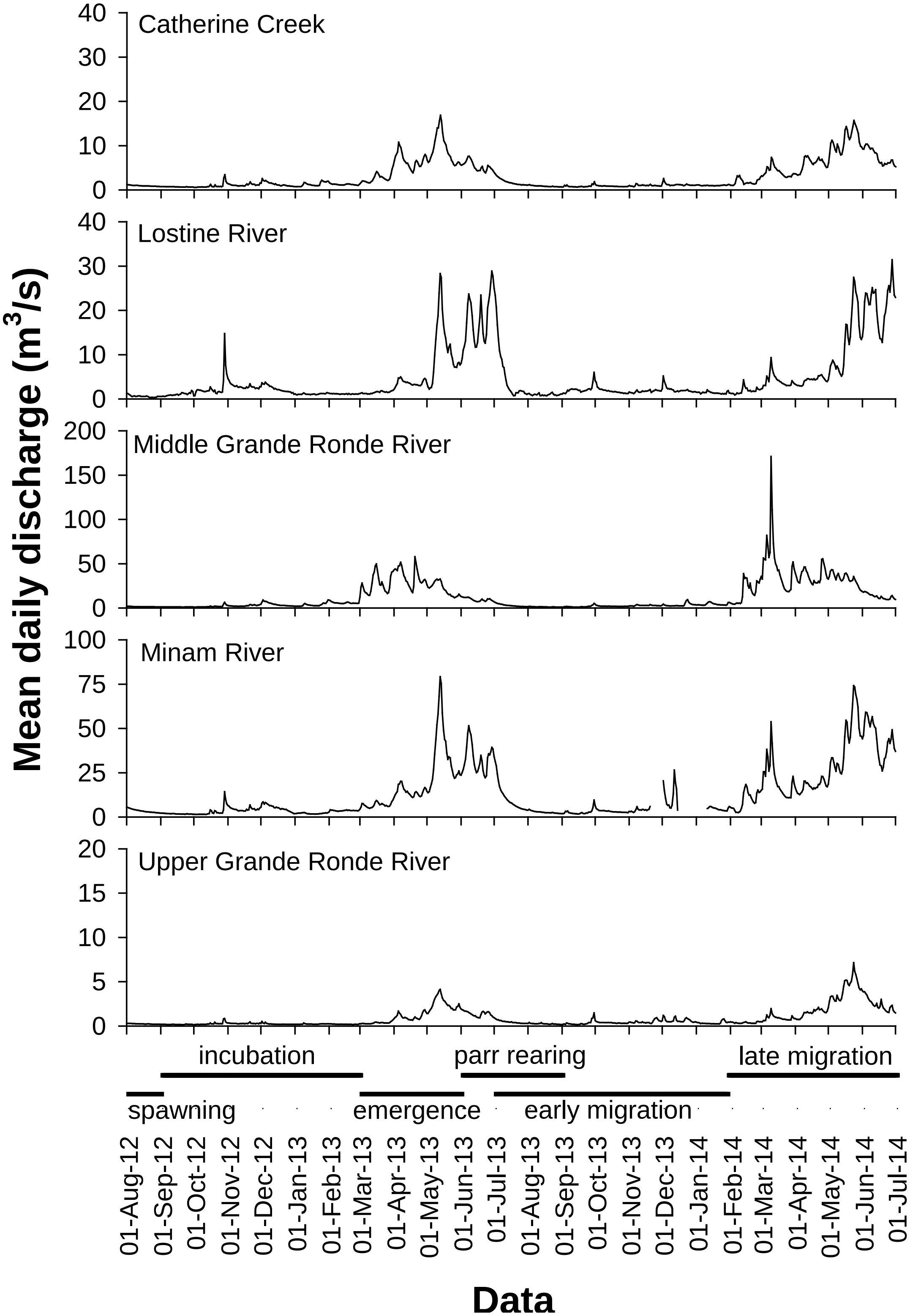
Appendix Figure B-17. Length frequency distributions for steelhead PIT-tagged at screw traps during fall 2012, and those subsequently observed at Snake or Columbia river dams during 2013 and 2014. Frequency is expressed as percent of total number tagged. ‘H’ is the test statistic for the Kruskal–Wallis one-way ANOVA on ranks of lengths. Dunn’s all pair-wise multiple comparison procedure was employed to compare groups among Catherine Creek, Lostine, and Minam rivers (α = 0.05).



Appendix Figure B-18. Length frequency distributions for steelhead PIT-tagged at screw traps during spring 2014, and those subsequently observed at Snake or Columbia river dams during spring 2014. Data were compared using the Mann-Whitney rank-sum test. Fork lengths are based on measurements taken at time of tagging. Frequency is expressed as percent of total number tagged (n_{tag}), and 'n_{obs}' represents number detected.



Appendix Figure B-19. Moving mean of maximum water temperature from four study streams in Grande Ronde River Subbasin during MY 2014. Data corresponds with juvenile spring Chinook salmon in-basin egg-to-emigrant life stages. Missing portions of a trend line represent periods where data were not available.



Appendix Figure B-20. Average daily discharge from four study streams in the Grande Ronde River Subbasin during MY 2014. Data corresponds with juvenile spring Chinook salmon in-basin egg-to-emigrant life stages.

Steelhead Spawner Surveys, and Abundance of Steelhead Spawners at the Population Level

Appendix Table B-12. Steelhead spawning ground survey characteristics, location and stream classification for sites in the UGRR basin, 2014.

Site ID	Stream	Panel	Stream Classification	Survey Distance (km)	Upstream Latitude	Upstream Longitude	Downstream Latitude	Downstream Longitude
092986	Fly Creek	Panel 1	Depositional	2.00	45.1949	-118.40397	45.2104	-118.396610
149594	Dark Canyon Creek	Panel 1	Source	2.13	45.3112	-118.40096	45.2969	-118.390200
275866	Meadow Creek	Panel 1	Transport	2.02	45.2938	-118.64340	45.2929	-118.623100
288410	Little Indian Creek	Panel 1	Source	2.15	45.4062	-117.80785	45.4125	-117.826740
316330	South Fork Catherine Creek	Panel 1	Source	2.07	45.1041	-117.59148	45.1005	-117.610700
420954	Grande Ronde River	Panel 1	Depositional	2.04	45.3155	-118.27548	45.3236	-118.258650
514458	Spring Creek	Panel 1	Transport	2.18	45.3955	-118.37271	45.3786	-118.361430
018904	Spring Creek	Annual	Transport	2.39	45.3472	-118.30733	45.3381	-118.286129
030904	McCoy Creek	Panel 1	Transport	2.48	45.3411	-118.55475	45.3488	-118.574785
047598	Rysdam Creek	Panel 1	Transport	2.16	45.6733	-117.83170	45.6918	-117.844200
052824	Five Points Creek	Random	Transport	2.04	45.4219	-118.16232	45.4184	-118.181400
059352	Clark Creek	Annual	Depositional	1.84	45.5002	-117.81994	45.5150	-117.828889
063704	Sheep Creek	Random	Source	1.94	45.3044	-118.15286	45.3042	-118.152980
072200	South Fork Catherine Creek	Random	Depositional	2.26	45.1005	-117.61070	45.1109	-117.629100
075080	Meadow Creek	Random	Transport	2.16	45.2961	-118.70047	45.2964	-118.679210
079752	Grande Ronde River	Annual	Depositional	1.99	45.1793	-118.38937	45.1933	-118.395185
101102	Phillips Creek	Annual	Depositional	2.30	45.5697	-117.99371	45.5669	-117.973246
101560	Meadow Creek	Annual	Transport	1.97	45.2924	-118.61218	45.2832	-118.602238
102872	Dry Creek	Panel 1	Transport	2.07	45.3678	-118.26620	45.3733	-118.288602
104942	Little Lookingglass Creek	Panel 1	Depositional	2.08	45.7535	-117.87833	45.7671	-117.886998
118408	West Chicken Creek	Annual	Source	1.95	45.0268	-118.40358	45.0445	-118.403882
120904	Burnt Corral Creek	Annual	Source	2.13	45.1740	-118.51651	45.1843	-118.499661
123964	Limber Jim Creek	Random	Source	2.09	45.1063	-118.28242	45.1046	-118.299280
125832	Meadow Creek	Annual	Depositional	2.17	45.2636	-118.55147	45.2714	-118.533272
143240	Tybow Creek	Panel 1	Source	2.01	45.2320	-118.46207	45.2145	-118.467850
147928	Five Points Creek	Annual	Depositional	2.36	45.4107	-118.20179	45.4034	-118.222762
163672	Whiskey Creek	Panel 1	Source	1.97	45.2701	-118.21970	45.2872	-118.218650
172104	Meadow Creek	Random	Depositional	2.10	45.2622	-118.40112	45.2511	-118.416320
177134	East Phillips Creek	Annual	Source	2.20	45.6345	-118.05570	45.6230	-118.072221

Appendix Table B-13. Steelhead spawning ground survey characteristics, location and stream classification for sites in the Joseph Creek basin, 2014.

Site ID	Stream	Panel	Stream Classification	Survey Distance (km)	Upstream Latitude	Upstream Longitude	Downstream Latitude	Downstream Longitude
002175	Crow Creek	Annual	Transport	2.07	45.6902	-117.15030	45.6902	-117.151930
037170	South Fork Chesnimnus Creek	Panel 3	Source	2.14	45.7260	-116.88738	45.7341	-116.870260
051026	Unnamed trib to Alder	Annual	Source	1.69	45.6939	-117.01259	45.7044	-117.021706
067711	Elk Creek	Panel 3	Transport	2.05	45.7002	-117.17113	45.7053	-117.152110
112130	Devils Run Creek	Annual	Source	2.24	45.7826	-116.96899	45.7801	-116.984205
141826	Basin Creek	Annual	Source	2.12	45.9128	-117.05728	45.9323	-117.057503
167426	Chesnimnus Creek	Annual	Depositional	2.44	45.7553	-116.99873	45.7507	-117.018780
169810	Chesnimnus Creek	Annual	Transport	2.08	45.7128	-116.91006	45.6975	-116.922844
192639	Crow Creek	Panel 3	Transport	2.13	45.6524	-117.14371	45.6708	-117.143200
231938	Cottonwood Creek	Panel 3	Source	2.00	45.8861	-116.98510	45.8680	-116.982500
249983	Elk Creek	Panel 3	Transport	2.13	45.6291	-117.19910	45.6478	-117.197230
255490	Billy Creek Tributary	Panel 3	Source	2.20	45.8028	-117.01440	45.8166	-117.021000
274559	Elk Creek	Panel 3	Source	2.13	45.6477	-117.19720	45.6640	-117.190430
301570	Cottonwood Creek	Annual	Source	1.88	45.9325	-117.05344	45.9430	-117.059020
339903	Swamp Creek	Panel 3	Transport	2.12	45.7703	-117.23261	45.7177	-117.229680
389247	Chesnimnus Creek	Annual	Depositional	1.94	45.6984	-117.12101	45.7051	-117.136075
390658	Chesnimnus Creek	Panel 3	Transport	2.18	45.6972	-116.92519	45.7143	-116.934740
427858	Chesnimnus Creek	Panel 3	Depositional	2.13	45.7173	-117.08565	45.7079	-117.090560
434111	Swamp Creek	Panel 3	Depositional	1.96	45.7865	-117.22978	45.8001	-117.229890
436738	Broady Creek	Panel 3	Source	2.10	45.9510	-117.07667	45.9453	-117.095590
471167	Little Elk Creek	Panel 3	Source	1.54	45.0944	-117.19869	45.6947	-117.185210
480514	Cottonwood Creek	Panel 3	Depositional	2.06	45.9826	-117.06148	45.9936	-117.050690
493394	Salmon Creek	Annual	Transport	1.92	45.7048	-117.04924	45.7188	-117.052223
508162	Joseph Creek	Panel 3	Depositional	2.11	45.7834	-117.17880	45.7896	-117.177210
515586	Chesnimnus Creek	Annual	Depositional	2.40	45.7370	-117.03171	45.7318	-117.049554

Appendix Table B-14. Completion dates and general results for redd surveys in the Upper Grande Ronde River basin and Deer Creek, 2014.

Site ID	Stream	No. surveys completed	Mean No. days between surveys	Redd Count	1st Survey	2nd Survey	3rd Survey	4th Survey	5th Survey	6th Survey	7th Survey
018904	Spring Creek	7	14.3	9	3/17/2014	3/31/2014	4/14/2014	4/28/2014	5/12/2014	5/27/2014	6/11/2014
030904	McCoy Creek	6	14.4	0	3/31/2014	4/14/2014	4/28/2014	5/12/2014	5/27/2014	6/11/2014	
047598	Rysdam Creek	5	14.3	4	3/24/2014	4/8/2014	4/23/2014	5/6/2014	5/20/2014		
052824	Five Points Creek	5	15	4	4/7/2014	4/22/2014	5/8/2014	5/22/2014	6/6/2014		
059352	Clark Creek	6	14.4	6	3/18/2014	4/1/2014	4/15/2014	4/29/2014	5/13/2014	5/29/2014	
063704	Sheep Creek	1	NA	0	5/14/2014						
072200	SF Catherine Creek	2	37	0	4/29/2014	6/5/2014					
075080	Meadow Creek	4	10	2	4/24/2014	5/5/2014	5/21/2014	6/3/2014			
079752	Grande Ronde River	3	32	0	3/25/2014	4/16/2014	5/28/2014				
092986	Fly Creek	6	14.4	4	3/25/2014	4/7/2014	4/21/2014	5/6/2014	5/22/2014	6/5/2014	
101102	Phillips Creek	6	14.2	1	3/26/2014	4/8/2014	4/23/2014	5/6/2014	5/20/2014	6/5/2014	
101560	Meadow Creek	5	14	1	4/8/2014	4/21/2014	5/5/2014	5/21/2014	6/3/2014		
102872	Dry Creek	5	13.8	0	3/25/2014	4/7/2014	4/21/2014	5/5/2014	5/19/2014		
104942	Little Lookingglass Creek	5	19.5	2	3/24/2014	4/8/2014	5/15/2014	5/29/2014	6/10/2014		
118408	West Chicken Creek	4	15	1	4/21/2014	5/6/2014	5/22/2014	6/5/2014			
120904	Burnt Corral Creek	5	14.3	0	3/17/2014	3/31/2014	4/14/2014	4/28/2014	5/13/2014		
123964	Limber Jim Creek	4	15	1	4/28/2014	5/14/2014	5/28/2014	6/12/2014			
125832	Meadow Creek	7	13	6	3/19/2014	4/3/2014	4/14/2014	4/30/2014	5/7/2014	5/21/2014	6/5/2014
143240	Tybow Creek	5	14.3	0	3/17/2014	3/31/2014	4/14/2014	4/30/2014	5/13/2014		
147928	Five Points Creek	5	13.8	3	4/15/2014	4/30/2014	5/14/2014	5/30/2014	6/9/2014		
149594	Dark Canyon Creek	5	14.3	7	4/8/2014	4/21/2014	5/7/2014	5/19/2014	6/4/2014		
163672	Whiskey Creek	7	14.2	3	3/17/2014	3/31/2014	4/14/2014	4/28/2014	5/12/2014	5/27/2014	6/10/2014
172104	Meadow Creek	7	13.7	0	3/19/2014	4/3/2014	4/14/2014	4/30/2014	5/13/2014	5/27/2014	6/9/2014
177134	East Phillips Creek	3	14	0	5/15/2014	5/28/2014	6/12/2014				
275866	Meadow Creek	5	14	1	4/8/2014	4/21/2014	5/5/2014	5/21/2014	6/3/2014		
288410	Little Indian Creek	6	14	0	4/1/2014	4/15/2014	4/29/2014	5/13/2014	5/29/2014	6/10/2014	
316330	SF Catherine Creek	2	37	0	4/29/2014	6/5/2014					
420954	Grande Ronde River	1	NA	0	6/5/2014						
514458	Spring Creek	4	0	10	4/22/2014	5/5/2014	5/19/2014	6/4/2014			
3-0	Deer Creek	6	14	10	3/20/2014	4/3/2014	4/17/2014	5/1/2014	5/15/2014	5/29/2014	
6-3	Deer Creek	6	14	5	3/20/2014	4/3/2014	4/17/2014	5/1/2014	5/15/2014	5/29/2014	
8-6	Deer Creek	5	11.2	3	4/3/2014	4/17/2014	5/1/2014	5/15/2014	5/29/2014		
10-8	Deer Creek	3	5.6	0	4/17/2014	5/1/2014	5/15/2014				
12-10	Deer Creek	1	NA	0	5/1/2014						

Appendix Table B-15. Completion dates and general results for redd surveys in the in the Joseph Creek basin, 2014.

Site ID	Stream	No. surveys completed	Mean No. days between surveys	Redd Count	1st Survey	2nd Survey	3rd Survey	4th Survey	5th Survey	6th Survey
002175	Crow Creek	4	9.8	5	3/21/2014	4/2/2014	4/15/2014	4/29/2014		
037170	SF Chesnimnus Creek	3	6.0	4	5/6/2014	5/19/2014	6/5/2014			
051026	Unnamed trib to Alder	4	10.5		3/26/2014	4/8/2014	4/22/2014	5/7/2014		
067711	Elk Creek	5	12.2	10	3/21/2014	4/2/2014	4/15/2014	4/29/2014	5/21/2014	
112130	Devils Run Creek	4	10.5	14	4/16/2014	5/5/2014	5/19/2014	5/28/2014		
141826	Basin Creek	4	10.0		3/24/2014	4/7/2014	4/28/2014	5/13/2014		
167426	Chesnimnus Creek	5	12.2	12	4/3/2014	4/21/2014	5/7/2014	5/20/2014	6/3/2014	
169810	Chesnimnus Creek	6	13.0	6	3/31/2014	4/9/2014	4/23/2014	5/6/2014	5/19/2014	6/4/14
192639	Crow Creek	4	8.2	6	3/19/2014	4/2/2014	4/15/2014	4/29/2014		
231938	Cottonwood Creek	2	2.8	7	5/8/2014	5/22/2014				
249983	Elk Creek	4	11.5		3/27/2014	4/9/2014	4/21/2014	5/12/2014		
255490	Unnamed trib to Billy	4	11.5		4/24/2014	5/12/2014	5/23/2014	6/9/2014		
274559	Elk Creek	4	11.5	6	3/27/2014	4/9/2014	4/21/2014	5/12/2014		
301570	Cottonwood Creek	4	9.7	6	3/24/2014	4/7/2014	4/28/2014	5/13/2014		
339903	Swamp Creek	3	8.8	4	4/1/2014	5/1/2014	5/15/2014			
389247	Chesnimnus Creek	4	10.5	6	4/16/2014	4/29/2014	5/14/2014	5/28/2014		
390658	Chesnimnus Creek	6	13.0	7	3/31/2014	4/9/2014	4/23/2014	5/6/2014	5/19/2014	6/4/14
427858	Chesnimnus Creek	4	12.0	15	4/16/2014	5/5/2014	5/20/2014	6/3/2014		
434111	Swamp Creek	3	7.3	13	4/14/2014	5/1/2014	5/13/2014			
436738	Broady Creek	3	12.3		3/25/2014	4/28/2014	5/13/2014			
471167	Little Elk Creek	4	9.0		3/17/2014	3/31/2014	4/15/2014	5/1/2014		
480514	Cottonwood Creek	4	12.5		3/24/2014	4/7/2014	4/29/2014	5/13/2014		
493394	Salmon Creek	5	14.0	2	3/26/2014	4/8/2014	4/22/2014	5/7/2014	5/21/2014	
508162	Joseph Creek	4	7.4	2	5/5/2014	5/14/2014	5/28/2014	6/11/2014		
515586	Chesnimnus Creek	5	16.8	5	4/3/2014	4/24/2014	5/7/2014	5/20/2014	6/9/2014	

Appendix Table B-16. Locations, dates, and characteristics of live steelhead observations in the UGRR and Deer Creek basins, 2014.

Site ID	Stream	Observation Date	Fin Clip	On/Off Redd
047598	Rysdam Creek	3/24/2014	Yes	Off
047598	Rysdam Creek	3/24/2014	No	Off
052824	Five Points Creek	5/8/2014	Unknown	Off
059352	Clark Creek	4/1/2014	No	On
059352	Clark Creek	4/1/2014	No	On
059352	Clark Creek	4/1/2014	No	On
059352	Clark Creek	4/1/2014	No	On
059352	Clark Creek	4/15/2014	Yes	On
059352	Clark Creek	4/15/2014	Unknown	On
059352	Clark Creek	4/15/2014	Unknown	On
101560	Meadow Creek	4/21/2014	Unknown	On
118408	West Chicken Creek	4/21/2014	Unknown	On
149594	Dark Canyon Creek	4/21/2014	Unknown	On
172104	Meadow Creek	5/27/2014	Unknown	Off
275866	Meadow Creek	4/21/2014	Yes	Off
420954	Grande Ronde River	6/6/2014	Unknown	Off
514458	Spring Creek	4/22/2014	No	Off
514458	Spring Creek	5/19/2014	Unknown	Off
514458	Spring Creek	5/5/2014	Unknown	On
Deer3-0	Deer Creek	4/17/2014	Unknown	Near
Deer3-0	Deer Creek	4/17/2014	Unknown	Off
Deer3-0	Deer Creek	4/17/2014	Yes	Off
Deer3-0	Deer Creek	4/17/2014	Yes	Off
Deer3-0	Deer Creek	4/17/2014	Yes	Off
Deer3-0	Deer Creek	4/17/2014	Yes	Off
Deer3-0	Deer Creek	5/15/2014	Unknown	On

Appendix Table B-17. Locations, dates, and characteristics of live steelhead observations in the Joseph Creek basin, 2014.

Site ID	Stream	Observation Date	Fin Clip	On/Off Redd
002175	Crow Creek	4/2/2014	Unknown	On
067711	Elk Creek	4/15/2014	Unknown	Off
112130	Devils Run Creek	5/5/2014	Unknown	Off
112130	Devils Run Creek	5/5/2014	Unknown	On
167426	Chesnimnus Creek	4/21/2014	No	On
167426	Chesnimnus Creek	4/21/2014	Unknown	On
167426	Chesnimnus Creek	4/21/2014	Unknown	On
167426	Chesnimnus Creek	4/21/2014	Unknown	On
192639	Crow Creek	3/19/2014	Unknown	On
192639	Crow Creek	4/2/2014	No	On
192639	Crow Creek	4/2/2014	No	On
274559	Elk Creek	4/9/2014	No	Off
274559	Elk Creek	4/9/2014	No	Off
390658	Chesnimnus Creek	4/9/2014	Unknown	Off
390658	Chesnimnus Creek	4/9/2014	Unknown	Off
390658	Chesnimnus Creek	4/9/2014	Unknown	Off
493394	Salmon Creek	3/26/2014	Unknown	Off
508162	Joseph Creek	5/14/2014	Unknown	Off

Appendix Table B-18. Locations, dates, and characteristics of dead steelhead observations in Joseph and Deer Creek basins, 2014.

Site ID	Stream	Date Observed	Fish Sex	Fork Length	Origin
037170	SF Chesnimnus Creek	5/19/2014	Male	590	Wild
112130	Devils Run Creek	5/19/2014	Male	720	Wild
Deer3-0	Deer Creek	5/15/2014	Male	625	Wild
Deer3-0	Deer Creek	5/15/2014	Male	570	Wild
Deer3-0	Deer Creek	5/15/2014	Male	560	Wild

Appendix Table B-19. Annual results of steelhead spawning ground surveys, 2008−2014. Available spawning habitat was refined yearly based on previous surveys.

Year	No. of sites	Spawning habitat (km)	Weight value	Redds observed	Distance surveyed (km)	Fish:redd ratio	Total spawner escapement	95% CI	CI as % of escapement
UGRR basin									
2008	29	1,301	44.9	24	64.2	4.07	2,096	±1,142	54.50%
2009	30	1,178	39.3	42	59.9	3.81	3,148	±1,047	33.20%
2010	29	934	32.2	109	56.4	1.6	2,876	±897	31.20%
2011	28	929	33.2	44	59.5	4.75	3,275	±1,028	31.40%
2012	30	897	29.9	70	60.7	3.14	3,261	±1,077	33.00%
2013	29	892	30.8	52	56.1	1.91	1,553	±757	48.70%
2014	29	892	30.8	65	61.3	2.67	2,512	±974	38.77%
Joseph Creek basin									
2012	30	384	12.8	67	58.4	3.14	1,357	±380	28.00%
2013	26	384	14.8	153	51.5	1.91	2,197 [a]	±934	42.50%
2014	25	384	15.4	130	51.8	2.67	2,522 [b]	±778	30.85%

a. With 2.2% hatchery proportion the total natural spawners is 2,149 (95% CI ±913).
b. With 1.1% hatchery proportion the total natural spawners is 2,494 (95% CI ±769).

Appendix Table B-20. Origin of adult steelhead passed above Joseph Creek, UGRR, Catherine Creek, Lookingglass Creek and Deer Creek weirs in 2014.

	Natural Origin	Hatchery Origin	Proportion Hatchery (%)	Total Fish
Joseph Creek*	145	0	0	145
UGRR**	8	0	0	8
Catherine Creek**	263	0	0	263
Lookingglass Creek**	178	2	1.1	180
Deer Creek***	48	0	0	48

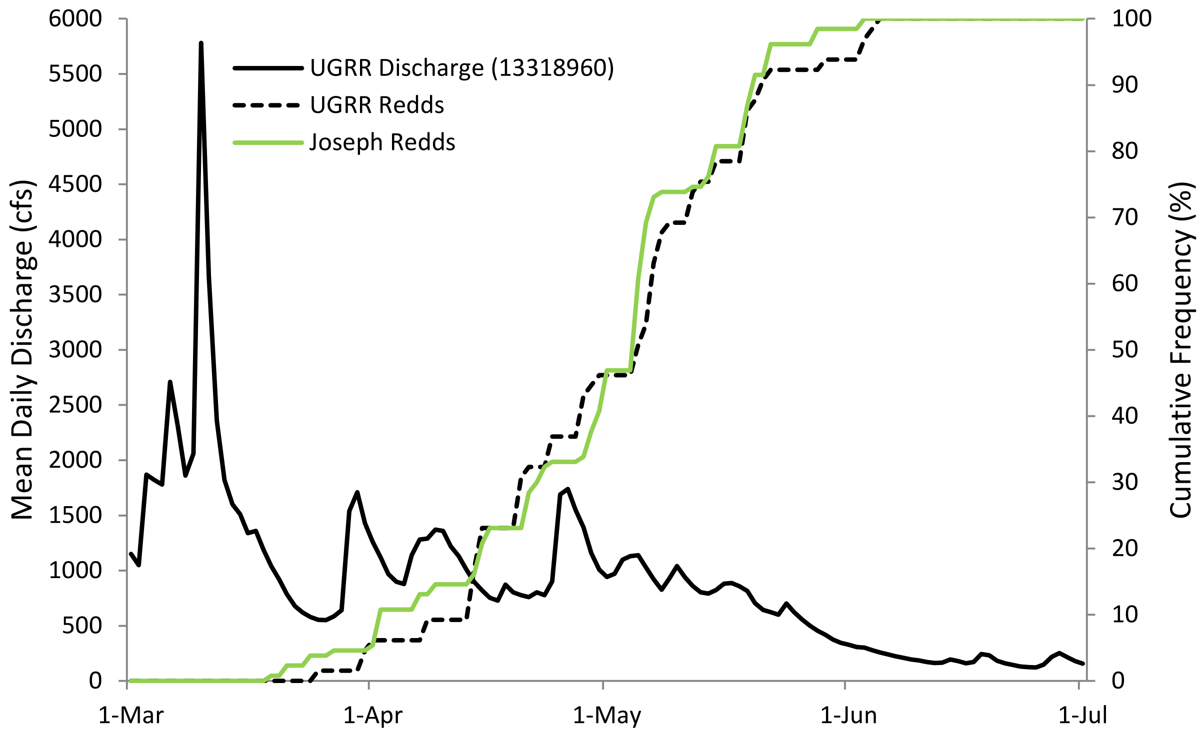
*Paul Kucera, Nez Perce Tribe, Department of Fisheries Resources Management, unpublished data, personal communication
**Michael McLean, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fisheries Program, unpublished data, personal communication
***Michael Flesher, Oregon Department of Fish & Wildlife, La Grande Fish Research, unpublished data, personal communication

Appendix Table B-21. Survey characteristics and spawning survey results, grouped by stream classification type for UGRR basin, 2014.

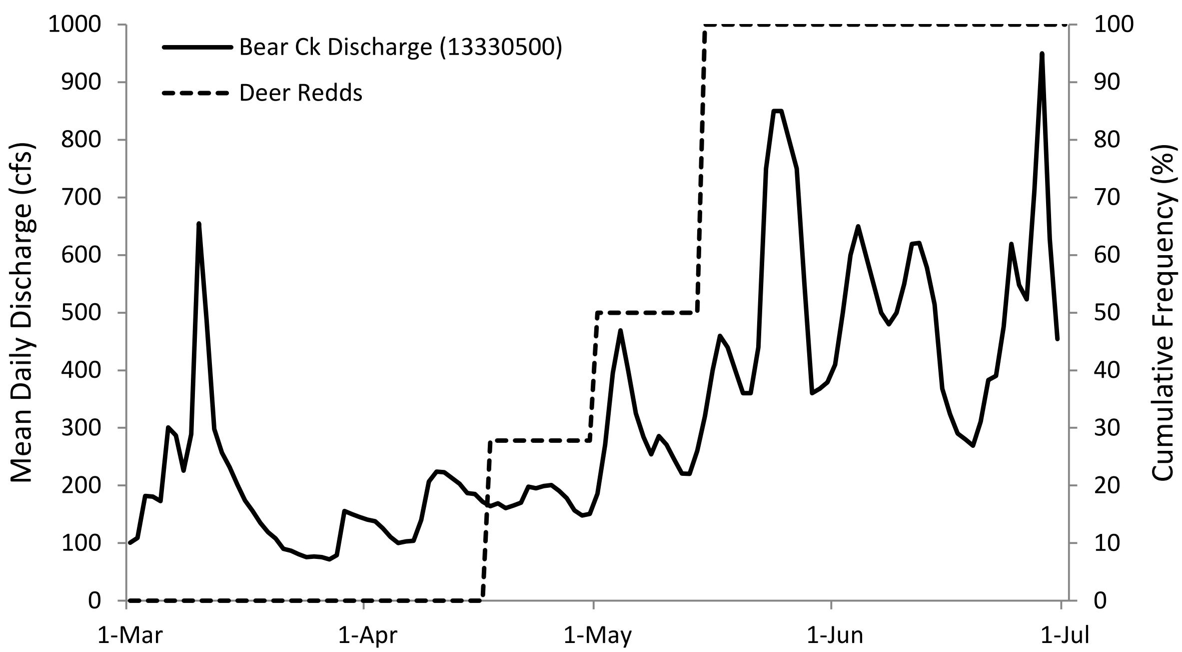
Stream Classification	No. of sites	Spawning habitat (km)	Weight value	Distance surveyed (km)	Total redds observed	Redds per km	Spawner escapement	Lower 95% CI	Upper 95% CI
Source	10	453	50.29	20.65	12	0.6	779	1	1557
Transport	9	243	26.96	19.46	31	1.6	1015	516	1514
Depositional	10	197	19.67	21.14	22	1.0	562	198	925
Total	**29**	**892**	**96.91**	**61.25**	**65**	1.1	**2,355**	**1,362**	**3,348**

Appendix Table B-22. Survey characteristics and spawning survey results, grouped by stream classification type for Joseph Creek basin, 2014.

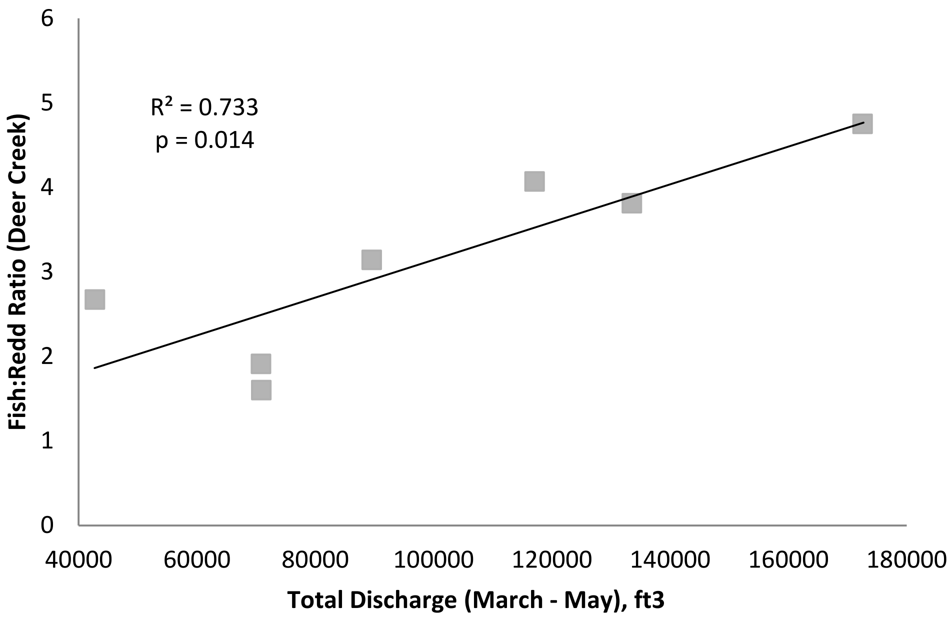
Stream Classification	No. of sites	Spawning habitat (km)	Weight value	Distance surveyed (km)	Total redds observed	Redds per km	Spawner escapement	Lower 95%CI	Upper 95% CI
Source	10	159	15.9	20.03	37	1.8	749	230	1267
Transport	8	115	14.3	16.68	40	2.4	732	445	1020
Depositional	7	111	15.8	15.04	53	3.5	1,043	510	1575
Total	**25**	**384**	**14.8**	**51.76**	**130**	**2.5**	**2,523**	**1,726**	**3,320**



Appendix Figure B-21. Cumulative frequency of observed redds and mean daily discharge during the spawning period for the UGRR basin (OWRD station #13318960) in 2014.



Appendix Figure B-22. Cumulative frequency of observed redds during the spawning period for Deer Creek and discharge from neighboring Bear Creek (OWRD station #13330500) in 2014.



Appendix Figure B-23 Relationship between total discharge in UGRR (Perry Station) and the fish:redd ratio derived from Deer Creek surveys, 2008−2014.

Steelhead and Chinook Salmon Parr Surveys, Steelhead and Chinook Salmon Parr Density, and Distribution

Appendix Table B-23. Basic descriptors and locations of UGRR basin CHaMP survey sites sampled in 2014.

Site ID	Stream	Easting	Northing	Mean BF Width(m)	Site Length(m)	Sample Method	Agency
CBW05583-013882	Peet Creek	373284	5013187	3.9	108	E-fish	ODFW
CBW05583-090282	Catherine Creek	443084	4999158	14.2	319	Snorkel	ODFW
CBW05583-092986	Fly Creek	389919	5006263	10.4	238	Snorkel	ODFW
CBW05583-095642	McCoy Creek	377395	5023150	6.5	157	E-fish	ODFW
CBW05583-108010	Limber Jim Creek	395288	4995287	7.3	151	Snorkel	CRITFC
CBW05583-135615	Gordon Creek	424796	5052325	5	133	Snorkel	ODFW
CBW05583-138554	Sheep Creek	385426	4990636	7	164	Snorkel	CRITFC
CBW05583-138666	N.F. Catherine Creek	449899	4997181	11.6	245	Snorkel	CRITFC
CBW05583-142490	Clark Creek	435842	5039108	7	162	Snorkel	ODFW
CBW05583-148970	Grande Ronde River	396652	4991082	9.8	195	Snorkel	CRITFC
CBW05583-149594	Dark Canyon Creek	390990	5016875	6.4	160	E-fish	ODFW
CBW05583-155818	Little Catherine Creek	443697	4999586	5.3	124	Snorkel	CRITFC
CBW05583-206314	Grande Ronde River	395733	4992134	9.8	175	Snorkel	CRITFC
CBW05583-217258	Catherine Creek	430856	5006819	12.5	287	Snorkel	CRITFC
CBW05583-228666	Sheep Creek	384568	4988261	5.1	120	Snorkel	CRITFC
CBW05583-235322	Grande Ronde River	391699	5001199	16	329	Snorkel	CRITFC
CBW05583-240730	Rock Creek	403974	5021621	5.7	111	Snorkel	ODFW
CBW05583-252730	Meadow Creek	389711	5012446	19.4	410	Snorkel	ODFW
CBW05583-269114	Grande Ronde River	391130	5012067	18.5	400	Snorkel	CRITFC
CBW05583-275866	Meadow Creek	371328	5016926	5.4	120	Snorkel	ODFW
CBW05583-280042	Grande Ronde River	397640	4990198	7.6	160	Snorkel	CRITFC
CBW05583-288410	Little Indian Creek	436482	5028709	5.2	117	Snorkel	ODFW
CBW05583-316330	S.F. Catherine Creek	453283	4994585	8	160	Snorkel	ODFW
CBW05583-321338	Grande Ronde River	392709	4999637	17.4	315	Snorkel	CRITFC
CBW05583-368042	Catherine Creek	448008	4996296	13.5	286	Snorkel	CRITFC
CBW05583-382778	Burnt Corral Creek	382857	5006843	4.6	120	E-fish	ODFW
CBW05583-384154	Willow Creek	423497	5038180	6	120	Snorkel	ODFW
CBW05583-405674	Catherine Creek	434103	5005125	16	327	Snorkel	CRITFC
CBW05583-420954	Grande Ronde River	401242	5019471	24.6	460	Snorkel	ODFW
CBW05583-430250	Catherine Creek	430569	5006845	15	329	Snorkel	CRITFC
CBW05583-446634	Catherine Creek	433309	5006190	10.6	240	Snorkel	ODFW
CBW05583-449626	Spring Creek	398780	5021838	8.6	207	Snorkel	ODFW
CBW05583-456106	Catherine Creek	445093	4996854	17.6	338	Snorkel	CRITFC
CBW05583-457530	Grande Ronde River	390390	5009618	23.2	487	Snorkel	CRITFC
CBW05583-480666	Waucup Creek	372806	5016477	2	120	Snorkel	ODFW
CBW05583-489882	Spring Creek	393123	5026378	4.5	124	E-fish	ODFW
CBW05583-490810	Sheep Creek	384899	4989132	5	128	Snorkel	CRITFC
CBW05583-512938	S.F. Catherine Creek	454156	4994785	5.8	122	Snorkel	CRITFC
CBW05583-514458	Spring Creek	392974	5027043	5.5	120	Snorkel	ODFW
CBW05583-527786	Catherine Creek	445937	4996469	13.5	288	Snorkel	ODFW
CBW05583-531546	California Gulch	398307	5026009	5	120	E-fish	ODFW
dsgn4-000001	N.F. Catherine Creek	449377	4996716	11	248	Snorkel	ODFW

Site ID	Stream	Easting	Northing	Mean BF Width(m)	Site Length(m)	Sample Method	Agency
dsgn4-000006	West Chicken Creek	389623	4990385	6	102	Snorkel	ODFW
dsgn4-000009	Grande Ronde River	397778	4990012	6.7	156	Snorkel	CRITFC
dsgn4-000010	Catherine Creek	444080	4998100	13.4	306	Snorkel	CRITFC
dsgn4-000092	Spring Creek	400379	5020191	6	126	E-fish	ODFW
dsgn4-000094	Fly Creek	385723	4997813	8	164	Snorkel	ODFW
dsgn4-000161	S.F. Catherine Creek	455527	4994690	8.5	196	Snorkel	ODFW
dsgn4-000168	N.F. Catherine Creek	451453	5000049	9.9	200	Snorkel	ODFW
dsgn4-000202	Grande Ronde River	390918	5010914	20.3	435	Snorkel	CRITFC
dsgn4-000204	Catherine Creek	432068	5006599	11.8	249	Snorkel	CRITFC
dsgn4-000205	Grande Ronde River	400036	5018999	31.8	600	Snorkel	ODFW
dsgn4-000213	Meadow Creek	390652	5013164	14.6	320	Snorkel	ODFW
dsgn4-000245	Grande Ronde River	392823	5013599	30	603	Snorkel	CRITFC
dsgn4-000277	Grande Ronde River	392552	4998648	17.3	360	Snorkel	CRITFC
ORW03446-101560	Meadow Creek	374224	5015656	8	155	Snorkel	ODFW
ORW03446-125832	Meadow Creek	378717	5013639	11	254	Snorkel	ODFW

Appendix Table B-24. Raw counts of steelhead and Chinook by size class for CHaMP sites snorkeled and electrofished (denoted with *) in 2014.

			Steelhead Size Class Counts							Chinook Size Class Counts						
		Est. Fork Length (mm)→	<50	50-80	80-130	130-200	200-250	>250	Total	<50	50-70	70-90	90-100	>100	Total	Adult
Site ID	Waterbody	Date														
CBW05583-013882	Peet Creek*	7/1	0	0	2	2	0	0	4	0	0	0	0	0	0	0
CBW05583-086186	Catherine Creek	9/15	0	6	15	24	2	0	47	0	2	77	94	17	190	17
CBW05583-090282	Catherine Creek	7/23	87	29	41	51	0	1	209	9	141	25	1	0	176	0
CBW05583-092986	Fly Creek	7/16	39	29	38	16	3	1	483	0	0	0	0	0	0	0
CBW05583-095642	McCoy Creek*	6/23	3	4	0	0	0	0	7	0	0	0	0	0	0	0
CBW05583-108010	Limber Jim Creek	8/7	25	15	9	0	0	0	49	0	0	0	0	0	0	0
CBW05583-113834	Minam River	8/30	0	4	73	76	19	3	175	0	38	85	16	0	139	0
CBW05583-135615	Gordon Creek	7/15	10	28	51	11	3	0	198	0	0	0	0	0	0	0
CBW05583-138554	Sheep Creek	8/6	8	15	36	5	1	0	65	0	34	1	0	0	35	0
CBW05583-138666	N.F. Catherine Creek	8/10	13	2	28	11	3	0	57	0	0	41	0	0	41	0
CBW05583-142490	Clark Creek	7/16	36	41	39	19	1	3	139	0	0	0	0	0	0	0
CBW05583-147626	Catherine Creek	8/11	45	10	32	25	2	0	114	2	113	31	1	0	147	0
CBW05583-147626	Catherine Creek	9/9	30	99	24	4	0	1	158	0	42	103	11	0	156	0
CBW05583-148970	Grande Ronde River	8/7	4	12	50	16	4	0	86	42	123	5	1	1	172	1
CBW05583-149594	Dark Canyon Creek*	7/7	0	2	13	4	1	0	20	0	0	0	0	0	0	0
CBW05583-155818	Little Catherine Creek	8/8	48	39	33	10	0	0	130	0	1	0	0	0	1	0
CBW05583-206314	Grande Ronde River	8/8	1	2	25	9	0	0	37	0	28	2	0	0	30	0
CBW05583-217258	Catherine Creek	8/9	29	15	8	6	0	0	58	0	155	9	0	2	166	2
CBW05583-217258	Catherine Creek	8/26	8	92	88	47	9	2	246	0	28	158	32	3	221	3
CBW05583-217258	Catherine Creek	9/15	5	44	41	42	3	1	136	0	22	107	29	0	158	0
CBW05583-228666	Sheep Creek	8/6	0	7	24	5	0	0	36	0	5	0	0	0	5	0
CBW05583-235322	Grande Ronde River	8/7	4	16	14	11	1	0	46	0	71	12	2	0	85	0
CBW05583-240730	Rock Creek	6/26	79	7	22	13	8	0	129	0	0	0	0	0	0	0
CBW05583-252730	Meadow Creek	7/14	3	1	0	0	0	0	4	0	0	0	0	0	0	0
CBW05583-269114	Grande Ronde River	8/6	4	17	4	0	0	0	25	0	16	2	0	0	18	0
CBW05583-275866	Meadow Creek	7/1	12	7	9	1	1	0	30	0	0	0	0	0	0	0
CBW05583-278698	Catherine Creek	9/9	5	13	2	2	0	0	22	0	6	66	7	0	79	0
CBW05583-280042	Grande Ronde River	8/7	12	5	7	2	1	0	27	37	64	11	1	0	113	0
CBW05583-288410	Little Indian Creek	7/2	0	3	1	0	0	0	4	0	0	0	0	0	0	0
CBW05583-316330	S.F. Catherine Creek	9/8	4	43	41	32	8	0	128	0	0	0	0	0	0	0

			Steelhead Size Class Counts							Chinook Size Class Counts						
	Est. Fork Length (mm)→		<50	50-80	80-130	130-200	200-250	>250	Total	<50	50-70	70-90	90-100	>100	Total	Adult
Site ID	Waterbody	Date														
CBW05583-321338	Grande Ronde River	8/8	12	1	64	32	5	0	114	0	28	18	0	1	47	1
CBW05583-368042	Catherine Creek	8/8	1	9	17	16	3	0	46	0	161	3	0	0	164	0
CBW05583-382778	Burnt Corral Creek*	7/8	0	11	7	3	0	0	21	0	0	0	0	0	0	0
CBW05583-384154	Willow Creek	7/16	8	11	1	0	0	0	20	0	0	0	0	0	0	0
CBW05583-405674	Catherine Creek	8/8	69	47	81	65	13	0	275	0	165	55	10	5	235	5
CBW05583-420954	Grande Ronde River	8/14	0	0	2	3	0	0	5	0	0	0	0	0	0	0
CBW05583-430250	Catherine Creek	8/9	0	2	0	0	0	0	2	0	22	0	0	0	22	0
CBW05583-430250	Catherine Creek	9/9	11	135	85	56	7	1	295	0	25	331	82	1	439	1
CBW05583-446634	Catherine Creek	9/2	0	40	18	31	22	4	115	0	33	37	2	0	72	0
CBW05583-449626	Spring Creek	6/30	7	3	0	0	0	0	10	0	0	0	0	0	0	0
CBW05583-456106	Catherine Creek	8/8	0	0	2	1	0	0	3	0	38	0	0	0	38	0
CBW05583-457530	Grande Ronde River	8/7	5	12	11	5	3	0	36	0	20	1	0	0	21	0
CBW05583-480666	Waucup Creek	7/1	20	9	17	4	0	0	50	0	0	0	0	0	0	0
CBW05583-489882	Spring Creek*	6/24	0	3	25	4	0	0	32	0	0	0	0	0	0	0
CBW05583-490810	Sheep Creek	8/6	1	2	32	6	0	0	41	1	1	0	0	0	2	0
CBW05583-512938	S.F. Catherine Creek	8/10	0	1	12	8	0	0	21	0	0	0	0	0	0	0
CBW05583-514458	Spring Creek	6/24	9	13	5	2	0	0	29	0	0	0	0	0	0	0
CBW05583-527786	Catherine Creek	7/28	12	131	101	79	7	2	440	8	647	50	0	1	706	1
CBW05583-531546	California Gulch	6/26	0	0	3	0	0	0	3	0	0	0	0	0	0	0
dsgn4-000001	N.F. Catherine Creek	9/3	0	0	1	0	0	0	1	0	0	0	0	0	0	0
dsgn4-000006	West Chicken Creek	6/25	5	24	13	3	1	0	46	0	0	0	0	0	0	0
dsgn4-000009	Grande Ronde River	8/7	9	6	19	7	0	0	41	8	108	15	1	0	132	0
dsgn4-000010	Catherine Creek	8/10	22	2	10	12	1	0	47	0	57	102	0	0	159	0
dsgn4-000010	Catherine Creek	8/11	27	78	68	23	16	6	218	28	443	66	0	0	537	0
dsgn4-000010	Catherine Creek	9/10	0	11	185	75	7	2	280	15	69	58	0	0	142	0
dsgn4-000092	Spring Creek*	6/25	0	5	2	0	0	0	7	0	0	0	0	0	0	0
dsgn4-000094	Fly Creek	7/16	3	0	0	0	0	0	3	0	0	0	0	0	0	0
dsgn4-000161	S.F. Catherine Creek	9/8	0	10	18	15	1	0	44	0	0	0	0	0	0	0
dsgn4-000168	N.F. Catherine Creek	9/3	0	0	3	10	3	2	18	0	0	0	0	0	0	0
dsgn4-000202	Grande Ronde River	8/7	0	4	1	1	1	0	7	0	1	0	0	0	1	0
dsgn4-000204	Catherine Creek	8/10	30	53	31	45	1	0	160	0	56	9	0	1	66	1

			Steelhead Size Class Counts							Chinook Size Class Counts						
		Est. Fork Length (mm)→	<50	50-80	80-130	130-200	200-250	>250	Total	<50	50-70	70-90	90-100	>100	Total	Adult
Site ID	Waterbody	Date														
dsgn4-000205	Grande Ronde River	8/14	0	22	3	1	0	0	26	0	0	0	0	0	0	0
dsgn4-000213	Meadow Creek	7/14	12	9	0	0	0	0	21	0	0	0	0	0	0	0
dsgn4-000245	Grande Ronde River	8/6	0	0	0	1	0	1	2	0	0	0	0	0	0	0
dsgn4-000277	Grande Ronde River	8/8	4	0	7	1	0	0	12	0	4	3	0	0	7	0
ORW03446-101560	Meadow Creek	7/21	25	5	7	6	3	0	46	0	0	0	0	0	0	0
ORW03446-101560	Meadow Creek	9/17	0	0	3	4	0	1	8	0	0	0	0	0	0	0
ORW03446-125832	Meadow Creek	7/24	69	29	32	22	2	0	154	0	1	0	0	0	1	0
ORW03446-125832	Meadow Creek	9/17	0	32	40	20	1	0	93	0	0	2	0	0	2	0

Appendix Table B-25. Estimated density of juvenile Chinook salmon (CH) and steelhead (ST) derived from snorkel and electrofishing (denoted with *) surveys, 2014. Densities were estimated using correction factors generated for these surveys as described in methods. Fastwater units include riffles, cascades and rapids.

			Density (fish/100m2) – Snorkel/Efish correction factor used					
			Pool Units		Run Units		Fastwater Units	
Site ID	Stream Name	Date	ST	CH	ST	CH	ST	CH
CBW05583-013882	Peet Creek*	7/1	4.66	0.00	0.00	0.00	2.76	0.00
CBW05583-086186	Catherine Creek	9/15	3.87	18.12	3.66	5.69	1.82	1.04
CBW05583-090282	Catherine Creek	7/23	33.84	19.19	1.51	10.30	9.49	9.57
CBW05583-092986	Fly Creek	7/16	86.76	0.00	115.67	0.00	60.71	0.00
CBW05583-095642	McCoy Creek*	6/23	1.08	0.00	2.12	0.00	0.00	0.00
CBW05583-108010	Limber Jim Creek	8/7	31.16	0.00	NA	NA	0.00	0.00
CBW05583-135615	Gordon Creek	7/15	223.13	0.00	103.05	0.00	65.77	0.00
CBW05583-138554	Sheep Creek	8/6	24.76	8.58	14.71	47.97	31.74	8.70
CBW05583-138666	N.F. Catherine Creek	8/10	46.93	32.13	NA	NA	9.49	8.78
CBW05583-142490	Clark Creek	7/16	151.91	0.00	32.60	0.00	20.61	0.00
CBW05583-147626	Catherine Creek	8/11	5.60	9.15	NA	NA	3.92	3.41
CBW05583-147626	Catherine Creek	9/9	7.69	11.19	NA	NA	4.98	1.90
CBW05583-148970	Grande Ronde River	8/7	16.06	36.80	NA	NA	8.99	3.66
CBW05583-149594	Dark Canyon Creek*	7/7	16.22	0.00	4.96	0.00	3.67	0.00
CBW05583-155818	Little Catherine Creek	8/8	109.35	0.94	NA	NA	53.36	0.00
CBW05583-206314	Grande Ronde River	8/8	20.58	21.63	NA	NA	14.92	3.95
CBW05583-217258	Catherine Creek	8/9	14.44	51.28	0.00	0.00	7.33	5.65
CBW05583-217258	Catherine Creek	8/26	49.75	52.90	0.00	0.00	13.12	8.31
CBW05583-217258	Catherine Creek	9/15	34.67	43.45	0.00	0.00	3.98	3.47
CBW05583-228666	Sheep Creek	8/6	33.08	4.97	NA	NA	10.09	0.00
CBW05583-235322	Grande Ronde River	8/7	7.96	14.89	5.04	15.65	5.30	4.11
CBW05583-240730	Rock Creek	6/26	222.14	0.00	149.83	0.00	26.82	0.00
CBW05583-252730	Meadow Creek	7/14	10.24	0.00	0.00	0.00	0.00	0.00
CBW05583-269114	Grande Ronde River	8/6	2.24	1.70	0.00	0.00	1.68	0.00
CBW05583-275866	Meadow Creek	7/1	10.06	0.00	NA	NA	42.04	0.00
CBW05583-278698	Catherine Creek	9/9	2.95	24.96	0.00	0.00	1.25	1.81
CBW05583-280042	Grande Ronde River	8/7	12.15	39.76	NA	NA	2.75	30.54
CBW05583-288410	Little Indian Creek	7/2	10.35	0.00	0.00	0.00	2.35	0.00
CBW05583-316330	S.F. Catherine Creek	9/8	33.97	0.00	NA	NA	27.52	0.00
CBW05583-321338	Grande Ronde River	8/8	16.57	7.27	19.80	11.75	14.97	3.74
CBW05583-368042	Catherine Creek	8/8	11.33	58.58	1.97	11.91	7.20	5.97
CBW05583-382778	Burnt Corral Creek*	7/8	17.24	0.00	0.00	0.00	13.03	0.00
CBW05583-384154	Willow Creek	7/16	NA	NA	8.44	0.00	NA	NA
CBW05583-405674	Catherine Creek	8/8	38.29	40.90	37.98	38.27	14.02	7.23
CBW05583-420954	Grande Ronde River	8/14	0.27	0.00	0.00	0.00	0.28	0.00
CBW05583-430250	Catherine Creek	8/9	0.49	5.31	0.00	0.53	0.00	0.00

			Density (fish/100m2) – Snorkel/Efish correction factor used					
			Pool Units		Run Units		Fastwater Units	
Site ID	Stream Name	Date	ST	CH	ST	CH	ST	CH
CBW05583-430250	Catherine Creek	9/9	58.05	92.03	3.31	2.15	6.79	8.18
CBW05583-446634	Catherine Creek	9/2	13.33	9.91	24.38	28.83	11.89	4.83
CBW05583-449626	Spring Creek	6/30	21.00	0.00	NA	NA	NA	NA
CBW05583-456106	Catherine Creek	8/8	0.26	8.38	1.26	6.95	0.38	0.80
CBW05583-457530	Grande Ronde River	8/7	1.24	0.20	4.95	3.59	0.52	0.00
CBW05583-480666	Waucup Creek	7/1	43.00	0.00	11.94	0.00	66.24	0.00
CBW05583-489882	Spring Creek*	6/24	20.30	0.00	35.70	0.00	9.94	0.00
CBW05583-490810	Sheep Creek	8/6	27.25	0.78	29.22	3.85	0.00	0.00
CBW05583-512938	S.F. Catherine Creek	8/10	29.19	0.00	NA	NA	14.50	0.00
CBW05583-514458	Spring Creek	6/24	22.39	0.00	11.06	0.00	17.72	0.00
CBW05583-527786	Catherine Creek	7/28	127.33	72.95	15.50	156.67	25.88	27.85
CBW05583-531546	California Gulch*	6/26	NA	NA	NA	NA	NA	NA
dsgn4-000001	N.F. Catherine Creek	9/3	0.00	0.00	NA	NA	0.13	0.00
dsgn4-000006	West Chicken Creek	6/25	46.57	0.00	53.65	0.00	16.69	0.00
dsgn4-000009	Grande Ronde River	8/7	12.77	46.68	0.00	70.66	10.50	21.02
dsgn4-000010	Catherine Creek	8/10	4.95	15.15	2.51	58.29	5.77	9.20
dsgn4-000010	Catherine Creek	8/11	12.90	57.71	72.69	61.97	12.24	5.32
dsgn4-000010	Catherine Creek	9/10	27.29	14.41	37.71	21.81	6.35	1.52
dsgn4-000092	Spring Creek*	6/25	1.33	0.00	21.15	0.00	1.43	0.00
dsgn4-000094	Fly Creek	7/16	1.36	0.00	1.63	0.00	0.60	0.00
dsgn4-000161	S.F. Catherine Creek	9/8	23.32	0.00	NA	NA	5.30	0.00
dsgn4-000168	N.F. Catherine Creek	9/3	4.75	0.00	NA	NA	2.40	0.00
dsgn4-000202	Grande Ronde River	8/7	0.70	0.00	0.24	0.00	0.38	0.00
dsgn4-000204	Catherine Creek	8/10	44.87	52.80	23.41	10.46	18.17	2.99
dsgn4-000205	Grande Ronde River	8/14	1.70	0.00	0.04	0.00	1.01	0.00
dsgn4-000213	Meadow Creek	7/14	0.55	0.00	2.33	0.00	1.52	0.00
dsgn4-000245	Grande Ronde River	8/6	0.32	0.00	0.00	0.00	0.16	0.00
dsgn4-000277	Grande Ronde River	8/8	NA	NA	3.16	1.84	0.00	0.00
ORW03446-101560	Meadow Creek	7/21	12.45	0.00	17.17	0.00	19.74	0.00
ORW03446-101560	Meadow Creek	9/17	4.95	0.00	0.00	0.00	0.00	0.00
ORW03446-125832	Meadow Creek	7/24	33.39	0.35	20.09	0.00	21.95	0.00
ORW03446-125832	Meadow Creek	9/17	20.78	0.00	8.59	1.51	13.58	0.00

Appendix Table B-26. Fish species/taxa observed during snorkel surveys, 2014. Percentage represents the proportional count of individuals, and is unrelated to fish size or biomass. Species codes at bottom of table.

Reach ID	**Stream Name**	**Date**	**Dominant (>50%)**	**Common (10-49%)**	**Rare (<10%)**
CBW05583-013882	Peet Creek*	7/1	CT	ST	
CBW05583-086186	Catherine Creek	9/15	RS	ST, LD, CH, NP	MW, CN
CBW05583-090282	Catherine Creek	7/23	CH	ST, MW	LD
CBW05583-092986	Fly Creek	7/16	LD	SD, SU, ST, CT	
CBW05583-095642	McCoy Creek*	6/23	ST		LD
CBW05583-108010	Limber Jim Creek	8/7	ST		CT
CBW05583-135615	Gordon Creek	7/15	ST	CT	
CBW05583-138554	Sheep Creek	8/6	ST	RS, CH	DC
CBW05583-138666	N.F. Catherine Creek	8/10	ST	CH	BT
CBW05583-142490	Clark Creek	7/16	ST	SD, LD	CT, RS
CBW05583-147626	Catherine Creek	8/11	CH	ST	MW
CBW05583-147626	Catherine Creek	9/9	CH	ST, MW	LD
CBW05583-148970	Grande Ronde River	8/7	CH	ST	MW
CBW05583-149594	Dark Canyon Creek*	7/7	ST		
CBW05583-155818	Little Catherine Creek	8/8	ST		CH
CBW05583-206314	Grande Ronde River	8/8	ST	CH	
CBW05583-217258	Catherine Creek	8/9	RS	CH, ST, MW	DC, SU
CBW05583-217258	Catherine Creek	8/26	CH	ST, MW, LD	CT
CBW05583-217258	Catherine Creek	9/15	CH	ST, RS	CT, LD, CN, MW
CBW05583-228666	Sheep Creek	8/6	ST	CT, CH, RS	SU
CBW05583-235322	Grande Ronde River	8/7	DC	CH, ST, RS, NP	CT, MS
CBW05583-240730	Rock Creek	6/26	ST	LD, SD, RS	CT
CBW05583-252730	Meadow Creek	7/14	SD	NP, RS	LD, ST, SU
CBW05583-269114	Grande Ronde River	8/6	RS	NP, SU, SD, LD	MW, CH, ST, CT
CBW05583-275866	Meadow Creek	7/1	ST	LD, SD, NP, RS	
CBW05583-278698	Catherine Creek	9/9	CH	ST, MW	CT
CBW05583-280042	Grande Ronde River	8/7	CH	ST	BT, CT
CBW05583-288410	Little Indian Creek	7/2	ST		
CBW05583-316330	S.F. Catherine Creek	9/8	ST		BT
CBW05583-321338	Grande Ronde River	8/8	ST	SU, CH, RS, DC	NP
CBW05583-368042	Catherine Creek	8/8	CH	ST	BT, MW
CBW05583-382778	Burnt Corral Creek*	7/8	ST		
CBW05583-384154	Willow Creek	7/16	RS	NP	ST, SD, CN
CBW05583-405674	Catherine Creek	8/8	ST	CH, MW	CT, DC
CBW05583-420954	Grande Ronde River	8/14	RS	NP, CT, SD	ST
CBW05583-430250	Catherine Creek	8/9	RS		MW, CH, ST
CBW05583-430250	Catherine Creek	9/9	RS	CH, ST, NP, MW	LD, CN, SU
CBW05583-446634	Catherine Creek	9/2	ST	CH, MW	
CBW05583-449626	Spring Creek	6/30	ST		
CBW05583-456106	Catherine Creek	8/8	CH	MW	ST
CBW05583-457530	Grande Ronde River	8/7	RS	NP, DC	ST, CH, MW, CT, SU

CBW05583-480666	Waucup Creek	7/1	ST	LD, SD	CT
CBW05583-489882	Spring Creek*	6/24	ST		
CBW05583-490810	Sheep Creek	8/6	ST	CH, RS	CT
CBW05583-512938	S.F. Catherine Creek	8/10	ST		
CBW05583-514458	Spring Creek	6/24	ST		
CBW05583-527786	Catherine Creek	7/28	CH	ST	MW
CBW05583-531546	California Gulch	6/26	ST		
dsgn4-000001	N.F. Catherine Creek	9/3	ST		
dsgn4-000006	West Chicken Creek	6/25	ST	CT	
dsgn4-000009	Grande Ronde River	8/7	CH	ST, MW	CT, BT
dsgn4-000010	Catherine Creek	8/10	CH	ST	MW
dsgn4-000010	Catherine Creek	8/11	CH	ST	MW
dsgn4-000010	Catherine Creek	9/10	ST	CH	
dsgn4-000092	Spring Creek*	6/25	ST		
dsgn4-000094	Fly Creek	7/16	LD	ST	
dsgn4-000161	S.F. Catherine Creek	9/8	ST	BT	
dsgn4-000168	N.F. Catherine Creek	9/3	ST	BT	
dsgn4-000202	Grande Ronde River	8/7	RS	NP, DC	SU, CT, ST, CH
dsgn4-000204	Catherine Creek	8/10	ST	CH, MW	DC, SU
dsgn4-000205	Grande Ronde River	8/14	RS	LD, NP, SD	ST
dsgn4-000213	Meadow Creek	7/14	RS	NP	ST, CT, IC, CN
dsgn4-000245	Grande Ronde River	8/6	RS	NP, LD, SD	SU, ST, CT, MW
dsgn4-000277	Grande Ronde River	8/8	DC	SU, RS, CH, ST	NP
ORW03446-101560	Meadow Creek	7/21	SD	ST, RS, LD	CT, NP, SU
ORW03446-101560	Meadow Creek	9/17	NP	SD, RS	CT, ST, SU
ORW03446-125832	Meadow Creek	7/24	SD	NP, RS, ST	SU, CH
ORW03446-125832	Meadow Creek	9/17	NP	ST, SD, LD, RS, SU	CH, CT, CN

ST=Steelhead, CH=Chinook, BT=Bull Trout, CN=unk. Sunfish, CT=Sculpin, DC=unk. dace, IC=unk. Catfish, MW=Mtn. Whitefish, LD=Longnose Dace, NP=Northern Pikeminnow, RS=Redside Shiner, SD=Speckled Dace, SU=unk. sucker

Appendix Table B-27. Capture statistics for electrofished sites, 2014.

				Pool Units		**FNT Units**		**Fast-Turb Units**		
Site ID	**Creek Name**	**Date**	**Spp.**	**n**	**Mean FL ±SD (mm)**	**n**	**Mean FL ±SD (mm)**	**n**	**Mean FL ±SD (mm)**	**CPUE (fish/hr)**
CBW05583-013882	Peet Creek	7/1	ST	3	128 (36)	0	na	1	114 (na)	10.3
CBW05583-095642	McCoy Creek	6/23	ST	1	72 (na)	6	47 (6)	0	na	28.9
CBW05583-149594	Dark Canyon Cr	7/7	ST	10	123 (51)	4	106 (31)	6	96 (25)	84.5
CBW05583-382778	Burnt Corral Cr	7/8	ST	10	92 (31)	0	na	11	88 (25)	43.4
CBW05583-489882	Spring Creek	6/24	ST	20	108 (20)	8	105 (18)	4	107 (22)	71.3
CBW05583-531546	California Gulch	6/26	ST	2	116 (1)	0	na	1	120 (na)	11.1
dsgn4-000092	Spring Creek	6/25	ST	1	59 (na)	3	84 (23)	3	63 (6)	24.0

Appendix C: List of Metrics and Indicators

Metrics collected by this project include:

- Abundance of juvenile spring Chinook salmon migrants
- Length of spring Chinook salmon migrants
- Survival of spring Chinook salmon migrants to Lower Granite Dam from several life stages
- Abundance of juvenile steelhead migrants
- Probability of surviving and migrating to Lower Granite Dam of juvenile steelhead migrants
- Age of juvenile steelhead migrants
- Length of juvenile steelhead migrants by age
- Steelhead redd abundance in the Upper Grande Ronde River Watershed and in the Joseph Creek Watershed
- Density and distribution of steelhead and Chinook salmon parr in the upper Grande Ronde River Watershed

Indicators calculated by this project include:

- Number of spring Chinook salmon smolt equivalents produced by population
- Number of spring Chinook salmon smolt equivalents produced per spawner by population
- Adult steelhead escapement in the Upper Grande Ronde River Watershed and in the Joseph Creek Watershed